



Final Report and Recommendations:  
**PUBLIC PENSION MANAGEMENT AND  
ASSET INVESTMENT REVIEW COMMISSION**

APPENDIX I: SUBMISSIONS AND EXHIBITS

2018

# Appendix I: Submissions and Exhibits

## Submissions by expert witnesses at Commission public hearings

### July 30, 2018

- Dr. Ludovic Phalippou, University of Oxford, “The benefits of transparency in private markets” (presentation)
- Jennifer Choi, ILPA, “Transparency in Public Sector Pensions Presentation” (presentation and written testimony)
- Lorelei Graye, “Perspectives on transparency – defining transparency in private equity and its hurdles, past and present” (written testimony)
- Renee Astphan, Rhode Island Office of the General Treasurer, “Transparent Treasury” (presentation)
- David Draine, The Pew Charitable Trusts, “Applying Stress testing To Pennsylvania’s Retirement Systems” (presentation and written testimony)
- The Pew Charitable Trusts, “Stress Testing for Public Sector Retirement Systems” (undated fact sheet)
- Dr. Chester Spatt, Carnegie Mellon University and MIT, “Funding Government Pensions and Risk Taking” (presentation and written testimony)
- Kenneth Kent, Cheiron, “Stress Testing” (presentation)
- Bob Stein, SOA Blue Ribbon Panel, “Society of Actuaries Blue Ribbon Panel on Public Plan Funding Measuring and Managing Risk” (presentation)
- Joseph Newton, GRS Retirement Consulting (untitled presentation on stress testing)

### September 20, 2018

- Dr. Ashby Monk, Stanford University, “Preliminary Analysis – Fees, Costs, Asset Allocation, Performance” (presentation and written testimony)
- Dr. Tim Jenkinson, University of Oxford, “Private equity investing” (presentation)
- Dr. Ludovic Phalippou, University of Oxford, “Private Equity & The Pennsylvanian Public Pension Funds” (presentation and written testimony)
- Craig Lazzara and Aye Soe, S&P Dow Jones Indices
  - “The Growth of Passive: What is Happening, and Why?” (presentation and written testimony)
  - S&P Dow Jones Indices, “Does Past Performance Matter? The Persistence Scorecard” (2018)
  - S&P Dow Jones Indices, “SPIVA® Institutional Scorecard: How Much Do Fees Affect the Active Versus Passive Debate” (2016)
  - S&P Dow Jones Indices, “Shooting the Messenger” (2017)
  - S&P Dow Jones Indices, “SPIVA® U.S. Scorecard” (2017)
  - S&P Dow Jones Indices, “The Slings and Arrows of Passive Fortune” (2018)
- Matthew Clark, South Dakota Investment Council, “Investment Structure” (presentation)
- Robert M. Maynard, Public Employee Retirement System of Idaho
  - “PERSI Conventional Investing” (presentation and written testimony)
  - Public Employee Retirement System of Idaho, “The PERSI Investment Portfolio” (undated fact sheet)
- Rochelle Klaskin and David Villa, State of Wisconsin Investment Board (undated fact sheet)
- Ashbel Williams, Florida State Board of Administration (written testimony)

- Overview of the State Board of Administration of Florida (undated fact sheet)
- Jean Pierre Aubry, Boston College, “Public Plan Investment Performance, 2001-2016” (presentation and written testimony)
- Kristen Doyle, Aon Hewitt (untitled presentation)
- Dr. Gregory W. Brown, University of North Carolina, “Alternative Investment Asset Allocation” (presentation)

### **October 25, 2018**

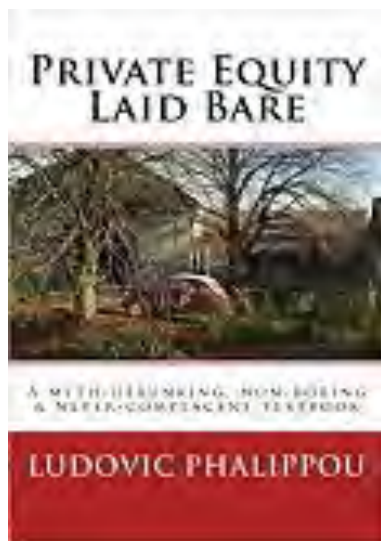
- Terri Sanchez and Bryan Lewis, SERS, “SERS Testimony to the PPM AIRC” (written testimony)
- Glen Grell and Jim Grossman, PSERS, “PSERS Testimony from Glen Grell and James Grossman” (written testimony)
- PSERS, “Proper Funding is Key” (undated fact sheet)
- PSERS, Compendium of Education Materials (See: <https://www.psers.pa.gov/About/Investment/Pages/Public-Pension-Management-and-Asset-Investment-Review-Commission.aspx#>)
- Dr. Ashby Monk, Stanford University, “Summary of Analysis and Recommendations” (presentation)
- Dr. Marcel Staub, Novarca Group, “PA Treasury Investment Cost Transparency & Optimization for SERS and PSERS” (presentation)
- Stephen Nesbitt, Cliffwater, LLC, “The Collective Wisdom in Managing Public Pension Assets” (presentation and written testimony)
- Dr. Charley Ellis, Investment Consultant, “Change and Its Impact” (presentation)

### **Additional Submissions and Exhibits:**

- “Approaches to Measuring Risks for Public Pensions,” Pew Charitable Trusts.
- “Report of the Blue Ribbon Panel on Public Pension Plan Funding” (Schaumburg, Illinois: Society of Actuaries, February 2014), Appendix IV, 52-59.
- David Draine, “Pennsylvania Pension Stress Test Report,” Pew Charitable Trusts.
- Sample Reporting Template, Institutional Limited Partners Association.
- “Websites of Pension Funds or Investment Boards with Notable Transparency Practices,” compiled by Pennsylvania Treasury Department.
- Ludovic Phalippou, “Report on SERS and PSERS Performance and Fees Paid.”
- Ludovic Phalippou, “SERS Analysis.”
- Ludovic Phalippou, “PSERS Analysis.”
- “Investment Costs and Transparency Guidelines,” Novarca.



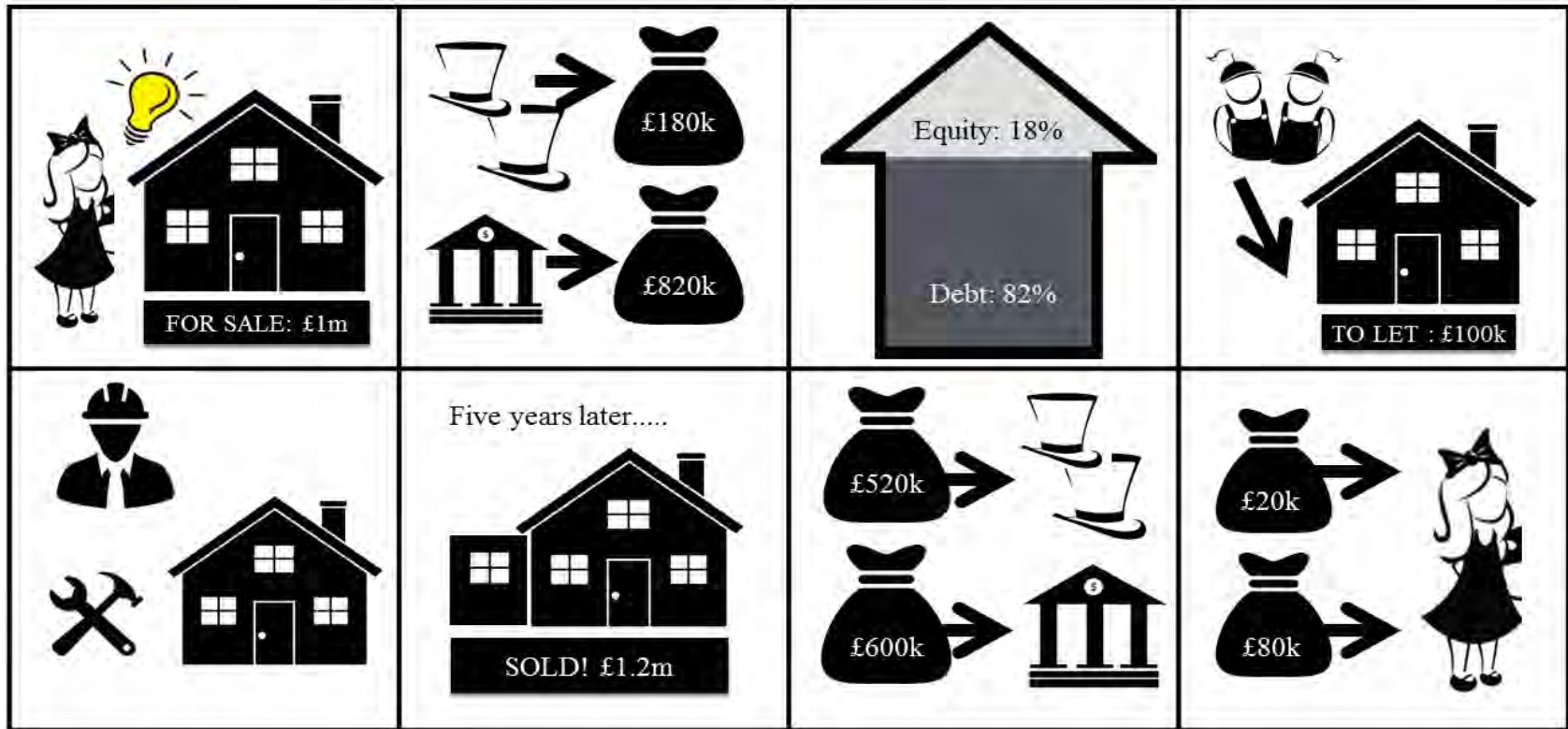
# The benefits of transparency in private markets



Ludovic Phalippou  
University of Oxford



# A private equity transaction



The exact same mechanism is used to purchase shopping malls (real estate), airports (infrastructure), corporations (LBOs/PE), forests ...

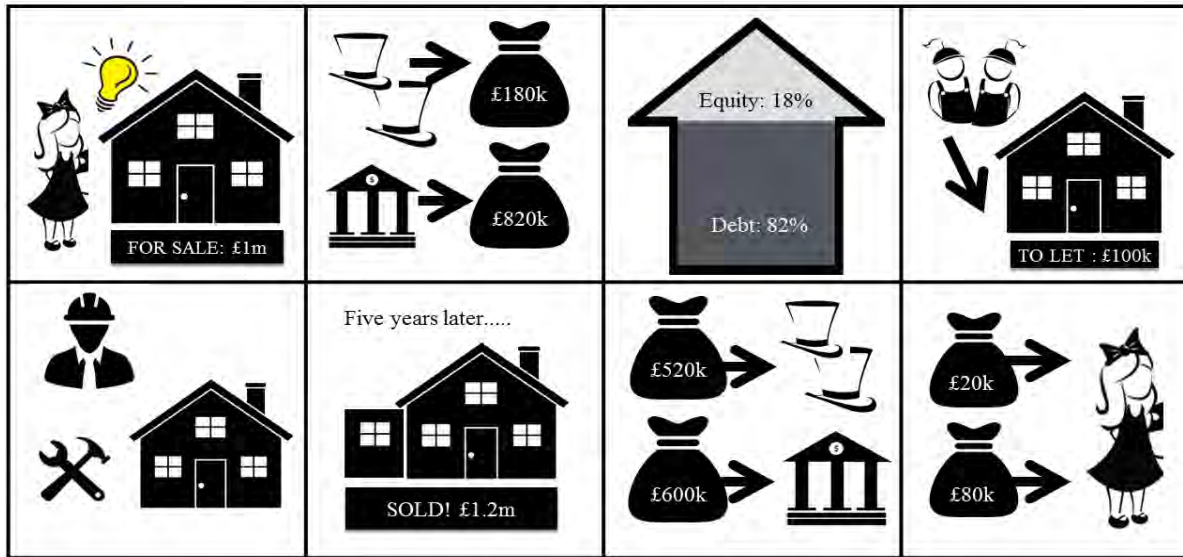
Featuring Alice (GP), Hatters (LPs), House (Portfolio company), Bank (Lender to the portfolio company), "Value Add" (Operating partners, consultants...)

# Example of corporations that have been (are) managed by PE firms





# Alignment of interests



- Alice controls the board of the House/Company (she appointed CEO etc.)
  - Alice and Hatter certainly both want the house to be worth as much as possible
- BUT**
- Alice might be tempted to, e.g., use a private jet and stay in a fancy hotel when inspecting the house improvement operations and pay for this using the rental income. She could also hire herself for consulting services. She could give money (kick-backs) to any consultant advising LPs to invest with her ...
  - This is unregulated. It is down to Alice's goodwill. If LPs do not have full information (or cannot process it), they do not know what she takes.
  - *NB: since 2012 the SEC is bringing some discipline... (will it last? be effective?..)*

# Who cares?



## Should LPs know how she behaves?

- Only LPs, or also the pensioners (it's their money)? What about the taxpayer (might be its money soon if the pension fund is underfunded)?

## Typical argument: It is all about net returns

- If Alice has delivered good returns in the past, there is no need to know the recipe

## Counter argument

- Potential fairness / ethics / societal concerns
- Future may differ from the past: what if Alice behaves as in the past but does not perform well anymore? What if expected returns are generally lower?
- Is it that clear that Alice has delivered good returns?
  - How to measure returns when Alice holds on to losers and values them herself?
  - How to measure risk?, i.e. what is the relevant benchmark?
  - Everyone wants to dress the numbers up to avoid embarrassment / loss of business: consultants, PE team at pension fund, CIO/CEO pension fund, trustees...
  - Note that consultants would earn a lot less if they advised low-cost solutions, and PE/HF are putting together nice conferences and annual investor meetings in 5\* hotels ...

# Everyone happy with this?



Table 10.1: CalPERS reported cost and fees for selected buyout funds in 2004 & 2005

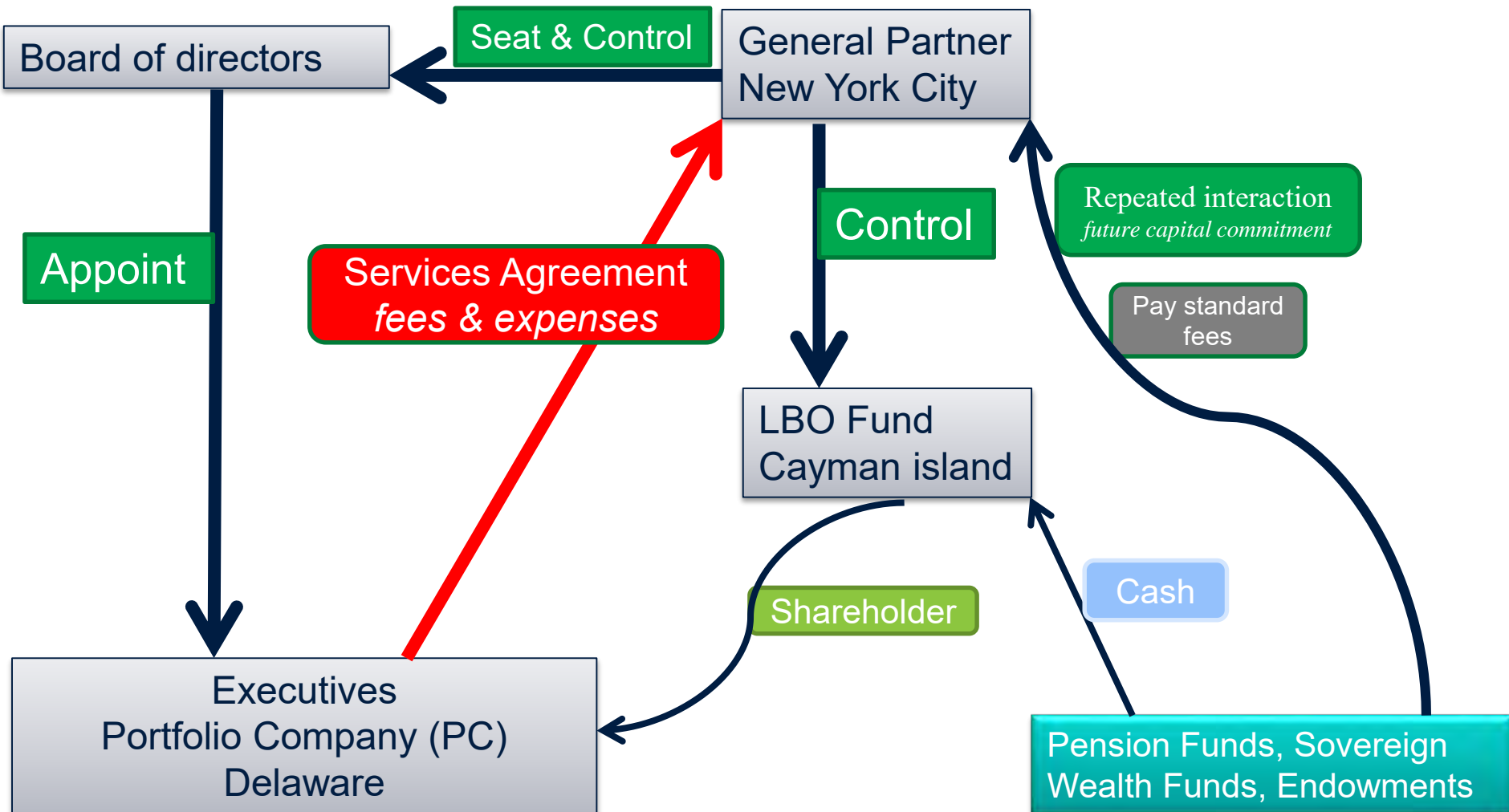
	Vintage Year	Capital Committed	Reported annual cost and fees			
			in dollars		% capital committed	
			2004	2005	2004	2005
Advent IV	2002	25m	258074	338852	1.0%	1.4%
Apollo V	2001	250m	165467	149513	0.1%	0.1%
Blackstone IV	2003	200m	0	31664	0.0%	0.0%
CVC III	2001	200m	2191960	1766954	1.1%	0.9%
KKR European	2001	75m	561145	0	0.7%	0.0%
Madison Dearborn IV	2000	150m	1214183	33384	0.8%	0.0%
TPG IV	2003	200m	338	1974366	0.0%	1.0%

■ This is how ALL pension funds, and other asset owners report fees. Total is usually about 1% to 1.5% of NAV

■ What is missing?

- Carried interest: realized and unrealized (about 2-3% p.a.)
- Fees charged to the asset (about 2-3% p.a.; see next slides)
- Fund expenses, Company expenses (no clue)
- Other related party transactions (at non arm's length prices), fee waivers...
- Exact co-investment arrangement

'Portfolio company fees' are shown in red below



See *Private Equity Portfolio Company Fees*, by Phalippou, Rauch, and Umler, in *Journal of Financial Economics*, 2018



# Example of a transaction



Deal conducted by Apollo and TPG

Announced Sept 2006, Effective Jan 2008

Debt: \$22 billion; TEV: \$31 billion



# What are these transaction and other fees for?



EXECUTION VERSION

## SERVICES AGREEMENT

This Services Agreement (the “Agreement”) is entered into as of January 28, 2008, by and among Harrah’s Entertainment, Inc., a Delaware corporation (the “Company”), Apollo Management VI, L.P., on behalf of affiliated investment funds (“Apollo Management”), Apollo Alternative Assets, L.P. (“Apollo Alternative,” and, together with Apollo Management, “Apollo”) and TPG Capital, L.P. (“TPG,” and, together with Apollo, the “Managers”). (...)

NOW, THEREFORE, in consideration of the mutual covenants contained herein, the parties hereto, intending to be legally bound, hereby agree as follows:

1. Services. Each Manager hereby severally agrees that, during the term of this Agreement (the “Term”), it will provide to the Company (...) from time to time, management, advisory and consulting services in relation to the affairs of the Company (...)

**Translation: I may do some work from time to time**

# What are these transaction and other fees for?



EXECUTION VERSION

## SERVICES AGREEMENT

This Services Agreement (the “Agreement”) is entered into as of January 28, 2008, by and among Harrah’s Entertainment, Inc., a Delaware corporation (the “Company”), Apollo Management VI, L.P., on behalf of affiliated investment funds (“Apollo Management”), Apollo Alternative Assets, L.P. (“Apollo Alternative,” and, together with Apollo Management, “Apollo”) and TPG Capital, L.P. (“TPG,” and, together with Apollo, the “Managers”). (...)

NOW, THEREFORE, in consideration of the mutual covenants contained herein, the parties hereto, intending to be legally bound, hereby agree as follows:

1. Services. Each Manager hereby severally agrees that, during the term of this Agreement (the “Term”), it will provide to the Company (...) from time to time, management, advisory and consulting services in relation to the affairs of the Company (...)

**Translation: I may do some work from time to time**

The Managers (...) will devote such time and efforts to the performance of the services contemplated hereby as the Managers deem reasonably necessary or appropriate; provided, however, that no minimum number of hours is required to be devoted by the Managers or the Manager Designees on a weekly, monthly, annual or other basis. (...)

**Translation: I’ll decide how much I’ll work**

**Potential translation: I won’t do anything**

# What are these transaction and other fees for?



## 2. Payment of Fees.

(a) As consideration to the Managers for their agreement to render the services in Section 1, on the date hereof, the Company will pay to the Managers (...) an aggregate transaction fee equal to \$200,000,000 (two hundred million dollars) (the “Transaction Fee”). (...) In addition to the Transaction Fee, on the date hereof, the Company will pay to the Managers (...) an amount equal to all out-of-pocket expenses incurred (...) including, without limitation, (i) the reasonable fees, expenses and disbursements of lawyers, accountants, consultants and other advisors that may have been retained by the Company and/or any Manager or its affiliates and (ii) any fees (including any financing fees) related to the Merger (all such fees and expenses, in the aggregate, the “Covered Costs”).

**Translation: Yay, I get \$200 million**

**(on top of what it costs to acquire the company?)**

**Note: GP already receives between 2% and 4% of the equity invested per year from those providing investment capital?**

**Potential translation: Wow, a \$200 million showing-up fee**

# What are these transaction and other fees for?



(b) During the Term, the Company will pay to the Managers (...) an annual monitoring fee equal to the greater of (x) \$30 million and (y) 1.0% (one percent) of the Company's EBITDA (as defined below) (the "Monitoring Fee") as compensation for the services provided by the Managers or the Manager Designees under this Agreement, (...)

**Translation:**

**I'll get at least \$30 million a year irrespective of how much I decide to work**

**Potential translation: Yay, at least \$30 million extra per year**

# What are these transaction and other fees for?



(c) During the Term, in addition to the fees paid pursuant to Section 2(b), the Company will pay to the Managers (...) an aggregate fee (the “Subsequent Fee”) in connection with the consummation of any financing or refinancing (equity or debt), dividend, recapitalization, acquisition, disposition, spin-off or split-off transactions involving the Company (...)

**Translation: If I do decide to do something, I'll charge extra**

# What are these transaction and other fees for?



4. Term. This Agreement will continue in full force and effect until the last day of the quarter in which the tenth anniversary of the consummation of the Merger occurs; (...) (x) this Agreement may be terminated at any time upon unanimous consent of the Managers and (y) this Agreement shall terminate automatically immediately prior to the earlier of (i) an Initial Public Offering (...) or (ii) (...) (any such sale transaction, a “Sale”), in each case, unless otherwise agreed by both Managers, (...) Apollo and TPG shall be released from any and all obligations and liabilities with respect to provision of the management, advisory and consulting services pursuant to this Agreement (...) Company shall pay to each Manager (...) a lump-sum amount equal to the net present value of the remaining Transaction Fee, the Monitoring Fee, the Subsequent Fee or any other fees pursuant to this Agreement (...)

**Translation: I can stop charging when I want but if I do  
I get all the money I was supposed to receive from that point up until 2018**

**Potential translation: I stop doing nothing when I feel like it  
and I get paid for all this work I would not have done**

“This isn’t like paying a termination fee to your cell phone provider because you don’t want to fulfil the term of your two-year agreement. It’s like your cell phone provider terminating your service after six months, and then demanding the next 18 months of payment anyway.” [Dan Primark, *Fortune*]



# Take-away on portfolio company fees



- This company ended up bankrupt and a total of \$300 million has been taken out of its cash till by the GPs
- Same thing for Toy's R'Us (\$500 million), Energy Future (\$600 million)...
- For a long time, those who knew kept that secret (most LPs were happily ignorant)
- Because of people researching this topic, spreading it in the press ..., i.e. pushing transparency,... the industry had to back up a bit
- GPs now often refund most of these fees to the LPs, and responded by saying 'Ah, yes, these were not very nice practices, but we've moved on now'
- Can you still trust these fund managers? There are many other ways for them to help themselves... are we satisfied with transparency achieved so far or do we want more?

# Why transparency can bring a lot more



- Besides ethical considerations, the sure-draining triggered by asymmetric fees (see extra slide),...
- If the actual figures are on the table in terms of fees and returns then investors would have more bargaining power and would not accept that:
  - Fund managers take 6-7% p.a., leaving them with returns that are close to those of public equity
  - Most fees are discretionary and unrelated to performance
  - Performance-related fees work only in one direction
  - Fees charged rely on the goodwill of fund managers, especially in bad times
  - Etc.
- Currently, investors try their best to hide all this. Some close their eyes, and some are increasingly investing in private markets all by themselves to avoid all of the above (and because it's a lot more exciting than investing in funds)





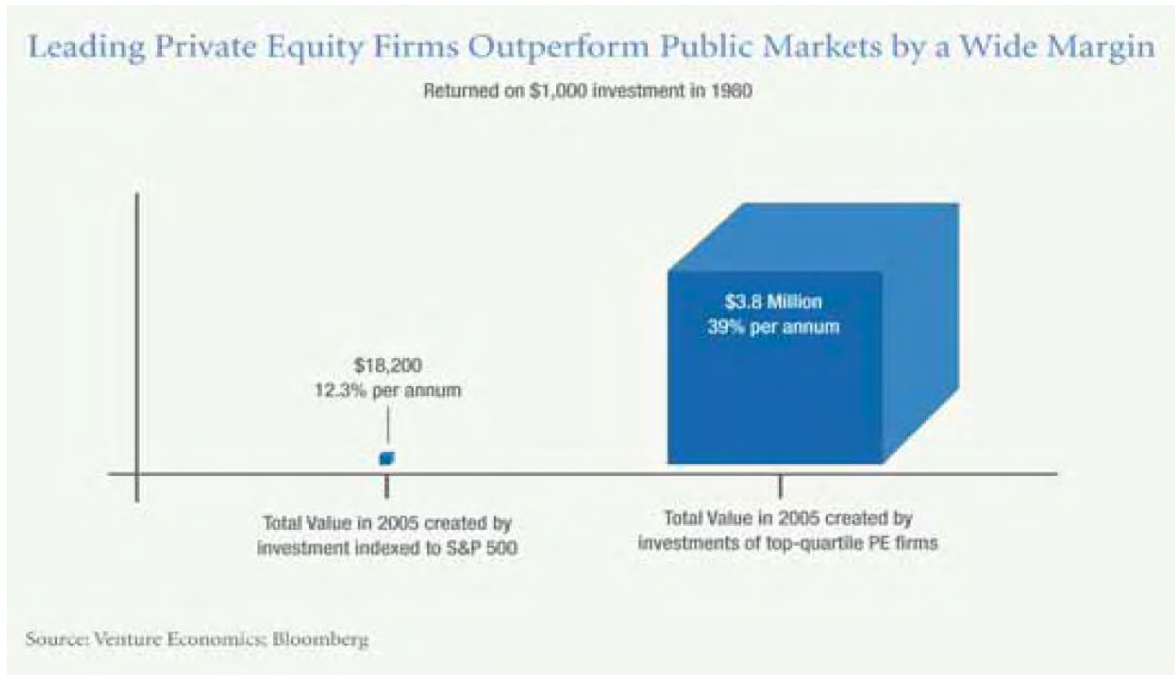
# Extra slides

# The tyranny of asymmetric fee structures



- So far most funds obtained an IRR  $> 8\%$ , hence nearly all earned a carry, which is expensive but at least returns have been above  $8\%$
- If PE returns are lower going forward, then might end up in the following situation:
  - Allocate \$10b to winner funds that return \$15b after fees, pay \$1b of carried interest to them
  - Allocate \$10b to loser funds that return \$5b after fees, no carry paid.
  - Total: Paid \$20b, received \$20b, some fund managers received \$1b!
  - By construction if you invest long enough with managers that charge an asymmetric fee, all the money is eventually transferred from pension funds to fund managers
  - Might be why HF and PE are sometimes called: a compensation package dressed up as an asset class

# Everyone happy with this?



- All performance figures cited are Internal Rate of Returns.
- These are NOT rates of returns!
- But generates very impressive numbers!
- Who has an incentive to do these computations correctly?

# Performance of PE funds – Done properly



- Performance is similar to that of *similar* listed equity
- Most optimistic views would select a major stock benchmark that has low returns (e.g. MSCI world, used to be Russell and S&P 500) – in this case, return is 3-4% above that stock-market index
- Other PE: Bad (Real Estate), Unclear (VC), Good but depends on benchmark (Credit, Infrastructure)



INSTITUTIONAL  
LIMITED PARTNERS  
ASSOCIATION

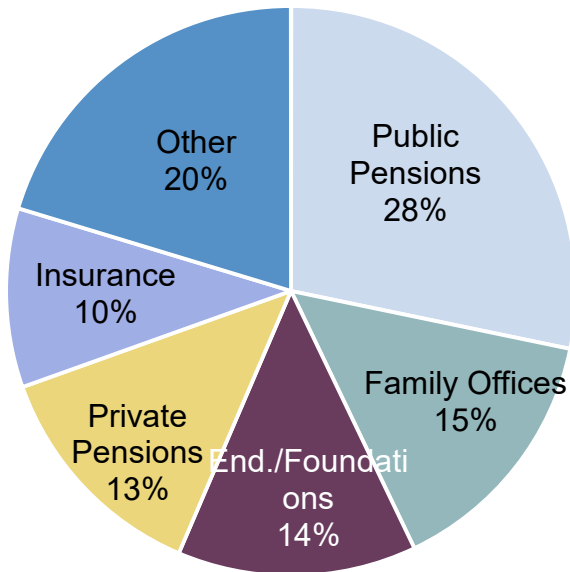
# Transparency in Public Sector Pensions

July 30, 2018

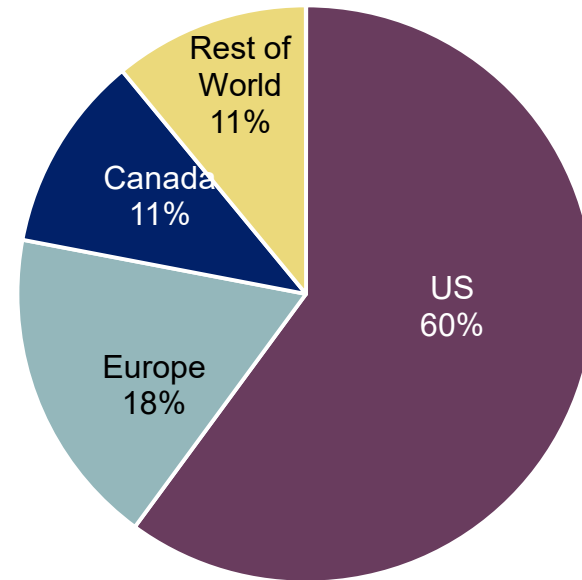
# ILPA: The Only Global Organization Exclusively for LPs

480+ Member organizations

>50% of institutional PE AUM



50+ countries represented



**~4,500 active professionals across diverse roles**

*—investment office, legal, compliance, accounting, PE and real assets*

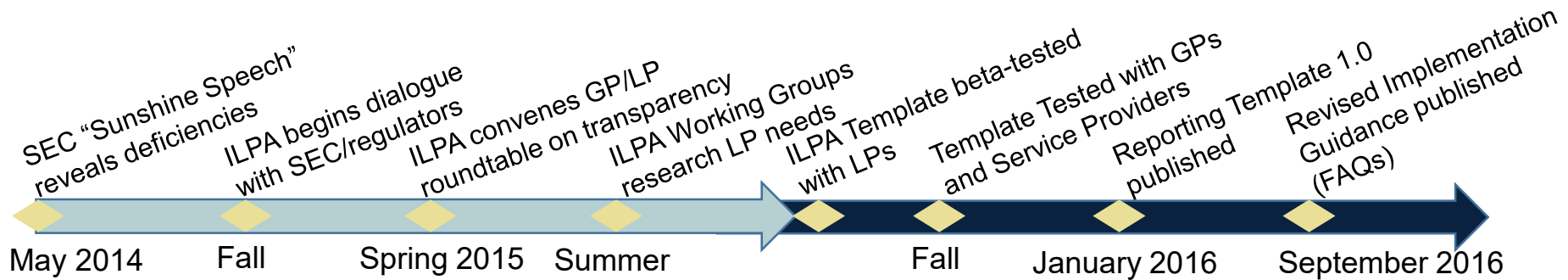
# ILPA Transparency Initiative (2015-16)

**Goal:** Broad-based effort May 2015-Feb 2016 to identify and promote enhanced, **uniform practices** to improve the quality of reporting and disclosures on costs to LPs. (42 participating organizations)

## OUTPUTS

- 1 Standardized fee and expense reporting template – quarterly, with expanded disclosure on fee offsets, partnership expenses, related parties, carried interest
- 2 Guidelines around fee/expense reporting, regulatory compliance and other disclosures
- 3 Recommendations on expanded scope of annual fund audits and role of third parties in enhanced assurances of LPA compliance

## TIMELINE



# ILPA's Reporting Template: Standardized Reporting on Costs to LPs

## Analyze & Aggregate

- LP investment costs
- Economics paid to the management company (incl. non-arms-length transactions)

## Establish Standard

- Management fees
- Fund expenses
- Carried interest
- Fees charged to portfolio companies

## Gain Consensus

- In consultation with
- 50 LP organizations
  - 25 GP organizations
  - 10 trade associations
  - 20 sample templates

Launched January 2016



# Key Features of the Reporting Template

Best Practices Fund II, L.P.	QTD (Oct-15 -	YTD (Jan-15 -	Since Inception (Feb-07 -	QTD (Oct-15 -	YTD (Jan-15 -	Since Inception (Feb-07 -	QTD (Oct-15 -	YTD (Jan-15 -	Since Inception (Feb-07 -
<b>A. Capital Account S</b>									
<b>A.1 NAV Reconciliatio</b>									
Beginning NAV - Net									
Contributions - Cash & N									
Distributions - Cash & N									
Total Cash / Non-Cash									
Net Operating Income									
(Management Fees									
Management Fee S									
(Partnership Expen									
(Partnership S									
(Partnership S									
(Partnership S									
(Partnership S									
(Partnership S									
(Partnership S									
Total Offsets to Fee									
Offset Categ									
Advisory Fee									
Broken Deal F									
Transaction C									
Directors Fee									
Monitoring F									
Capital Marke									
Organization									
Placement Fee									
Other Offset									
Reconciliation for Un									
Offset Balance (Roll-f									
(Total Management									
Fee Waives									
Interest Income									
Dividend Income									
(Interest Expense)									
Other Income/(Exp									
Total Net Operating I									
(Placement Fees)									
Realized Gain / (Loss)									
Change in Unrealized									
Ending NAV - Net of									
Reconciliation for Ac									
Incentive Allocati									

- Quarterly Frequency
- Individual LP Balances
- Two Tiers Of Detail: Headline or Advanced Information Gathering
- XML Format For Incorporation Into Current Reporting Packages
- Detailed NAV Reconciliation
- Detailed Partnership Cost And Offset Disclosures
- Portfolio Company Cost Information
- LP Commitment Reconciliation
- Map Of GP Sources of Revenue
- Fund Of Funds Overlay
- Definitional Clarity For Common Fees And Expenses

# Endorsing Organizations

## LIMITED PARTNERS

American Trading and Production Corporation

AP2

APG

Alberta Teachers' Retirement Fund

AlpInvest Partners

Bancóldex

Board of Education Retirement System of the City of New York

BBC Pension Scheme

British Columbia Investment Management Corporation (bcIMC)

BrightHouse Financial

BRK Capital

CalPERS

CalSTRS

CDC Gabon

City of Fresno Retirement Systems

Canada Pension Plan Investment Board (CPPIB)

Canadian Medical Protective Association (CMPA)

Chicago Teachers' Pension Fund

Colorado PERA

Commodore Management Co.

Commonwealth of Pennsylvania, Public School Employees' Retirement System (PSERS)

Commonwealth Superannuation Corporation

The Connecticut Retirement Plans and Trust Funds

District of Columbia Retirement Board

The Connecticut Retirement Plans and Trust Funds

District of Columbia Retirement Board

Employees Retirement System of Texas (ERS)

Eskom Pension and Provident Fund

FCA US LLC

Fikes Family Office

Fire and Police Pension Association of Colorado

Florida SBA

GF Private Equity Group, LLC

Guardian Life Insurance Company of America

Halifax Regional Municipality Master Trust

Hydro-Quebec Pension Plan

Illinois State Treasurer's Office

IMANT

Indiana Public Retirement System (INPRS)

Iowa Public Employees' Retirement System

Kaiser Permanent

Kentucky Retirement Systems

Los Angeles Fire and Police Pensions (LAFPP)

Los Angeles County Employees Retirement Association (LACERA)

Lockheed Martin Investment Management Company

M&G Private Funds Investment

Maryland State Retirement and Pension System

MERS of Michigan

MetLife

Minnesota State Board of Investment

Missouri State Employee's Retirement System (MOSERS)

MoDOT & Patrol Employees' Retirement System

Montana Board of Investments

MP Investment Management

Municipal Employees Retirement System of Michigan

New Jersey Division of Investment

New Mexico Educational Retirement Board (NMERB)

New York City Employees' Retirement System

New York City Fire Pension Fund

New York City Police Pension Fund

New York City Office of the Comptroller

New York State Common Retirement Fund

New York State Teachers' Retirement System

Nordea Life & Pensions

Omega Overseas Investments, Inc.

Ohio PERS

Ohio SERS

Ontario Pension Board (OPB)

Ontario Teachers' Pension Plan

Oregon State Treasury

Pavilion Alternatives group

PECA-Family Office

PenSam

Pensionskassernes Administration (PKA)

Pennsylvania Treasury

PGB PD

PGGM Investments

Realdania

Royal Mail Pension Plan

Sacramento County Employee's Retirement System

San Mateo County Employees' Retirement Association (SamCERA)

Sampension KP Livsforsikring a/s

San Diego County Employees Retirement Association (SDCERA)

Sentinel Trust Company

South Carolina Retirement System Investment Commission

SPF Beheer

State of Rhode Island

State of Wisconsin Investment Board

State Teachers Retirement System of Ohio

Storebrand Asset Management AS

Suva

Teachers' Retirement System of the City of New York

Teacher Retirement System of Texas (TRS)

Teachers' Retirement System of Kentucky

Teachers' Retirement System of the State of Illinois

Texas Permanent School Fund

Textron Employee Pension Plan

The Dow Chemical Company

The Public Employees Retirement Association of New Mexico

University of California Regents

University of Toronto Asset Management Corporation (UTAM)

University of Missouri

USS Investment Management Limited

Utah Retirement Systems

Varma Mutual Pension Insurance Company

Virginia 529

Virginia Retirement System

Washington State Investment Board

Wespath Benefits and Investments

World Bank Group Retirement Benefit Plans

Zurich Alternative Asset Management

# Endorsing Organizations

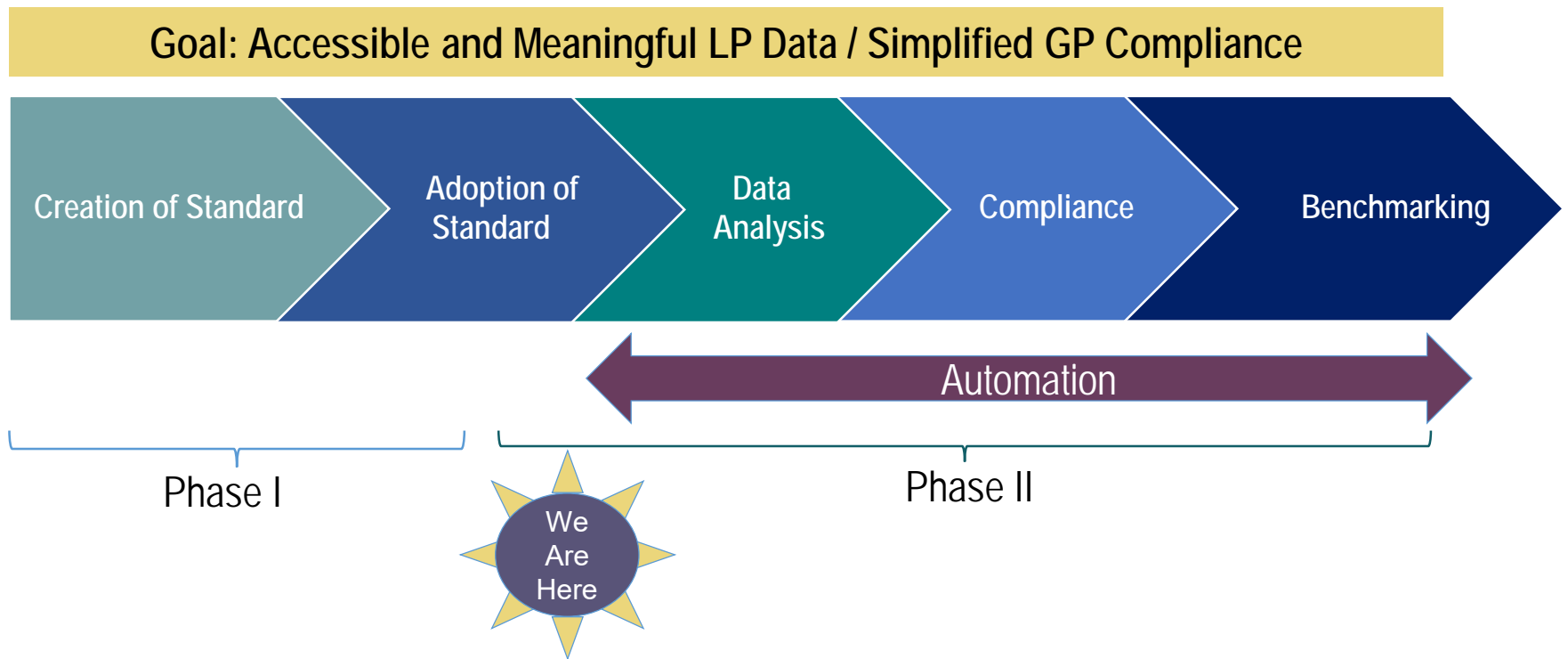
## GENERAL PARTNERS

Advent International  
Apollo  
Ares Management  
Blackstone  
Bridgepoint  
The Carlyle Group  
CCMP  
Emerald Peak Private Equity  
Genstar Capital  
Helios Investment Partners  
Hellman & Friedman  
Jaguar Growth Partners  
KKR  
Oaktree Capital Management  
Onex  
Paladin Realty Partners  
Permira  
Phoenix Partners  
Rockstreet Partners  
Riverstone Holdings, LLC  
Scale Venture Partners  
Searchlight Capital Partners  
Silver Lake  
TowerBrook Capital Partners  
TPG  
Triple P Capital

## CONSULTANTS, FoFs and 3<sup>RD</sup> PARTY ORGANIZATIONS

Aksia LLC  
Albourne  
AlterDomus  
AlternativeSoft  
Apex Fund Services  
Cambridge Associates  
Capital Analytics  
CEM Benchmarking  
Citco Fund Services (USA) Inc.  
Colmore  
SS&C/Conifer Financial Services  
Edgehaven  
eFront Financial Services  
Federation of the Dutch Pension Funds (Pensioenfederatie)  
Gen II Fund Services, LLC  
Intralinks  
Meketa Investment Group  
Mission Creek Capital Partners, Inc  
Morningside Capital Management  
National Association of State Treasurers  
Optimize Capital Partners  
Pantheon  
Pathway Capital Management  
Pavilion Alternatives Group  
PEA Accounting Insights  
Pension Consulting Alliance, LLC  
PEF Services  
PFA Solutions  
SS&C Advent  
SEI Investment Manager Services  
Solovis, Inc.  
TorreyCove Capital Partners  
TresVista  
UMB Fund Services  
Upwelling Capital

# Entering the Next Phase: Realizing Implementation Benefits



# Industry Uptake of the ILPA Template

**300+**

**Estimated 300+ managers provide the ILPA Reporting Template to investors requesting it**

**26%**  
of PE AUM

**GPs that have endorsed the template, publicly committing to provide to LPs**

**22%**

**Survey: 22% of GPs use the ILPA Fee Reporting Template**

**↑ 69%**

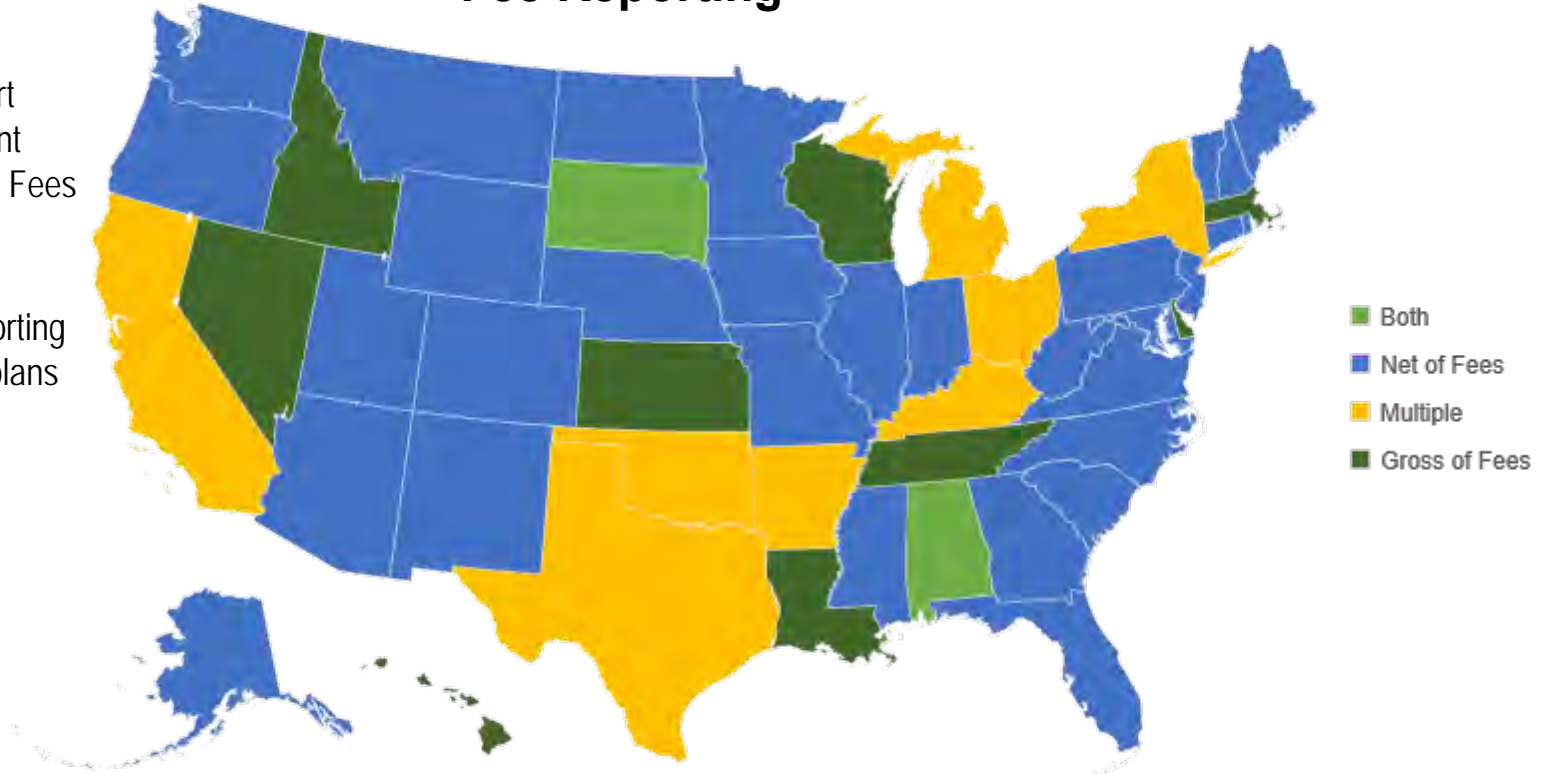
**GP adoption of the template grew 69% between 2016 and 2018**

# Inconsistent Levels of Public Disclosure

## Public Pension Investment Performance Fee Reporting

Most States Report Pension Investment Performance After Fees

Within states, reporting practices among plans may differ



Source: ILPA analysis using 2016 and 2017 CAFRs via publicplansdata.org.

# Legislating Transparency in PE

## US State-Level Transparency Efforts

## California AB 2833

Alabama	Failed
Arizona	Enacted
<b>California</b>	<b>Passed into Law</b>
Illinois	Pending
Kentucky	Failed
Louisiana	Pending
New Jersey	Failed
Pennsylvania	Pending
Rhode Island	Pending
Texas	Enacted
Washington	Enacted



- More granular PE fee and expense disclosures by public plans
- Applies to all new fund commitments from Jan. 2017
- Ambiguous or silent on real estate, secondaries, funds of funds; threshold for compliance (i.e., what constitutes “best efforts”)

Source: National Conference of State Legislatures, Bloomberg BusinessWeek.

# Navigating Complexity and Compliance Challenges in Public Reporting of PE Costs

**Expensive asset class, negotiated terms**

**Opaque industry**

**Defining reported costs – fees only, fees plus carry?**

**Accuracy of data on costs**

## **Costs *in Context***

- Importance of understanding impact to *bottom line* – (out)performance versus rest of portfolio
- Downside to “sitting out”—damage to relationships, negotiation influence

## **LPs are Driving Standardization**

- LPs requesting/requiring ILPA template via side letters, included as “must have” in investment policy

## **Which costs matter, to whom, and why?**

- Hard to normalize PE costs (across funds, vs other asset classes)
- Methodological variances in public reporting make benchmarking difficult

## **Trust but verify**

- Fee template data outside of PE fund audit scope – onus on LPs to validate (for now)
- Can internal resources assume burden of absorbing, monitoring cost data?





INSTITUTIONAL  
LIMITED PARTNERS  
ASSOCIATION



30 JULY 2018

Prepared for:  
The State of Pennsylvania  
Joint State Government Commission:  
Public Pension Management and  
Asset Investment Review Commission



*Summary of panel discussion:  
Perspectives on transparency – defining transparency  
in private equity and its hurdles, past and present*



PREPARED BY: LORELEI GRAYE

## TRANSPARENCY IN PRIVATE EQUITY

### DEFINING TRANSPARENCY

The elements required for transparency in private equity by its investors or limited partners (LPs) are consistency, granularity, and optical depth with an eye to automation in data aggregation.

- Consistency means achieving broadly accepted standards for the line items in general partner (GP) to LP reporting, including LP-centric investment costs, and their definitions or calculations so that an investor can make 'apples-to-apples' comparisons
- Granularity can be defined as a measure of the level of detail in reporting which could be applied to an everyday concept such as knowing your net paycheck amount compared with the more granular detail of having your gross pay and a breakdown of all withholdings
- Optical depth (an appropriated physics term) used to describe the depth of transparency such as fund-level or portfolio company level

### SUFFICIENT REPORTING

GPs typically agree up front to the types and level of detailed reporting that will be provided in LPAs and side letters, the legal agreements signed with investors.

Further, many GPs will explain that their reporting is "sufficient" meaning that they meet all requirements as agreed. Or, that in addition to meeting LPA requirements, their reporting already provides all the details that an investor is requesting such as the granular details of the ILPA Template<sup>1</sup>.

If this is true, one is left to wonder where then is the lack of transparency for investors?

It is in the lack of standardization of reporting and the resulting inability to automate the collection of accurate, consistent, and sufficiently granular incoming data across many investments within the LP's portfolio.

---

<sup>11</sup> See [www.ILPA.org](http://www.ILPA.org)

## Example A

% of capital  
Partner %

Total capital commitment  
Capital contributed to date (includes transfers)  
Remaining commitment

**Opening capital balance**  
Contributions during the period  
Contributions receivable  
Distributions during the period  
Transfer of interest  
Syndication costs

**Investment results**  
Interest income  
Management fees  
Management fee offset  
Other expenses  
Realised gain/(loss)  
Deemed gain/(loss)  
Change in unrealised gain/loss; Net investment results  
Unrealised loss on cash escrow  
Equity interest in net operating income and realised gain from investees  
Equity interest in change in unrealised depreciation from investees  
Incentive allocation

**Closing capital balance**

## Example B

**Statement of changes in capital account  
from October 1, 20xx to December 31, 20xx**

Capital commitment

Capital account balance at October 1, 20xx, at cost

Net operating income (loss)

Partnership distributions

Capital account balance at December 31, 20xx, at cost

Net unrealised appreciation of investments at October 1, 20xx

Change in net unrealised appreciation/ depreciation of investments

## HURDLES TO TRANSPARENCY

### IN THE BEGINNING

We have seen a concerted push by LPs for more transparency in the last decade and investor knowledge of fee<sup>2</sup> practices continue to increase. The progress made has been mostly coordinated by organizations such as the ILPA or Institutional Limited Partner Association<sup>3</sup> and their educational efforts.

Early resistance from the GP side to increasing transparency cannot be summed up as the private equity manager's desire to "hide" fees or avoid scrutiny; there were some reasonable GP concerns such as fee information being taken out of context and need to first understand what LPs sought in reporting.

Frequent questions from both sides were:

- As LPs can we press our GPs for additional details or certain templates on current investments without LPA provisions and will it interfere with our ability to invest in future funds with this GP?
- GPs wanted to know for what would LPs use this information and with whom would it be shared?

### CURRENT HURDLES

Today, we have hundreds of GPs completing the ILPA Template and other accepted standard templates and efforts such as the ADS Initiative seeking to automate and streamline reporting. Taking the current format from PDFs and Excel files to digital, transportable data files that can be mapped into any LP technology for capturing portfolio data.

However, there are some lingering barriers to adoption and/or automation:

- PDFs versus Excel hindering automation
- Customization of Standards preventing scale
- Plus-one requests for templates are not in place of other custom requests
- Market conditions giving GPs the upper hand in negotiations
- Need for adaptation to all areas of broader private equity space

---

<sup>2</sup> The word "fee" is often used in LP conversations to include not only the GP management fee but also to refer collectively to carried interest which is a share of profits, fund-level expenses, and certain charges that occur at the operating company level.

<sup>3</sup> See [www.ilpa.org](http://www.ilpa.org)

- Proprietary data concerns with certain details at greater optical depth
- Public records or FOIA that interfere with GP compliance or LP requests
  - In the US, it is important to provide for both an appropriate and useful level of transparency to the public while allowing the public pension fiduciaries to access detailed, pertinent investment information required for analysis and decision-making without risk of violating contracts or exposing competitive or proprietary information

## SUMMARY

The goals or elements required to achieve transparency in private equity remain the same today and while substantial progress has been made, a coalescence of LPs and all supporting or oversight bodies is needed to continue to push, together, toward the future, desired state.

Sunlight in private equity has the potential to chase away real and perceived threats but over-exposure could be damaging to all involved.

It is prudent for an LP to seek to measure and monitor investment costs in context. This effort has been approached by LPs as a compliance exercise for LPA adherence and for analysis in the overall fund performance for consideration on future investments or renegotiations. Further, it is only over a period of years – much in line with the private equity lifecycle – that more granular information becomes most useful providing for comparative trends and an opportunity to perform higher analytics.

It will be important in the coming months and years for pension fiduciaries to continue to pursue a very objective and rational view of private equity and its investment costs, which must always be viewed in context of returns, while considering private equity's role in the portfolio allocation and its benefit to the plan beneficiaries.

## ABOUT



### LORELEI GRAYE

Lorelei Graye is founder and independent consultant for Leodoran Financial which currently advises PFA Solutions, Colmore, Ipreo and contributes to industry efforts in private capital that seek to benefit the industry as a whole.

Ms. Graye is speaker, author, and often-cited subject matter expert in private fund reporting focusing on key issues surrounding public pension policy while serving institutional investors (LPs), GPs, and their service providers globally by providing operational and procurement expertise, communications, marketing, and strategic management consulting.

Prior to founding Leodoran, Ms. Graye served the public retirement system in South Carolina where she spearheaded the State's development and implementation of an annual fee collection, validation, and reporting process which was featured in a prominent CEM Benchmarking study<sup>4</sup>. Ms. Graye has traveled extensively since that time to promote best practices and build consensus among commercial firms, institutional investors, trustees, regulators, and policymakers around the globe that are focused on private equity.

A key supporter of the ILPA Fee Transparency Initiative<sup>5</sup>, an Ambassador of the Transparency Task Force<sup>6</sup>, and organizer of the 2018 ADS Initiative<sup>7</sup>, Ms. Graye has over 20 years of business experience with degrees in finance and accounting, summa cum laude.

---

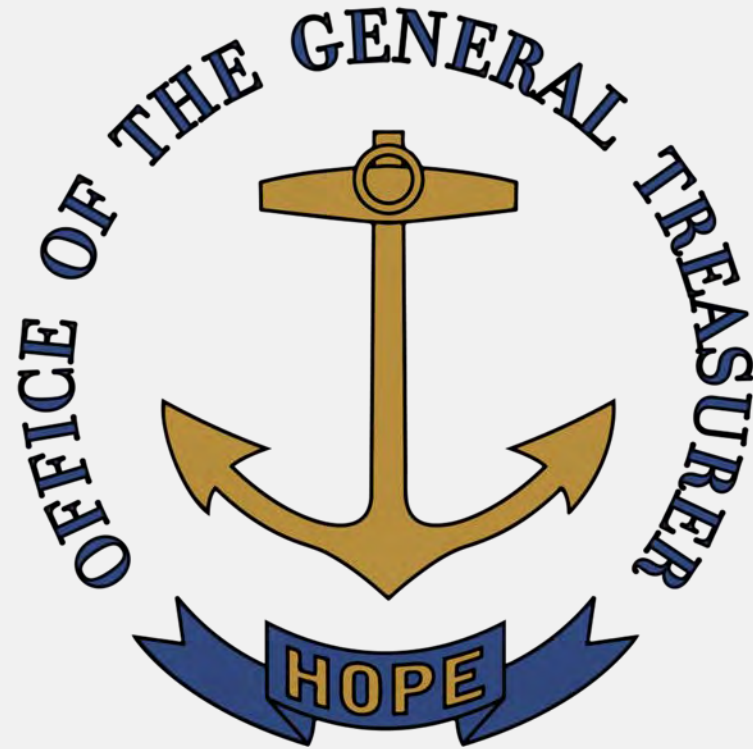
<sup>4</sup> Dang, Andrea CFA; Dupont, David CFA; Mike Heale. "The Time Has Come for Standardized Total Cost Disclosure for Private Equity"

<sup>5</sup> See [www.ILPA.org](http://www.ILPA.org)

<sup>6</sup> See [www.TransparencyTaskForce.org](http://www.TransparencyTaskForce.org)

<sup>7</sup> See [www.ADSInitiative.org](http://www.ADSInitiative.org)





# Transparent Treasury

General Treasurer Seth Magaziner | 2018

# Transparent Treasury

---

**In 2015 Treasurer Magaziner launched Transparent Treasury, one of the most comprehensive transparency policies in the nation**

| Requires pension fund managers to allow their performance and fees to be published online in order for state to invest

| Since Rhode Island launched Transparent Treasury in 2015, New York City, California, and other large funds are have adopted similar policies

| Former SEC Chairman Arthur Levitt Jr said RI's transparency model "should be implemented in every public fund"

# Transparent Treasury

---

| Each manager must sign:

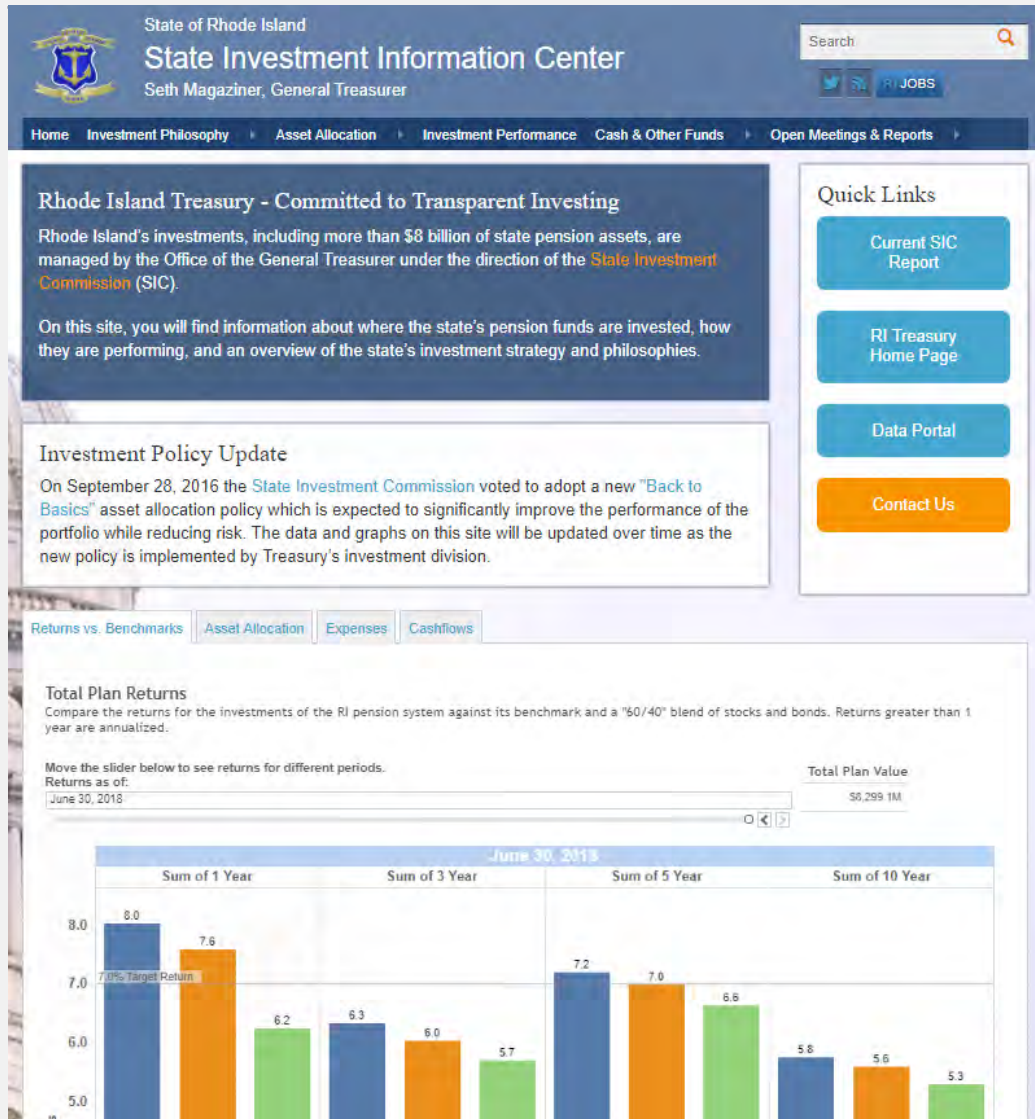
- A Transparency Agreement, committing to disclosure of fees, terms and basic information of the fund.
- An Investor Code of Conduct, affirming that the firm will maintain high ethical standards and strictly adhere to SEC and MSRB rules.
- A Placement Agent Certificate, affirming that no placement agents were compensated in connection with RI's investment.

# Implementation

---

- | All funds new to the ERSRI portfolio after June of 2015 are required to permit public reporting of their fees and expenses.
- | While funds that received investment from the SIC prior to June 2015 are grandfathered from the individualized reporting requirement, Treasury staff has requested that they voluntarily allow disclosure, which most (85%) have agreed to do.
- | Since 2015, the Investment division has not had any difficulty accessing investment opportunities as a result of this policy.
- | With this effort, and other similar efforts around the country, transparency is becoming the new normal.

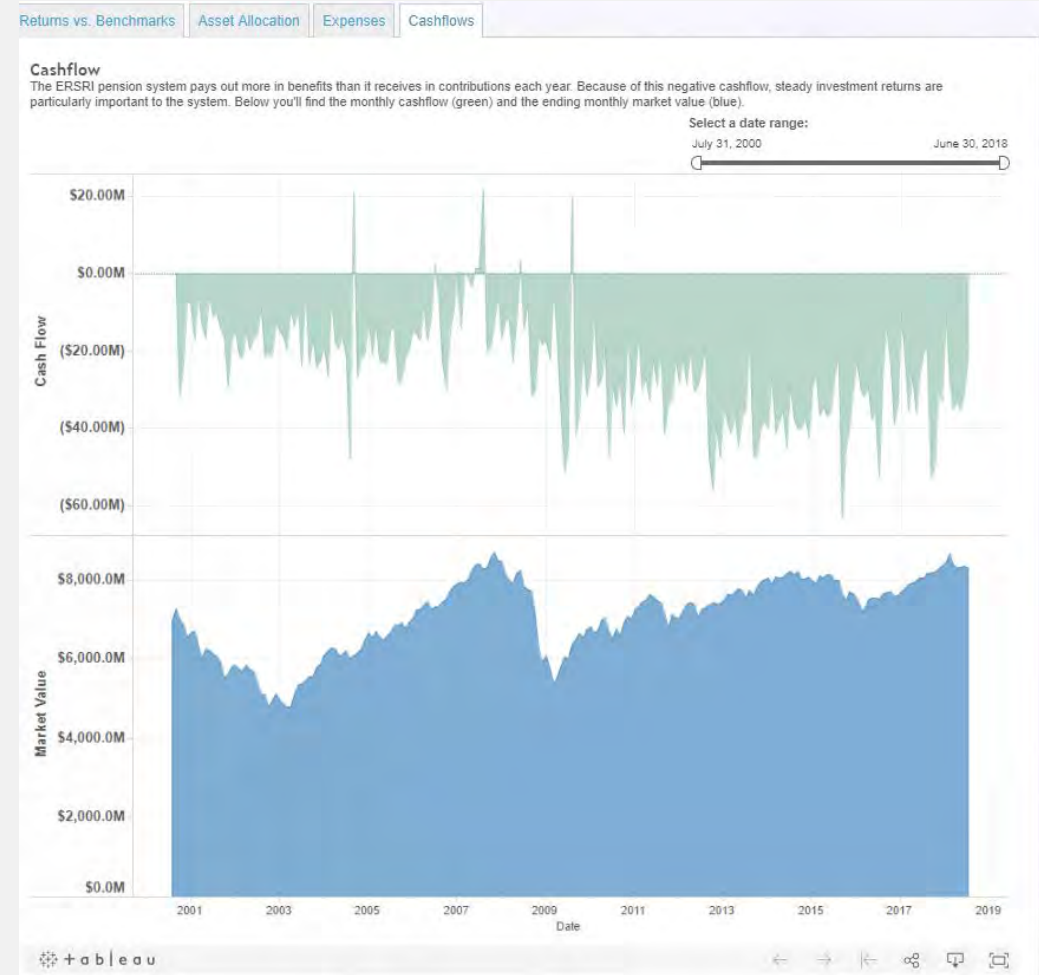
# Making Information Accessible



<http://investments.treasury.ri.gov>

- Public portal providing information on pension investments
- Monthly performance, expenses, cash flows, asset allocation changes, and investment manager information.
- The site also includes public meeting notices and links to Investment Commission meeting materials

# investments.treasury.ri.gov

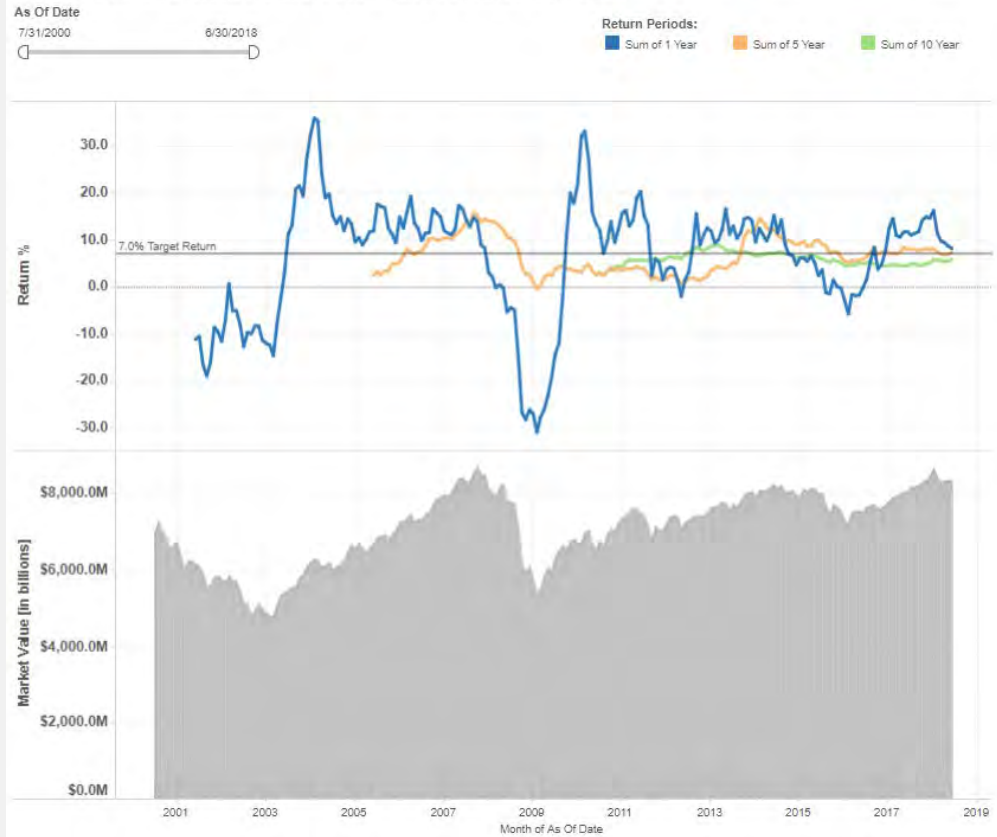




# investments.treasury.ri.gov

## Total Plan Returns and Value History

The line chart shows the 1 Year (blue), 5 Year (orange), and 10 Year (green) returns for the pension fund. The area chart at the bottom shows the growth over time of the total investment fund, in billions. (Returns and fund balances were reported on a quarterly basis until July 2000 and monthly thereafter.)



## Employees' Retirement System of Rhode Island Investment Expense Analysis

**FY 2017**  
in \$000's

Asset Class / Type	Management Fees	Fund Expenses	Performance Expense	Total Investment Expense	Expense Ratio
Global Equity Indexes	\$1,199	\$267		<b>1,466</b>	0.02%
Equity Hedge Funds	7,545	1,450	6,935	<b>15,930</b>	0.21%
Private Equity	10,056	3,267	11,067	<b>24,389</b>	0.31%
Subtotal Equity/Growth	18,800	4,984	18,002	<b>41,785</b>	0.54%
Subtotal Fixed Income	1,342			<b>1,342</b>	0.02%
Real Estate	5,884	934	306	<b>7,124</b>	0.09%
Infrastructure	2,848	469	282	<b>3,599</b>	0.05%
Subtotal Real Assets	8,732	1,402	588	<b>10,722</b>	0.14%
Bank Loans/High Yield	1,029			<b>1,029</b>	0.01%
Inflation Linked Bonds	309			<b>309</b>	0.00%
Absolute Return Hedge Funds	8,763	1,156	9,086	<b>19,004</b>	0.24%
Subtotal Real Return	10,101	1,156	9,086	<b>20,342</b>	0.26%
Subtotal Crisis Protection	18	106		<b>124</b>	0.00%
Beta Overlay	245	73		<b>318</b>	0.00%
Cash	361			<b>361</b>	0.00%
Subtotal Other Managers	606	73		<b>679</b>	0.01%
<b>Subtotal Manager Expense</b>	<b>\$39,599</b>	<b>\$7,720</b>	<b>\$27,676</b>	<b>\$74,995</b>	<b>0.97%</b>
Expense Ratio	0.51%	0.10%	0.36%	0.97%	
Consulting	\$950			<b>\$950</b>	0.01%
Custody	489			<b>489</b>	0.01%
Legal & Other	110			<b>110</b>	0.00%
Research	82			<b>82</b>	0.00%
Personnel / Operating	1,316			<b>1,316</b>	0.02%
<b>Subtotal Other Expenses</b>	<b>\$2,946</b>			<b>\$2,946</b>	<b>0.04%</b>



# investments.treasury.ri.gov

State of Rhode Island
Search 

## State Investment Information Center

Seth Magaziner, General Treasurer

Home
Investment Philosophy
Asset Allocation
Investment Performance
Cash & Other Funds
Open Meetings & Reports

OVERVIEW
ASSET ALLOCATION
INVESTMENT MANAGERS

### Investment Manager Directory

The investment manager directory is a comprehensive list of the investment managers hired by the State Investment Commission. The directory provides background on each manager, including how much money the SIC has invested, when the SIC invested with the manager, and a description of the asset class and approach.

The Expense tab lists annual expense reports which includes both direct and indirect fees paid to each manager.

Download the entire manager database as either a [CSV](#) file or [JSON](#)

Public Growth
Private Growth
Volatility Protection
Inflation Protection
Crisis Protection
Income
Manager Expenses

#### State Street Global Advisors (SSgA)

Founded in 1978 as the asset management division of State Street Corporation, SSgA provides institutional investment management services. In 1995, all of State Street's investment management services were reorganized as SSgA, headquartered in Boston, MA. At the time of investment, the division employed more than 2,000 people globally in 17 countries, with nine investment centers across the Americas, Europe and Asia.

Website: <http://www.ssga.com/>

Investment Approach	Initial Investment	Role in the Portfolio
These passive funds seek investment returns that approximate as closely as practical the performance of the target indexes, all of which are weighted based on market capitalization. The MSCI Canada fund is composed of Canadian common stocks. The MSCI EAFE fund consists of developed-market common stocks across Europe, Australasia and the Far East. The MSCI Emerging Markets fund is composed of common stocks from emerging markets across Asia, Europe, Latin America, and Africa. The Russell 3000 fund consists of large-, mid- and small-capitalization common stocks in the U.S. equity market.	<ul style="list-style-type: none"> <li>• \$1,636,329,331 investment to the Russell 3000 Index NL Fund in September 2012.</li> <li>• \$93,364,000 investment to the MSCI Canada Index NL Fund in August 2012.</li> <li>• \$804,223,000 investment to the MSCI EAFE Index NL Fund in</li> </ul>	This investment is part of the 40% ERSRI policy allocation to public growth.

### Proxy Voting Guidelines

Rhode Island Treasury's proxy voting guidelines reflect the fiduciary duty of the Rhode Island Treasurer's Office to vote proxies in the best interest of our members and constituents. Our goal is to vote our proxies in accordance with both their financial interests and their values. You can download our current proxy voting policy [here](#).

#### Proxy Voting Dashboard

Filters Votes Management Proposal Sector

##### Filters

[Reset Filters](#)

##### Meeting Date Range

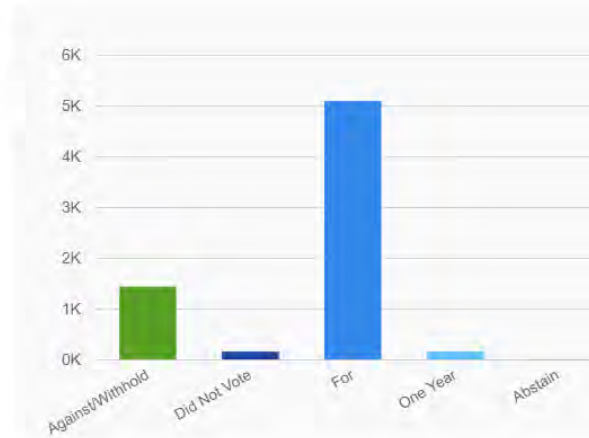
From  to

##### Fund

##### Company Search

### Voting Statistics

Across 6,687 unique proposals available to vote, we voted 6,606 for which 0 proposals were voted in varying ways for the same meeting agenda item.



# Transparent Treasury is Now the Law in RI

---

In 2017, at the request of Treasurer Magaziner, the Rhode Island General Assembly enacted RIGL 35-10-15.

“Transparency is essential to good government. As Treasurer, I take seriously my obligation to set a high standard of reporting that publicly discloses investment performance and fees. I commend the General Assembly for codifying my "Transparent Treasury" policy, ensuring this level of transparency will continue across future Treasury administrations.”

*-Treasurer Seth Magaziner*



Office of the General Treasurer  
Statehouse, Room 102

Providence, RI 02903

401-222-2397

<http://www.treasury.ri.gov>

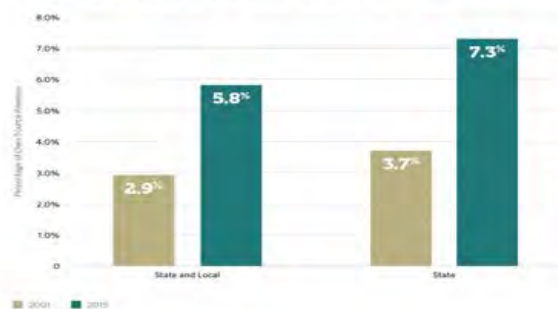
## STRESS TESTING FOR PUBLIC SECTOR RETIREMENT SYSTEMS

STATE AND LOCAL PENSION DEBT AS A SHARE OF GROSS DOMESTIC PRODUCT



Source: Pew analysis of data from the Federal Reserve

CONTRIBUTIONS AS A SHARE OF OWN SOURCE REVENUE  
Budget Allocation to Pensions Doubled from 2001 to 2015



Source: Pew analysis of data from the Federal Reserve

In 2017, state and local governments reported total unfunded pension liabilities of \$1.6 trillion – a larger deficit in both absolute terms and as a percent of U.S. gross domestic product (GDP) than at any time before the Great Recession. This deficit matters because more taxpayer dollars are needed each year to make up the difference, crowding out budgets for other essential government services. Looking forward, consistent under-funding, budget pressures, risky investment policies, and rising benefit costs make public pension systems more vulnerable than they have ever been to an economic downturn.

In response, actuarial and governmental accounting standards are being implemented to ensure that lawmakers and stakeholders are better informed of the financial risks they face for their public retirement systems. In fact, the Actuarial Standards Board recently adopted a new Standard of Practice, (ASOP No. 51), for public plan actuaries on reporting risks related to pension obligations, cost, and contributions. The new guidelines, which go into effect this November, are a significant culmination of over 10 years of efforts in the field to act on recommendations made in a 2014 report on ways to strengthening public pension plan funding commissioned by the Society of Actuaries.

At the same time, officials are eager to strengthen the long-term financial health of their public-sector pension systems and, in several states, have embraced a nonpartisan, data-

driven approach to more precisely assess whether they can fulfill benefit promises made to workers.

Called **stress testing**, this new practice can show policymakers how adverse economic conditions could affect their state or municipal retirement system's investments and, in turn, impact state budgets. Moreover, **comprehensive stress testing** builds upon existing reporting practices, aligns with emerging actuarial standards, and produces results that are designed to be accessible to a broader audience of officials and budget specialists, fit for the purposes of informing policy decisions and long-term financial planning.

### 1. WHAT EXACTLY IS STRESS TESTING?

Stress testing is a simulation technique used to determine the impact of downside economic scenarios on financial balance sheets. One of the most notable examples of stress testing comes from The Dodd-Frank Wall Street Reforms and Consumer Protection Act of 2010, passed in response to the 2008 financial crisis.

For public pensions, stress testing incorporates existing actuarial projections and investment sensitivity analyses as inputs, and evaluates plan solvency and employer costs using multiple financial scenarios at varying levels of market volatility.

### 2. WHY IS STRESS TESTING IMPORTANT FOR PUBLIC RETIREMENT PLANS AND WHAT DOES IT TELL US?

Public pension plans are more vulnerable than ever to an economic downturn, based on reported levels of pension debt, measures of investment risk, and rising costs associated with an aging population. State and local officials need tools to ensure that policies are in place to weather the economic uncertainty ahead and ensure that pension costs are affordable for taxpayers while benefit promises to workers are safeguarded. Stress testing can:

- Aid administrators and policymakers in planning for the next recession by demonstrating the potential impacts on pension costs and liabilities, including the likelihood of retirement system insolvency.
- Promote good funding policies and practices by illustrating the importance of maintaining fiscal discipline.

- Serve as a valuable tool for assessing a range of possible economic outcomes when scoring proposed reforms.

Ultimately, what gets measured gets managed; Stress testing can help policymakers responsibly manage retirement funds through all cycles of the economy.

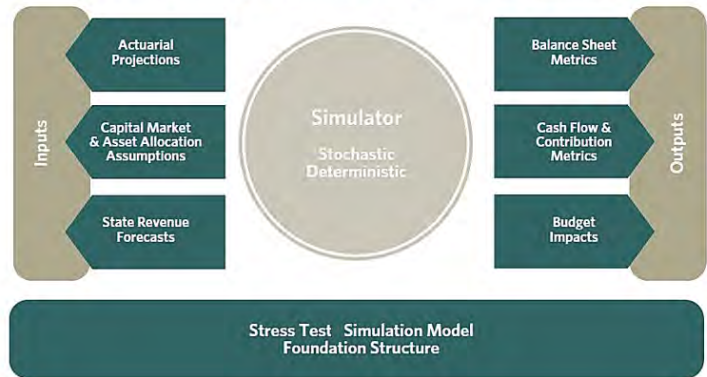
### 3. WHAT SHOULD COMPREHENSIVE STRESS TESTING INCLUDE?

Comprehensive stress testing should:

- Build on existing actuarial projections, investment analysis, and reporting requirements for pension plans to ensure efficiency in costs.
- Include well-constructed economic scenarios that account for (1) periods of lower than expected investment returns; (2) the impact of a recession, including an initial loss in value for plan assets followed by a period of lower economic growth; and, (3) the impact of financial market variability from year to year, even in a growing economy.
- Incorporate a state or municipality’s economic outlook as well as its track record in making annual required contributions as inputs, and present results in manner that informs broader policy and budget discussions.

#### STRESS TESTING SIMULATION MODEL FOUNDATION STRUCTURE

Pew’s simulation tool incorporates a state or municipality’s financials as inputs, simulates economic condition, and produces key projections and metrics.



Pew’s model provides an example of a comprehensive approach to stress testing for public pension funds. To request additional information on the methodology and framework applied in our model please send a request to the contact listed below.

### 4. IS THIS JUST AN ACADEMIC EXERCISE? WHICH STATES HAVE ADOPTED LEGISLATION REQUIRING STRESS TESTING?

Stress testing is **not** just an academic exercise. In the past year, California, Colorado, Connecticut, Hawaii, Virginia, New Jersey, and Washington have performed stress test analyses or adopted reporting requirements to include this information in standard reporting going forward.

In fact, reforms adopted in Colorado in 2018 were influenced, in part, by the results of a stress testing exercise conducted in 2015, as part of a mandatory requirement to assess the effectiveness of prior reforms. The results indicated that without additional policy intervention, there was approximately a one-in-four chance of pension system insolvency.

Pennsylvania’s 2017 reforms were also informed by a similar analysis produced by the state’s independent fiscal office. The state is now conducting a formal study to evaluate how stress testing could be included as part of regular reporting going forward.

### 5. AREN’T RETIREMENT PLANS ALREADY PRODUCING THIS TYPE OF ANALYSIS?

Pension plan actuaries and investment consultants regularly produce studies that include long-term projections based on state-specific assumptions, as well as asset/liability studies that examine outcomes based on a range of investment return scenarios. These analyses provide essential inputs, but comprehensive stress testing goes a step further by applying these analyses in a way that accounts for a state’s overall economic conditions, tax collections, as well as the state officials record in making required contributions, to inform broader policy discussions and long-term financial planning.

Adopting comprehensive stress test reporting by statute is not only a reflection of the importance of this type of analysis, it is the best way for policymakers to provide clear guidance to plans on what the analysis should include and how frequently it should be produced.

### 6. HOW ARE OTHER STATES ESTABLISHING THIS AS A CRITICAL REPORTING REQUIREMENT?

The last five states to adopt stress testing – Colorado, Connecticut, Hawaii, New Jersey, and Virginia – have all done so through legislation. In general, the language is included in either the statutory provisions establishing the public employees’ retirement system records and reports requirements, or in the provisions establishing actuarial economic assumptions sections of state law. The level of specificity varies by state with Hawaii including the most prescriptive detail.

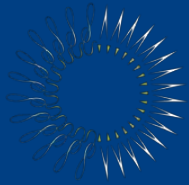
FOR MORE INFORMATION ABOUT PEW’S SIMULATION TOOL AND ANALYTIC FRAMEWORK FOR STRESS TESTING CONTACT:

FATIMA YOUSOFI AT [fyousofi@pewtrusts.org](mailto:fyousofi@pewtrusts.org)

OR VISIT

[www.pewtrusts.org/pensions](http://www.pewtrusts.org/pensions)





THE  
**PEW**  
CHARITABLE TRUSTS

# APPLYING STRESS TESTING TO PENNSYLVANIA'S RETIREMENT SYSTEMS

**PENNSYLVANIA PUBLIC PENSION MANAGEMENT AND  
ASSET INVESTMENT REVIEW COMMISSION  
HARRISBURG, PA  
JULY 30, 2018**

DAVID DRAINE, SENIOR OFFICER  
STRENGTHENING PUBLIC SECTOR RETIREMENT SYSTEMS

# WHAT IS STRESS TESTING?

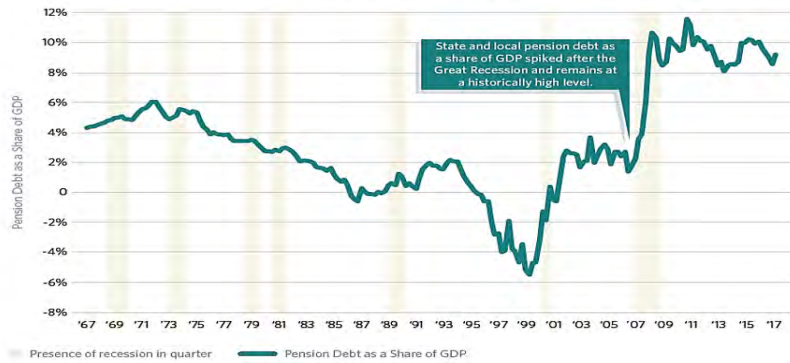
- Simulation technique used to assess the impact of different economic conditions on pension balance sheets and governmental budgets.
- Central to emerging actuarial reporting standards (Actuarial Standard of Practice No. 51.)
- Budget tool to help policymakers plan for the next recession and better manage economic uncertainty.



# PUBLIC PENSIONS VULNERABLE TO NEXT ECONOMIC DOWNTURN

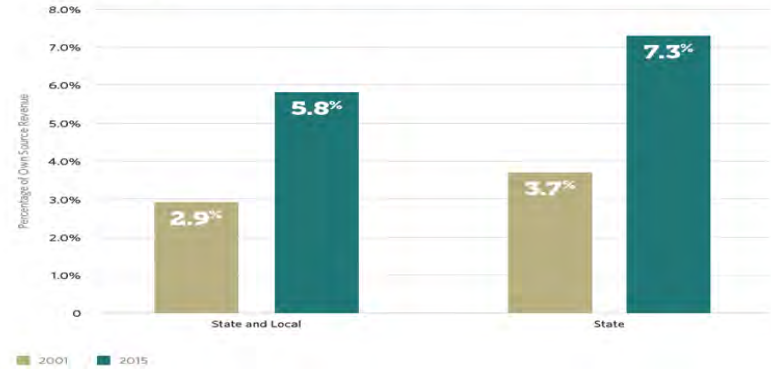
In aggregate, state and local pension systems have never been more exposed to market volatility, based on fiscal measures and economic outlook

### STATE AND LOCAL PENSION DEBT AS A SHARE OF GROSS DOMESTIC PRODUCT



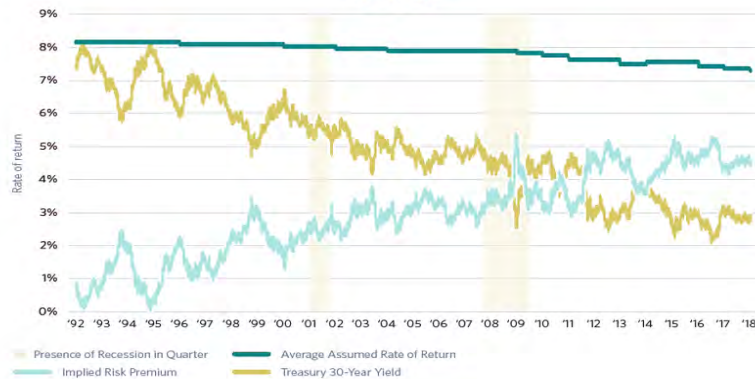
### CONTRIBUTIONS AS A SHARE OF OWN SOURCE REVENUE

Budget Allocation to Pensions Doubled from 2001 to 2015



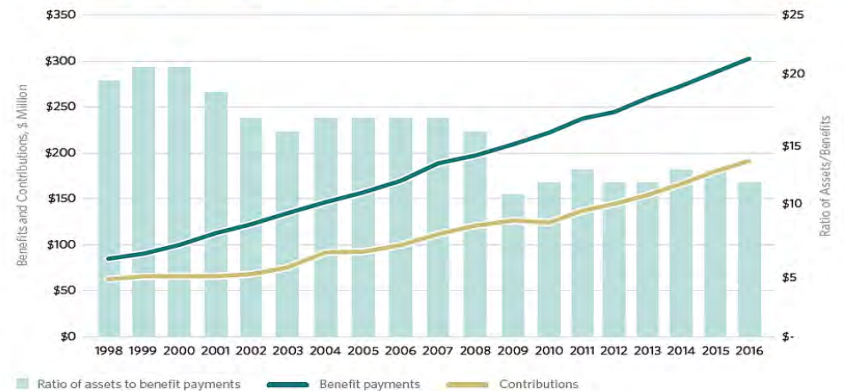
### PENSION FUND RISK PREMIUM AT HISTORIC HIGH

Plan's average assumed rate of return remains relatively stable, while bond yields have declined



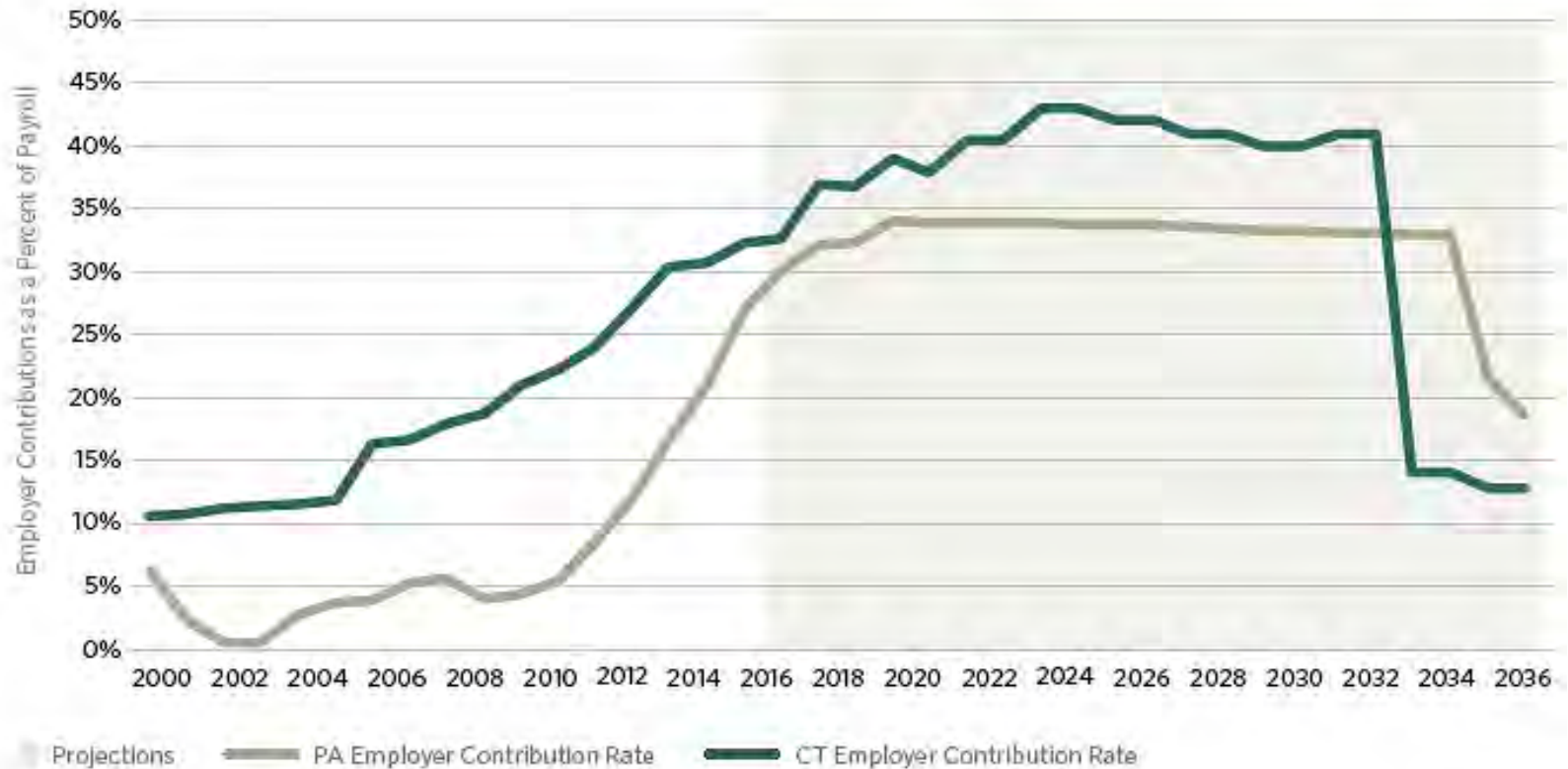
### BENEFITS & CONTRIBUTIONS FOR STATE & LOCAL PLANS

Widening Operating Cash Flow Gap and Reduced Asset to Benefit Coverage



# PENNSYLVANIA AND CONNECTICUT'S EMPLOYER CONTRIBUTION RATES OVER TIME

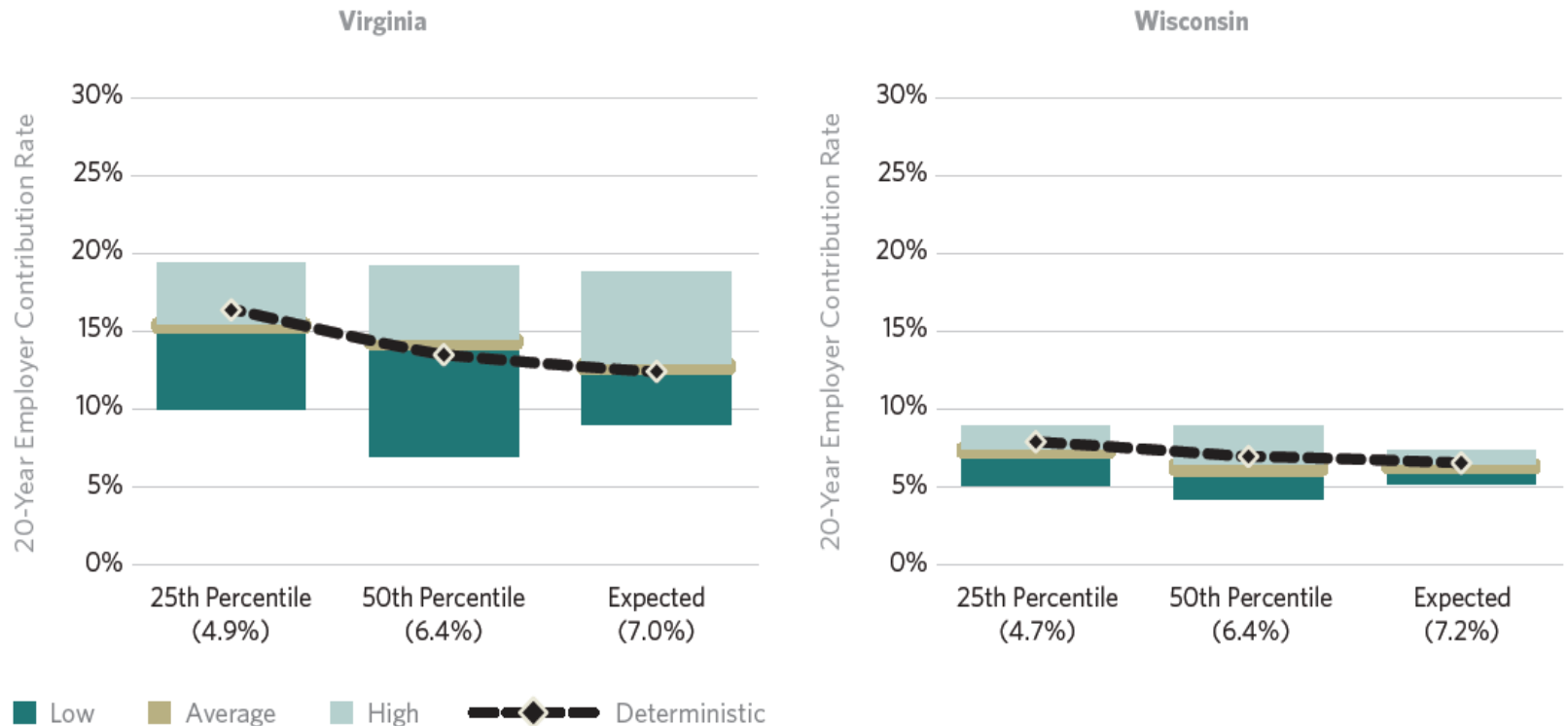
Under plans' assumed rates of return and the state policy contribution assumption



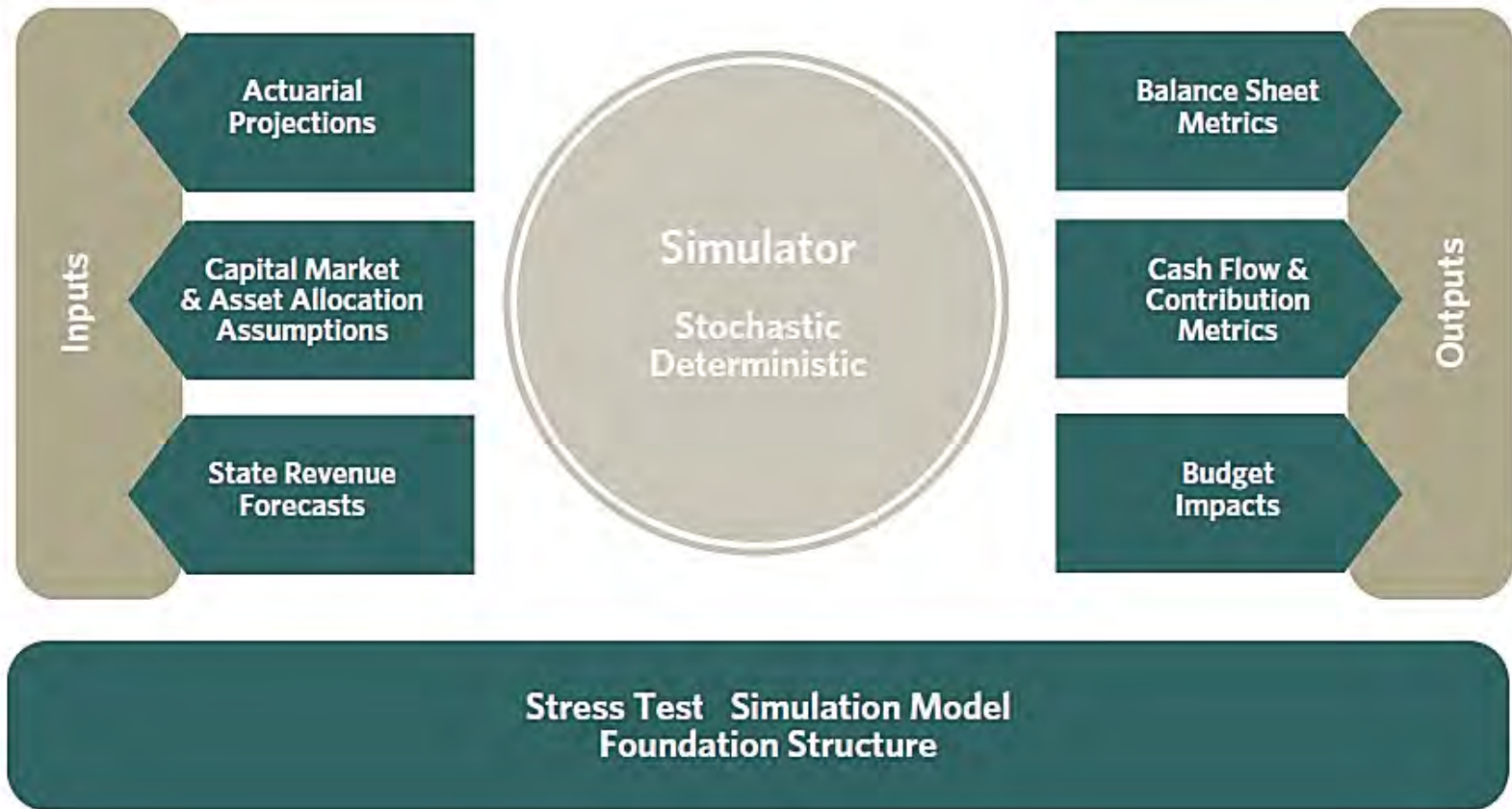
Source: The Pew Charitable Trust and The Terry Group, based on publicly available Comprehensive Annual Financial Reports (CAFR), actuarial reports and valuations, other public documents, or as provided by plan officials.

# PROJECTED IMPACT OF VOLATILITY OF COSTS FOR VIRGINIA AND WISCONSIN

Funding policy has a significant impact on the range of required contributions

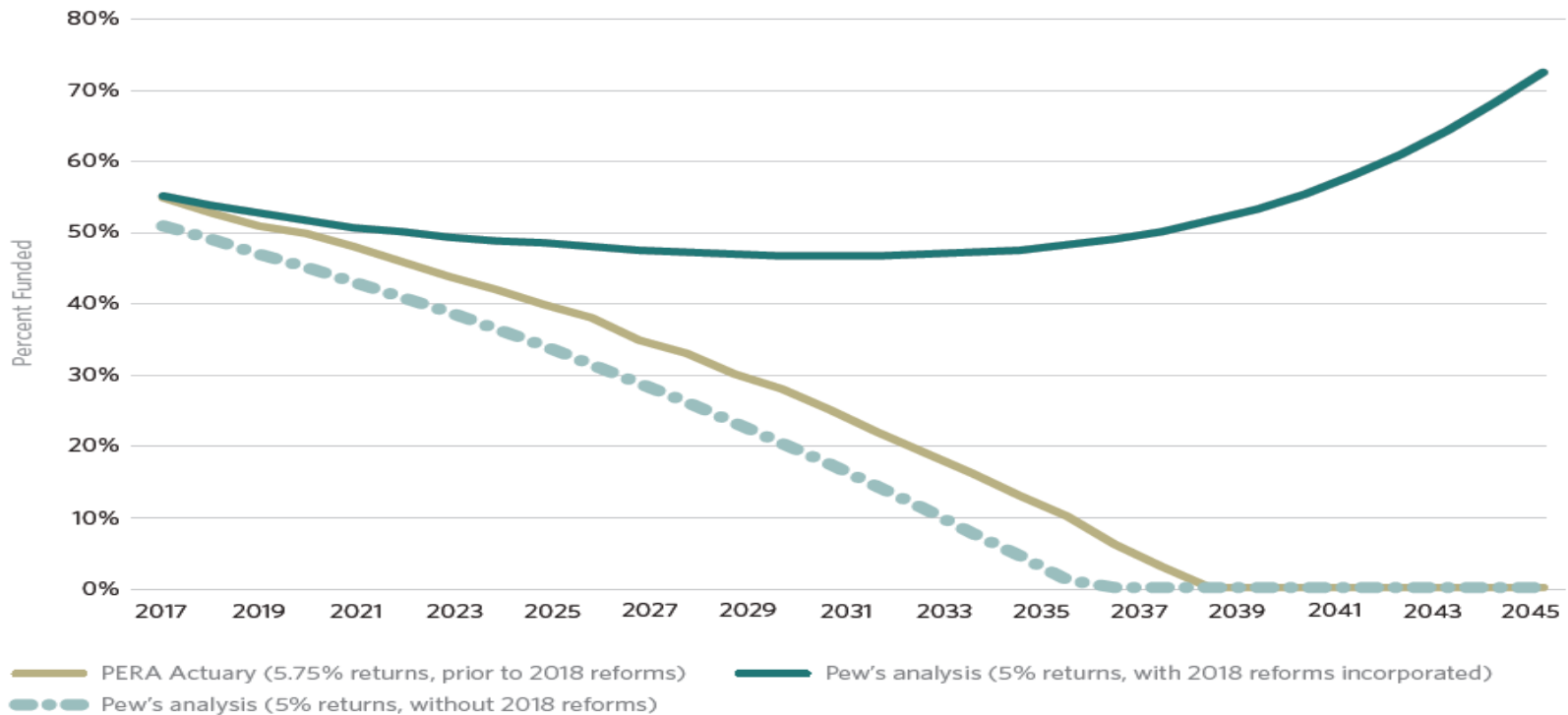


# STRESS TESTING SIMULATION MODEL FOUNDATION STRUCTURE



# COLORADO'S PROJECTED FUNDED STATUS BEFORE AND AFTER PENSION REFORMS

*Funded Status for PERA's State Division, Under Lower than Expected Investment Returns*



Notes: Projections based on Colorado's Public Employees Retirement Systems (PERA) 2016 valuation. Reform projections do not include changes to the definition of payroll as outlined in the final legislation as we anticipate the effect on fiscal impact to be minor. Additionally, our model simplified the risk sharing features to be fully on in low return scenarios. Finally, a 20% take-up rate for the DC plan was assumed. Sources: The Pew Charitable Trusts and the Terry Group



# PENNSYLVANIA'S IFO USES STRESS TESTING

Using risk analysis to assess potential policy changes allows policymakers to consider the full impact of pension legislation.

**Table 8: Potential New Employee Risk Reduction for Fiscal Years 2018-19 to 2049-50**

ARR Reduction	Cash Flow			Present Value at 3.6%			Present Value at 7.25/7.5%		
	PSERS	SERS	Total	PSERS	SERS	Total	PSERS	SERS	Total
100 basis points	\$4,196	\$2,294	\$6,490	\$1,884	\$1,040	\$2,924	\$926	\$494	\$1,420
200 basis points	8,392	4,589	12,981	3,768	2,079	5,847	1,853	988	2,841

Notes: Amounts in millions. Present value as of June 30, 2018. ARR is the assumed rate of return. Basis point reduction is applied to the ARR for the respective system.

A01354 and A01558 to SB 1

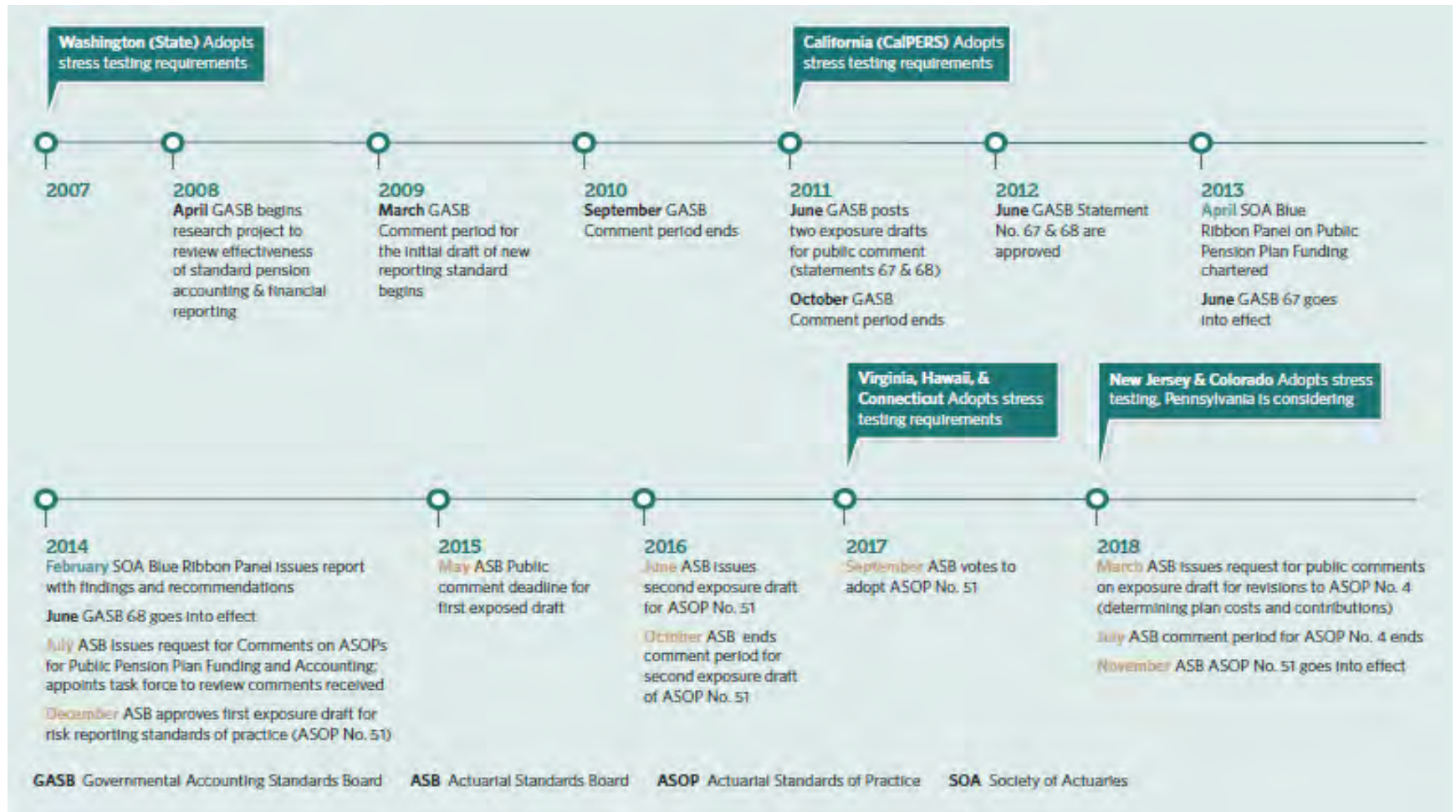
16

Independent Fiscal Office

Notes: Pennsylvania Independent Fiscal Office Actuarial Note for Amendments 01354 and 01558 to Senate Bill 1; June 3, 2017.

# RISK REPORTING DEVELOPMENTS FOR PUBLIC PENSIONS

Recent changes in reporting standards have led to increased momentum among states in adopting stress testing.





## WHY IS STRESS TESTING IMPORTANT FOR STATES?

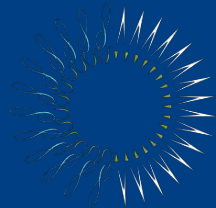
- Pensions risk reporting is coming - Actuarial Standard of Practice (ASOP) No. 51 goes into effect this November.
- State budgets are more vulnerable to the next recession.
- Provides a scorecard to assess current and proposed funding policies, based on a range of possible market outcomes.

Ultimately...

**What gets Measured gets Managed!**

## IMPLEMENTING STRESS TESTING

- Primary focus is on *investment* and *contribution risks* (e.g. ASOP No. 51)
- Build on existing reporting requirements (e.g. GASB) and analyses (e.g. Asset/Liability studies), BUT...
- Incorporates **revenue** and **budget** components.
- Develop report with budget officials and broader audience in mind.
- Establish a standardized approach that is both accessible and extensible.



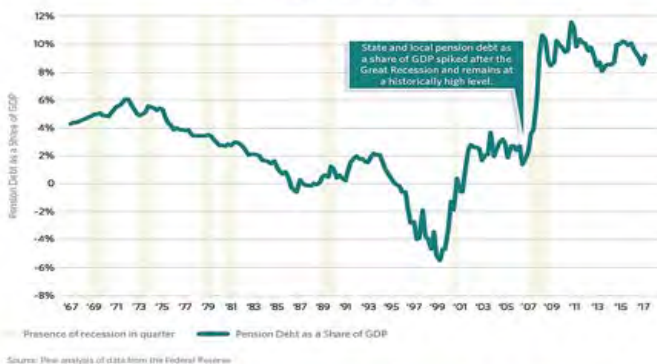
THE  
**PEW**  
CHARITABLE TRUSTS

DAVID DRAINE  
[ddraine@pewtrusts.org](mailto:ddraine@pewtrusts.org)  
202-552-2012  
[pewtrusts.org/publicpensions](http://pewtrusts.org/publicpensions)

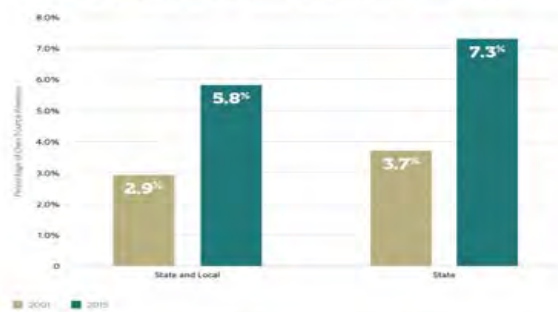
[pewtrusts.org](http://pewtrusts.org)

## STRESS TESTING FOR PUBLIC SECTOR RETIREMENT SYSTEMS

STATE AND LOCAL PENSION DEBT AS A SHARE OF GROSS DOMESTIC PRODUCT



CONTRIBUTIONS AS A SHARE OF OWN SOURCE REVENUE  
Budget Allocation to Pensions Doubled from 2001 to 2015



In 2017, state and local governments reported total unfunded pension liabilities of \$1.6 trillion – a larger deficit in both absolute terms and as a percent of U.S. gross domestic product (GDP) than at any time before the Great Recession. This deficit matters because more taxpayer dollars are needed each year to make up the difference, crowding out budgets for other essential government services. Looking forward, consistent under-funding, budget pressures, risky investment policies, and rising benefit costs make public pension systems more vulnerable than they have ever been to an economic downturn.

In response, actuarial and governmental accounting standards are being implemented to ensure that lawmakers and stakeholders are better informed of the financial risks they face for their public retirement systems. In fact, the Actuarial Standards Board recently adopted a new Standard of Practice, (ASOP No. 51), for public plan actuaries on reporting risks related to pension obligations, cost, and contributions. The new guidelines, which go into effect this November, are a significant culmination of over 10 years of efforts in the field to act on recommendations made in a 2014 report on ways to strengthening public pension plan funding commissioned by the Society of Actuaries.

At the same time, officials are eager to strengthen the long-term financial health of their public-sector pension systems and, in several states, have embraced a nonpartisan, data-driven approach to more precisely assess whether they can fulfill benefit promises made to workers.

Called **stress testing**, this new practice can show policymakers how adverse economic conditions could affect their state or municipal retirement system's investments and, in turn, impact state budgets. Moreover, **comprehensive stress testing** builds upon existing reporting practices, aligns with emerging actuarial standards, and produces results that are designed to be accessible to a broader audience of officials and budget specialists, fit for the purposes of informing policy decisions and long-term financial planning.

### 1. WHAT EXACTLY IS STRESS TESTING?

Stress testing is a simulation technique used to determine the impact of downside economic scenarios on financial balance sheets. One of the most notable examples of stress testing comes from The Dodd-Frank Wall Street Reforms and Consumer Protection Act of 2010, passed in response to the 2008 financial crisis.

For public pensions, stress testing incorporates existing actuarial projections and investment sensitivity analyses as inputs, and evaluates plan solvency and employer costs using multiple financial scenarios at varying levels of market volatility.

### 2. WHY IS STRESS TESTING IMPORTANT FOR PUBLIC RETIREMENT PLANS AND WHAT DOES IT TELL US?

Public pension plans are more vulnerable than ever to an economic downturn, based on reported levels of pension debt, measures of investment risk, and rising costs associated with an aging population. State and local officials need tools to ensure that policies are in place to weather the economic uncertainty ahead and ensure that pension costs are affordable for taxpayers while benefit promises to workers are safeguarded. Stress testing can:

- Aid administrators and policymakers in planning for the next recession by demonstrating the potential impacts on pension costs and liabilities, including the likelihood of retirement system insolvency.
- Promote good funding policies and practices by illustrating the importance of maintaining fiscal discipline.

- Serve as a valuable tool for assessing a range of possible economic outcomes when scoring proposed reforms.

Ultimately, what gets measured gets managed; Stress testing can help policymakers responsibly manage retirement funds through all cycles of the economy.

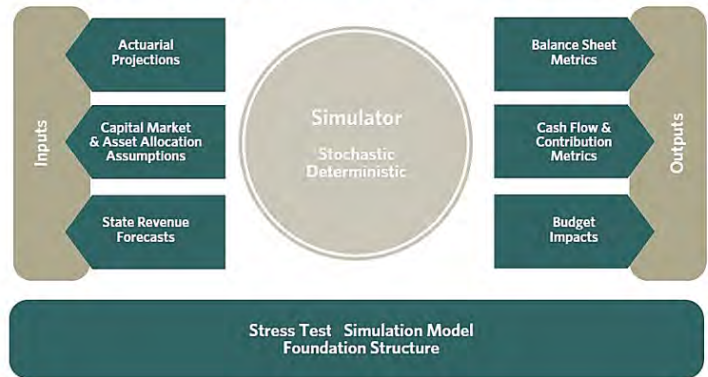
### 3. WHAT SHOULD COMPREHENSIVE STRESS TESTING INCLUDE?

Comprehensive stress testing should:

- Build on existing actuarial projections, investment analysis, and reporting requirements for pension plans to ensure efficiency in costs.
- Include well-constructed economic scenarios that account for (1) periods of lower than expected investment returns; (2) the impact of a recession, including an initial loss in value for plan assets followed by a period of lower economic growth; and, (3) the impact of financial market variability from year to year, even in a growing economy.
- Incorporate a state or municipality’s economic outlook as well as its track record in making annual required contributions as inputs, and present results in manner that informs broader policy and budget discussions.

#### STRESS TESTING SIMULATION MODEL FOUNDATION STRUCTURE

Pew’s simulation tool incorporates a state or municipality’s financials as inputs, simulates economic condition, and produces key projections and metrics.



Pew’s model provides an example of a comprehensive approach to stress testing for public pension funds. To request additional information on the methodology and framework applied in our model please send a request to the contact listed below.

### 4. IS THIS JUST AN ACADEMIC EXERCISE? WHICH STATES HAVE ADOPTED LEGISLATION REQUIRING STRESS TESTING?

Stress testing is **not** just an academic exercise. In the past year, California, Colorado, Connecticut, Hawaii, Virginia, New Jersey, and Washington have performed stress test analyses or adopted reporting requirements to include this information in standard reporting going forward.

In fact, reforms adopted in Colorado in 2018 were influenced, in part, by the results of a stress testing exercise conducted in 2015, as part of a mandatory requirement to assess the effectiveness of prior reforms. The results indicated that without additional policy intervention, there was approximately a one-in-four chance of pension system insolvency.

Pennsylvania’s 2017 reforms were also informed by a similar analysis produced by the state’s independent fiscal office. The state is now conducting a formal study to evaluate how stress testing could be included as part of regular reporting going forward.

### 5. AREN’T RETIREMENT PLANS ALREADY PRODUCING THIS TYPE OF ANALYSIS?

Pension plan actuaries and investment consultants regularly produce studies that include long-term projections based on state-specific assumptions, as well as asset/liability studies that examine outcomes based on a range of investment return scenarios. These analyses provide essential inputs, but comprehensive stress testing goes a step further by applying these analyses in a way that accounts for a state’s overall economic conditions, tax collections, as well as the state officials record in making required contributions, to inform broader policy discussions and long-term financial planning.

Adopting comprehensive stress test reporting by statute is not only a reflection of the importance of this type of analysis, it is the best way for policymakers to provide clear guidance to plans on what the analysis should include and how frequently it should be produced.

### 6. HOW ARE OTHER STATES ESTABLISHING THIS AS A CRITICAL REPORTING REQUIREMENT?

The last five states to adopt stress testing – Colorado, Connecticut, Hawaii, New Jersey, and Virginia – have all done so through legislation. In general, the language is included in either the statutory provisions establishing the public employees’ retirement system records and reports requirements, or in the provisions establishing actuarial economic assumptions sections of state law. The level of specificity varies by state with Hawaii including the most prescriptive detail.

FOR MORE INFORMATION ABOUT PEW’S SIMULATION TOOL AND ANALYTIC FRAMEWORK FOR STRESS TESTING CONTACT:

FATIMA YOUSOFI AT [fyousofi@pewtrusts.org](mailto:fyousofi@pewtrusts.org)

OR VISIT

[www.pewtrusts.org/pensions](http://www.pewtrusts.org/pensions)

# “Funding Government Pensions and Risk Taking”

Chester Spatt

Carnegie Mellon University, MIT and NBER

July 30, 2018



Public Pension Management and Asset Investment  
Review Commission

Harrisburg, PA

# Background

- Faculty member at Carnegie Mellon, 1979-
- Chaired Professor of Finance, Tepper School, Carnegie Mellon, 1996--
- Distinguished Visiting Prof at MIT, 2017-19
- Chief Economist, SEC, 2004-2007
- Co-Founder and 2<sup>nd</sup> Exec. Editor, *Review of Financial Studies*
- Member, Model Validation Council, Federal Reserve; 2012, 2013 and 2014
- Expert on Valuation, Portfolio Theory, Asset Pricing, Taxes & Regulation



# What is Financial Market Risk?

- Systematic (aggregate) risk cannot be diversified away in forming portfolios
- Idiosyncratic risk is diversified in a portfolio
- Risk premium is associated with systematic, but not idiosyncratic, risk
- Payoffs valuable in weak economic states
- Risk is not simply about returns of 30% and zero every other year
- Instead, risks reflects a possibility of huge market losses (e.g., -40% on an economy-wide basis); permanent loss of wealth

# Pension Liabilities and Risk

- Pension recipients anticipate that the pensions will be paid in all circumstances
- To the extent that this expectation is correct, then per financial theory the actuarial liabilities are riskless and should be discounted at risk-free rates (and NOT at equity-like returns)
- Underfunding equals liabilities discounted at risk-free (*not risky*) rates less the current value of assets.

# Pension Liabilities & Risk (cont.)

- Is it reasonable to invest in equity?
  - If there is an expectation that the defined benefit plan will not pay off when the market does badly, then equity investment would reflect this payoff risk
  - Valuable to hedge pension risks correlated with the economy (Lucas and Zeldes, 2006)
- Who should bear the risk associated with inadequate market returns (e.g., 2008 w/o the subsequent recovery)?
  - Workers? Taxpayers? Which generations?

# Underfunding and Transparency

- Is it ethical for politicians and union leaders to negotiate underfunded plans without being transparent and without resolving the risk-sharing issue?
- What was the “collective bargain”?
  - Should taxpayers or workers assume the risk?
- Politicians and union leaders are agents; future principals are not currently active
  - Agency conflict: Negotiators vs. principals
- Commission, Treasurer, and trustees could play an important role in transparency

# Pension Assets & Equity Risks?

- A little bit of equity risk can be borne without moving the pension plan from risk neutrality; investors are locally risk neutral & earn risk premium
- To the extent that the economy has natural risks, these could be borne and spread out among available capital in the economy—equilibrium risk bearing

# Pension Assets & Equity Risks?

- Equilibrium argument (demand = supply) suggests baseline demand reflects relative supplies of risky assets
- This leads to a form of the CAPM—demand for an efficient portfolio that is fully diversified along the risk-return frontier (“tangency portfolio”) should reflect the supplies of risky assets (“market portfolio”)

# Pension Assets & Equity Risks?

- Another reason to bear equity risk is the possibility that poor absolute performance would create an opportunity to bargain away benefits due to the threat implied by limited funding (Detroit, Puerto Rico, etc.)
- This impact is strongest when the plan is most underfunded--Spatt (2005) discusses in a private pension plan setting.
- The broader argument undercuts PA's bargaining posture, suggesting PA not hold equity!



# Leverage and Borrowing

- Leverage leads to greater systematic risk and potential for further underfunding
- Who bears those risks? Workers? Taxpayers?
- Concern about excess (inefficient) risk-taking
- Equilibrium analysis does *not* support generic use of leverage, except to potentially bargain away future benefits
- Costs are crucial with leverage

# Illiquid Assets

- Illiquid assets have liquidity costs (and challenging to adjust and costly to manage); relatively unsophisticated investors don't have comparative advantage in owning illiquid assets
- View projected returns skeptically
- Basic measurement problem with illiquid assets—riskiness is often understated since valuations are artificially smoothed
- Illiquid assets should be only modestly held as just slight role in market portfolio

# Managers vs. Investors

- Berk and Green (*JPE*, 2004)—rents are earned by asset managers whose skills are scarce (investment capital is not scarce).
- Why would PA be able to capture such rents from scarce managerial skills?
- Costs are extremely important to consider in evaluating managers (Spatt, 2007, Harrisburg speech)

***Chester Spatt's Statement on "Funding Government Pensions and Risk Taking," for the Public Pension Management and Asset Investment Review Commission, July 30, 2018***

I am pleased and honored to have the opportunity to present my views to the Commission at its hearing today. I am the Pamela R. and Kenneth B. Dunn Professor of Finance at the Tepper School of Business at Carnegie Mellon University, where I have been a faculty member since 1979 and also am currently serving as the Golub Distinguished Visiting Professor of Finance at the Massachusetts Institute of Technology. I also served as the Chief Economist of the U.S. Securities and Exchange Commission in Washington, D.C. from July 2004 until July 2007. I was co-founder and the second Executive Editor of the *Review of Financial Studies*, which quickly emerged as one of the preeminent journals in financial economics, as well as a Past President and Program Chair of the Western Finance Association. I have served as a member of several federal advisory committees, including the Federal Reserve Bank's Model Validation Council, which provided feedback to the Federal Reserve Bank on its validation of the first several rounds of stress tests under the Dodd-Frank Act. My expertise as a faculty member includes such areas as valuation, portfolio theory, asset pricing, taxes and financial regulation.

I'll begin the substance of my presentation by defining financial market risks. It is helpful to classify these risks into two categories, systematic or aggregate risk—which because of the commonality in the risk cannot be diversified away by forming a portfolio of assets—and idiosyncratic risk—which is largely eliminated by forming a diversified portfolio. Risk premium is earned by bearing systematic risk, but not idiosyncratic risk. To shed more light on the nature of risk I note that payoffs are especially valuable in weak states of the economy (e.g., after low market returns). For example, risk is not simply about the variability in returns in individual assets, such as when these have returns of 30% and 0% every other year. Instead, risk and especially priced risk reflect the possibility of huge in overall wealth losses (e.g., about 40% after the financial crisis) and a permanent loss of wealth.

Pension recipients anticipate that pensions will be paid in all states of the economy and that the plan sponsor will not default on these payments. To the extent that this perspective is correct, then the actuarial liabilities would be riskless and according to financial theory these liabilities should be discounted at risk-free rates (and not at equity-like returns as suggested by accounting). We would then measure underfunding as the liabilities discounted at risk-free rates less the current value of the plan's assets.

One important rationale for equity investment in pension plans is if it is valuable to hedge pension risks that are correlated with the economy (e.g., if the collective pension obligation of the plan is correlated sufficiently with the market return and the economy as in the case where that determines the individual benefit or the number of beneficiaries), see Lucas and Zeldes (2006). Of course, if the defined-benefit pension plan invests in equity, it is still obligated to make its payments even in the states of nature in which the returns fall short. However, if the plan does not fulfill its obligations, then there could be significant risk to the liabilities—which is important for the beneficiaries and plan sponsor to acknowledge. This raises an important issue: Who should bear the risks associated with inadequate market returns (e.g., 2008 without the subsequent recovery)? Workers/Beneficiaries? Taxpayers? Which generations?

The potential for underfunding of public pension plans highlights the importance of transparency and raises a number of ethical issues and challenges. Is it ethical for politicians and union leaders to negotiate underfunded plans without being transparent and without resolving the risk-sharing issues when the return on investments falls short? How did “collective bargaining” address this? Should taxpayers or workers assume this risk? Both politicians and union leaders are agents negotiating for others—taxpayers and workers. However, unlike standard

“agency problems,” arguably many of the important “principals,” future taxpayers and workers, are not currently active. I do think that the Commission, the Treasurer and, going forward, the pension trustees could all play an important role in facilitating transparency in such contexts.

On the broad question of whether pensions should bear equity risks, I am not a “hawk” who asserts absolutely not. I view traditional portfolio theory as suggesting some scope for pension plans to hold some equity. Indeed, a small amount of equity can be held without moving the pension plan from risk neutrality; if the investors hold little risk they are locally risk neutral and able to earn risk premium without taking on material risk. More fundamentally, to the extent that the economy has natural risks, these should be borne and spread out among capital in the economy—that is the essence of equilibrium risk sharing. The formal equilibrium analysis under which Demand = Supply suggests that baseline relative demands should reflect relative asset supplies. This leads to a form of the “Capital Asset Pricing Model” in which the demand for an efficient portfolio that is fully diversified along the risk-return frontier (“tangency portfolio”) should equal the supplies of risky assets (“market portfolio”).

Another reason that both private and public pension plans would desire to bear equity risk is the possibility that poor absolute performance



would create an opportunity to bargain away previously granted pension benefits due to the threat implied by limited funding. The potential for this in the public arena is illustrated by such situations as Detroit and Puerto Rico. This impact would be greatest when the pension plan is the most underfunded. For example, in my lecture at Georgetown (Spatt (2005)) I discussed this in a private pension plan setting in which the threat of bankruptcy and plan termination were important. Even in the public pension case without a formal bankruptcy process, there still is a fundamental moral hazard problem that remains and that leaves open the possibility of future renegotiation between the pension beneficiaries and the taxpayers and is tied to underfunding and excess risk-taking (the taxpayers have a strong incentive to push this given the possibility that funding collapses). More broadly, the implications of underfunding (due to low contributions or inadequate returns from past risk taking) in driving excess risk taking are important. Indeed, the deeper point remains that the potential for this underfunding undercuts Pennsylvania's collective bargaining posture, suggesting Pennsylvania being forced to not hold excessive equity!

The Pennsylvania pension plan appears to have considerable leverage in recent years. Leverage leads to greater systematic risk and potential for further underfunding. Again this leaves open the question of who bears the risks? Workers and beneficiaries or taxpayers? Leverage

raises concern about excess (inefficient) risk-taking; unlike basic risk-taking, equilibrium considerations do not support the generic use of leverage, except as a way for Pennsylvania to try to bargain away some future benefits when risk taking performs badly (and that should be costly in making current bargaining more problematic). An additional confounding issue with leverage is that the cost of management increases artificially.

Illiquid assets have liquidity costs, though this may be only a limited disadvantage in a pension plan context. Still such positions are challenging to adjust and costly to manage. Relatively unsophisticated investors do not have a comparative advantage in owning such assets. The lack of frequent asset marking (valuation) and lack of market liquidity suggests the need for viewing projected and historical returns skeptically. For example, historical (and projected) returns may be overstated and indeed, riskiness is often understated since valuations are artificially smoothed. Both of these suggest that portfolio models will produce excessive holdings of illiquid assets. Indeed, this is consistent with the observation that the holdings of illiquid assets in some portfolios are disproportionate; instead, their role should be modest as they only have a slight weight in the capital markets.

One additional point to highlight is that rents are earned by asset managers with scarce skills (Berk and Green (2004)); this does not imply that the rents flow through to investment capital that is not scarce (all investors would be happy to earn excess returns, if these were available). I would not expect Pennsylvania to capture the rents from those with scarce managerial skills. Costs are extremely important to consider in evaluating managers (e.g., Spatt, 2007, Harrisburg) and potentially even in evaluating asset allocation and the presence of leverage.

#### References

Berk, J., and R. Green, 2004, "Mutual Fund Flows and Performance in Rational Markets," *Journal of Political Economy* 112, 1269-1295.

Lucas, D. and S. Zeldes, 2006, "Valuing and Hedging Defined Benefit Pension Obligations: The Role of Stocks Revisited," working paper.

Spatt, C., 2005, "Why Private Pensions Matter to the Public Capital Markets, Speech by SEC Staff, Georgetown University, Washington, D.C.

Spatt, C., 2007, "Public Plan Investment and the Role of Indexing," Speech by SEC Staff, Harrisburg, PA.

Stress Testing



Classic Values, Innovative Advice

# Public Pension Management and Asset Investment Review Commission Hearing

July 30, 2018

Kenneth A. Kent, FSA, FCA, MAAA, EA  
Principal Consulting Actuary

# Topics for Discussion



Background

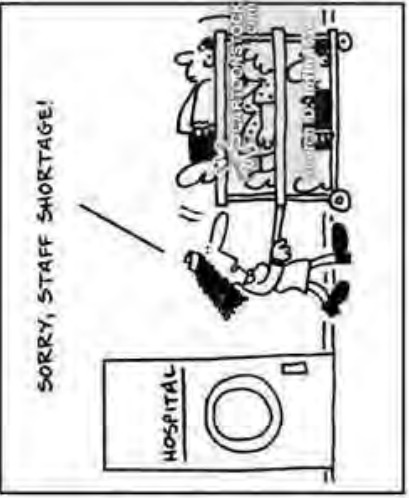
Stress Testing?

How Does It Work?

Why is it important?

Show me!

# Background- The Pension Landscape



Classic Values, Innovative Advice

July 30, 2018

2



# Background – Who's Talking About It



ACTUARIAL STANDARDS BOARD



Classic Values, Innovative Advice

July 30, 2018

3



# Background – What is Missing



TABLE I-1  
SUMMARY OF PRINCIPAL RESULTS

	1/1/2016	1/1/2017	Change
<b>Participant Counts</b>			
Actives	10,007	9,068	( 9.4%)
Terminated Vested	11,569	11,719	1.3%
In Pay Status	6,768	7,202	6.4%
Total	28,344	27,989	( 1.3%)
<b>Financial Information</b>			
Market Value of Assets	\$ 811,196,890	\$ 852,950,933	5.1%
Actuarial Value of Assets	808,789,046	854,711,912	5.7%
Present Value of Future Benefits	\$ 1,083,650,064	\$ 1,116,899,660	3.1%
Actuarial / PPA Liability	\$ 980,555,899	\$ 1,018,756,653	3.9%
Surplus / (Unfunded) based on Actuarial Value of Assets	(171,766,853)	(164,044,741)	( 4.5%)
Funded Ratio based on Actuarial Value of Assets	82.5%		
Funded Ratio based on Market Value of Assets	82.7%		
Present Value of Vested Benefits for Withdrawal Liability	\$ 1,465,060,430	\$	
Surplus / (Unfunded) based on Market Value of Assets	(653,863,540)		
<b>Gain / (Loss), Minimum Funding, and Cash Flows</b>			
Actuarial Investment Gain / (Loss)	\$ 5,647,769	\$	
Liability Gain / (Loss)	(5,812,620)		
Minimum Required Contribution (before Credit Balance)	35,499,289 *		
Credit Balance	10,897,907		
Prior Year Contributions (net from all sources)	\$ 33,879,790	\$	
Prior Year Benefit Payouts	41,343,465		
Prior Year Administrative Expenses	3,158,567		
Prior Year Total Investment Income (Net)	20,730,005		



# Background – Who Is Using It



## Insurance Industry

- Require Solvency Testing Using *Dynamic Financial Analysis since 1980 to forecast ruin probabilities*

## Banking Industry

- Dodd-Frank - established stress tests as a key component for regulators to gauge the banking industry health

## Social Security Trustees Report

- Optimistic, pessimistic and best estimate

# Stress Testing ?



It is **NOT** a solution

It is a measurement

It is **NOT** a decision

It is information necessary to  
make better decisions

It is **NOT** a risk

It is a visualization of the potential  
outcome of risk



Classic Values, Innovative Advice

July 30, 2018

6

# Stress Testing ?

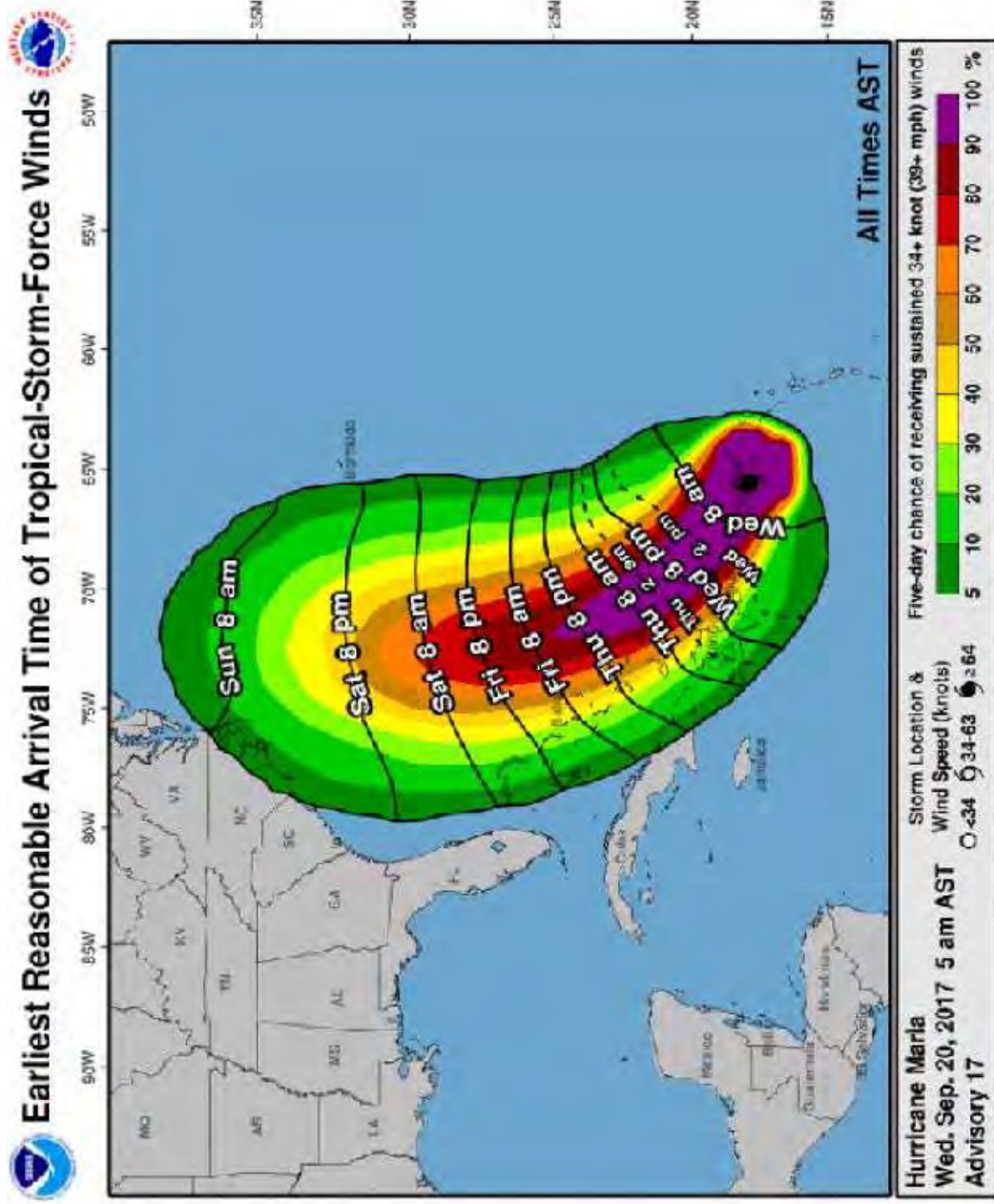


Stress testing measures the risk of a financial system's ability to meet future obligations

For Pension plans the risk emanates from two typical structures:

- If contributions can vary - the risk of sustainability
- If contributions are fixed - the risk of insolvency

# Why is Stress Testing Important

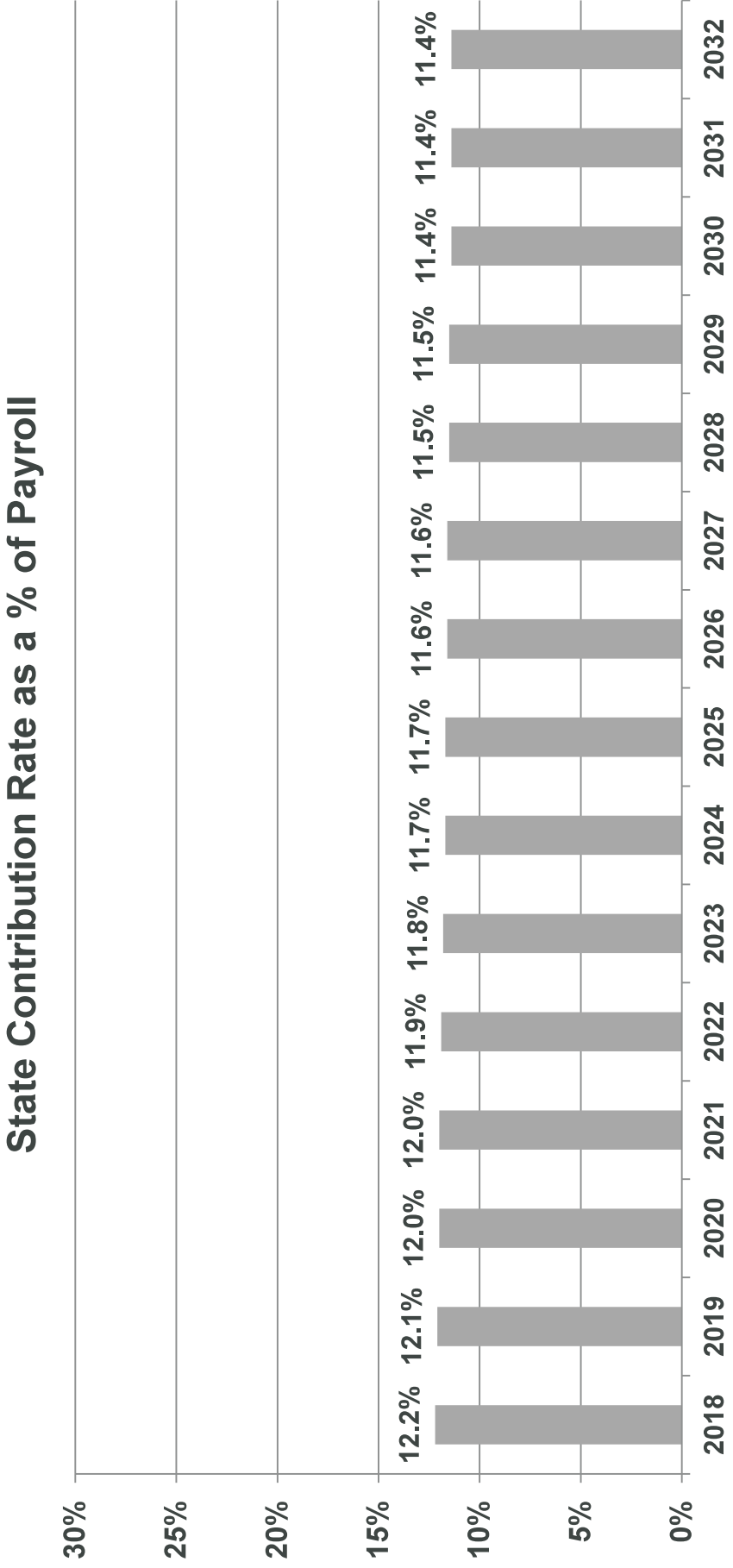


Classic Values, Innovative Advice

# Baseline Projection: Not A Stress Test



You start with a projection of expected results (best estimate actuarial assumptions)

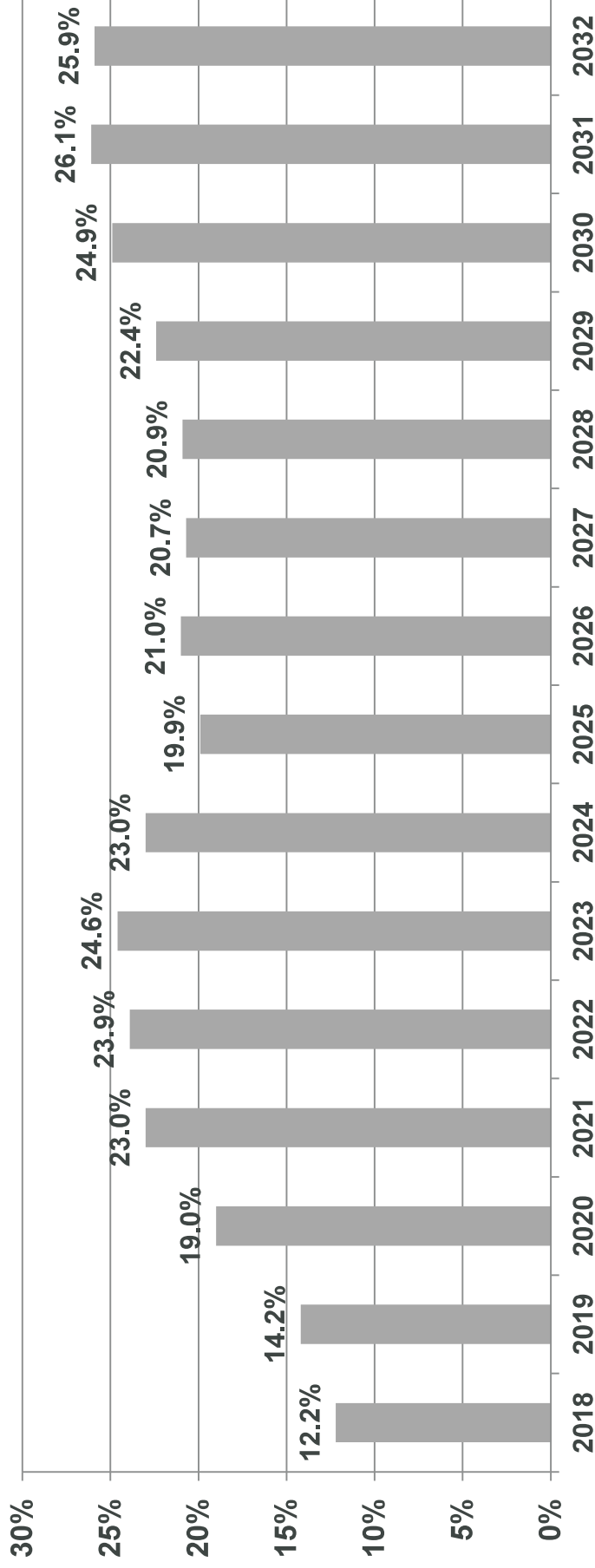


# A Simple Stress Test



Then test what happens if your expectations are off (project out alternative results within expected ranges)

State Contribution Rate as a % of Payroll

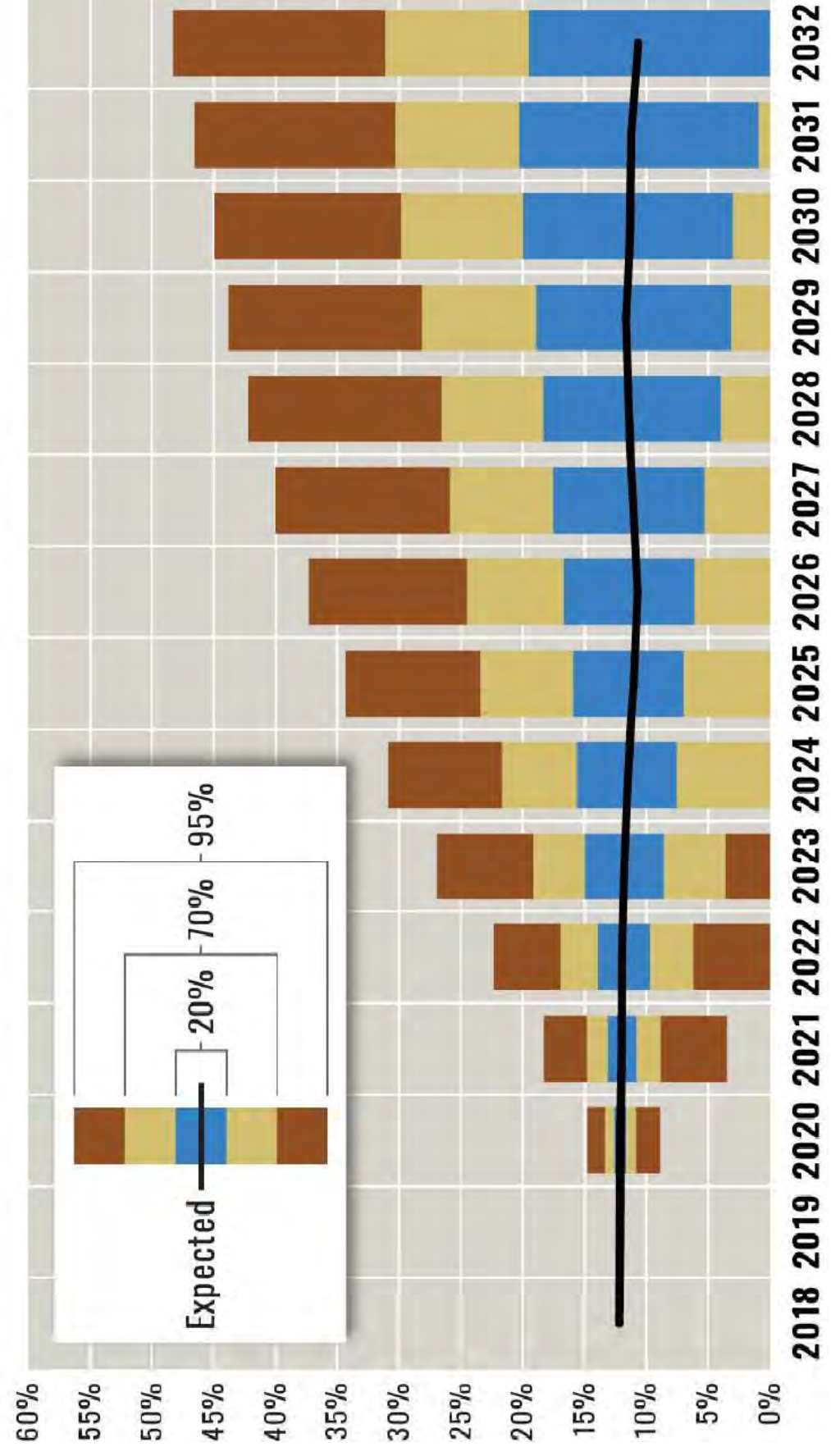




# Stress Testing- An Illustration



**Figure 4** Plan sponsor contribution as a percent of payroll





# Net Cash Flow Is Zero



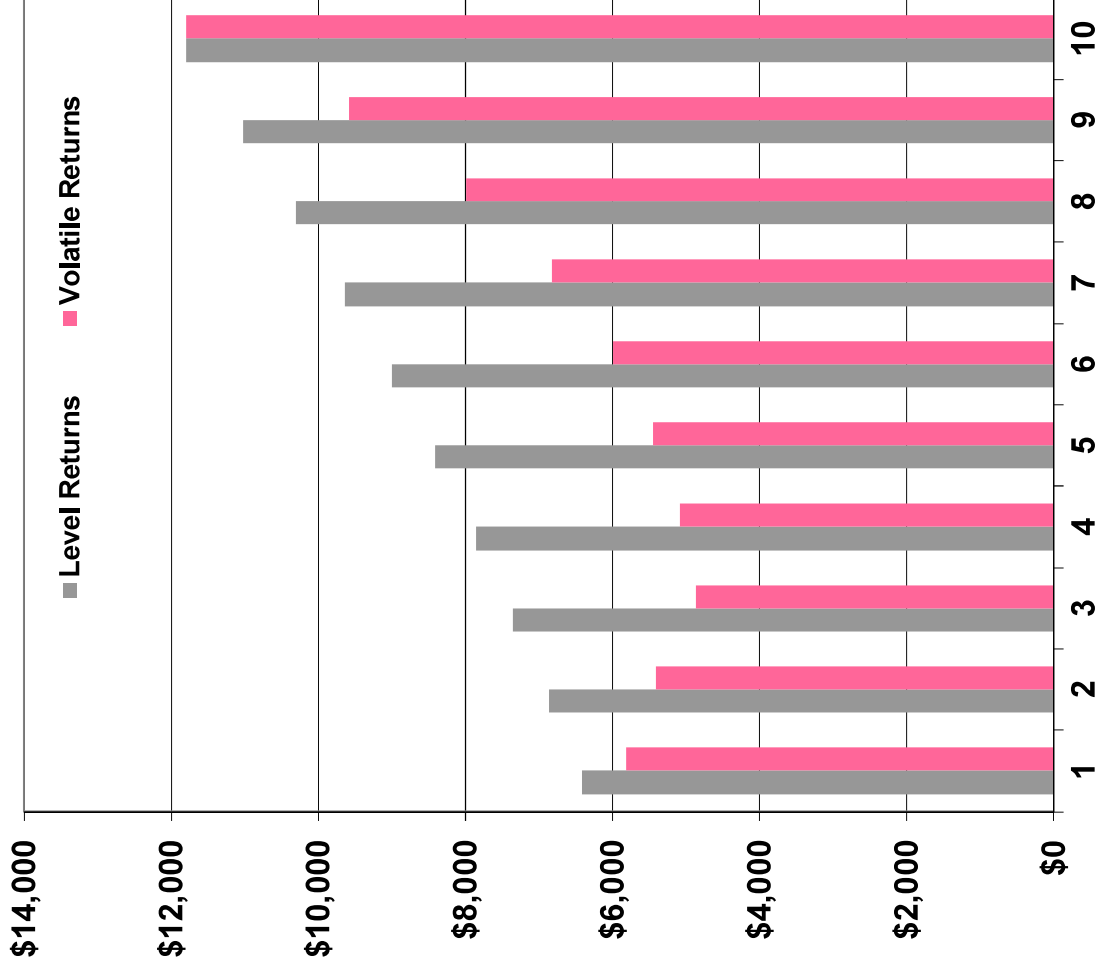
Starting Assets	\$ 6,000	Net Cash Flow Growth	0.0%
Net Cash Flow	0.0%	Market Cycle	downup

Year	New Cash Flow	ASSETS	
		Level Returns	Volatile Returns
1	\$ -	7.0%	-3.0%
2	\$ -	7.0%	-7.0%
3	\$ -	7.0%	-10.0%
4	\$ -	7.0%	4.5%
5	\$ -	7.0%	7.0%
6	\$ -	7.0%	10.0%
7	\$ -	7.0%	14.0%
8	\$ -	7.0%	17.0%
9	\$ -	7.0%	20.0%
10	\$ -	7.0%	23.1%
		<b>\$11,803</b>	<b>\$11,803</b>

reported return = 7.00% *time weighted returns*

actual return = 7.00% *dollar weighted returns*

Asset Loss/(Gain) \$0 **or** 0%



# Negative Cash Flows – Down/Up Markets



Starting Assets	<b>\$ 6,000</b>	Net Cash Flow Growth	<b>4.0%</b>
Net Cash Flow	<b>-4.0%</b>	Market Cycle	<b>down</b>

Year	New Cash Flow	ASSETS	
		Level Returns	volatile
1	\$ (240.0)	7.0%	\$5,584
2	\$ (249.6)	7.0%	\$4,952
3	\$ (259.6)	7.0%	\$4,211
4	\$ (270.0)	7.0%	\$4,125
5	\$ (280.8)	7.0%	\$4,123
6	\$ (292.0)	7.0%	\$4,229
7	\$ (303.7)	7.0%	\$4,497
8	\$ (315.8)	7.0%	\$4,920
9	\$ (328.5)	7.0%	\$5,544
10	\$ (341.6)	7.0%	<b>\$6,443</b>

reported return = **7.00%** **7.00%** time weighted returns

actual return = **7.00%** **5.42%** dollar weighted returns

Asset Loss/(Gain) **\$1,330** **or** **-17%**



# Negative Cash Flow – Up/Down Returns



Starting Assets	\$ 6,000	Net Cash Flow Growth	4.0%
Net Cash Flow	-4.0%	Market Cycle	updown

Year	New Cash Flow	Level Returns		ASSETS	
		Level Returns	Volatile Returns	level	volatile
1	\$ (240.0)	7.0%	23.0%	\$6,172	\$7,114
2	\$ (249.6)	7.0%	20.0%	\$6,346	\$8,263
3	\$ (259.6)	7.0%	17.0%	\$6,521	\$9,387
4	\$ (270.0)	7.0%	14.0%	\$6,698	\$10,413
5	\$ (280.8)	7.0%	10.0%	\$6,877	\$11,160
6	\$ (292.0)	7.0%	7.0%	\$7,056	\$11,639
7	\$ (303.7)	7.0%	4.5%	\$7,236	\$11,854
8	\$ (315.8)	7.0%	-10.0%	\$7,416	\$10,369
9	\$ (328.5)	7.0%	-7.0%	\$7,595	\$9,326
10	\$ (341.6)	7.0%	-3.0%	\$7,774	\$8,715

reported return = 7.00% *time weighted returns*

actual return = 7.99% *dollar weighted returns*

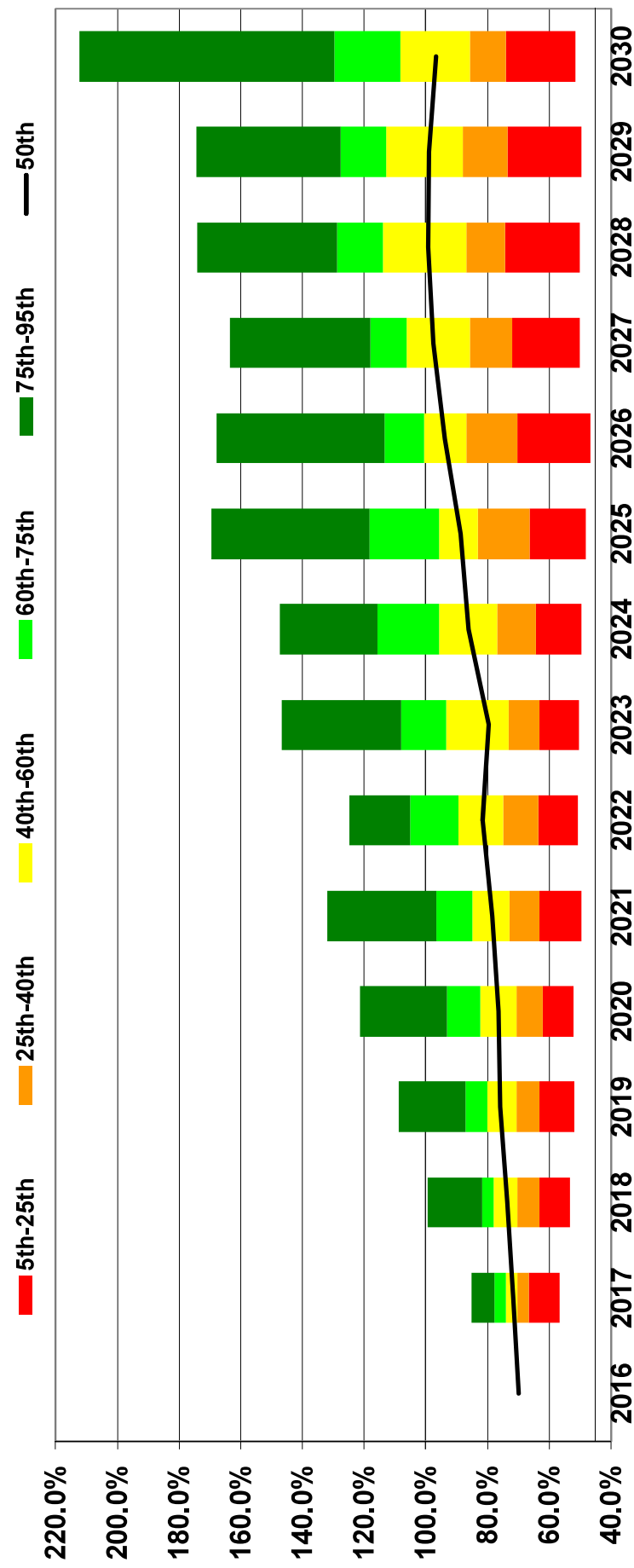
Asset Loss/(Gain) (\$941) **or** 12%



# Why is Stress Testing Important



MVA Funding Ratio



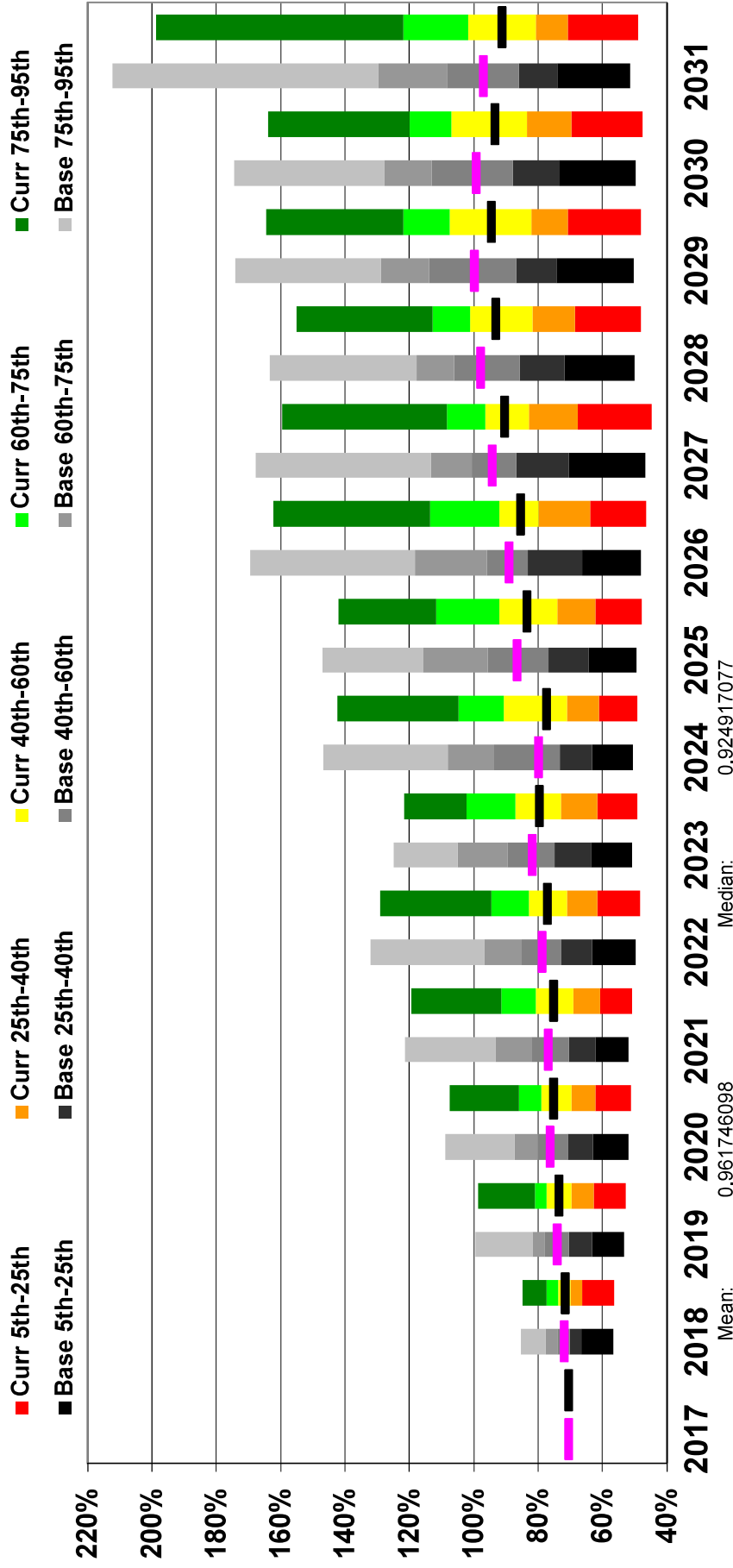
Geometric Standard  
Return Deviation

Current	7.25%	14.00%	Complete
Baseline	7.25%	14.00%	Complete

# Why is Stress Testing Important



## MVA Funding Ratio



Geometric Standard  
Return Deviation

Geometric Standard	Return	Deviation
Current	6.75%	14.00%
Baseline	7.25%	14.00%

Complete	Complete
Complete	Complete



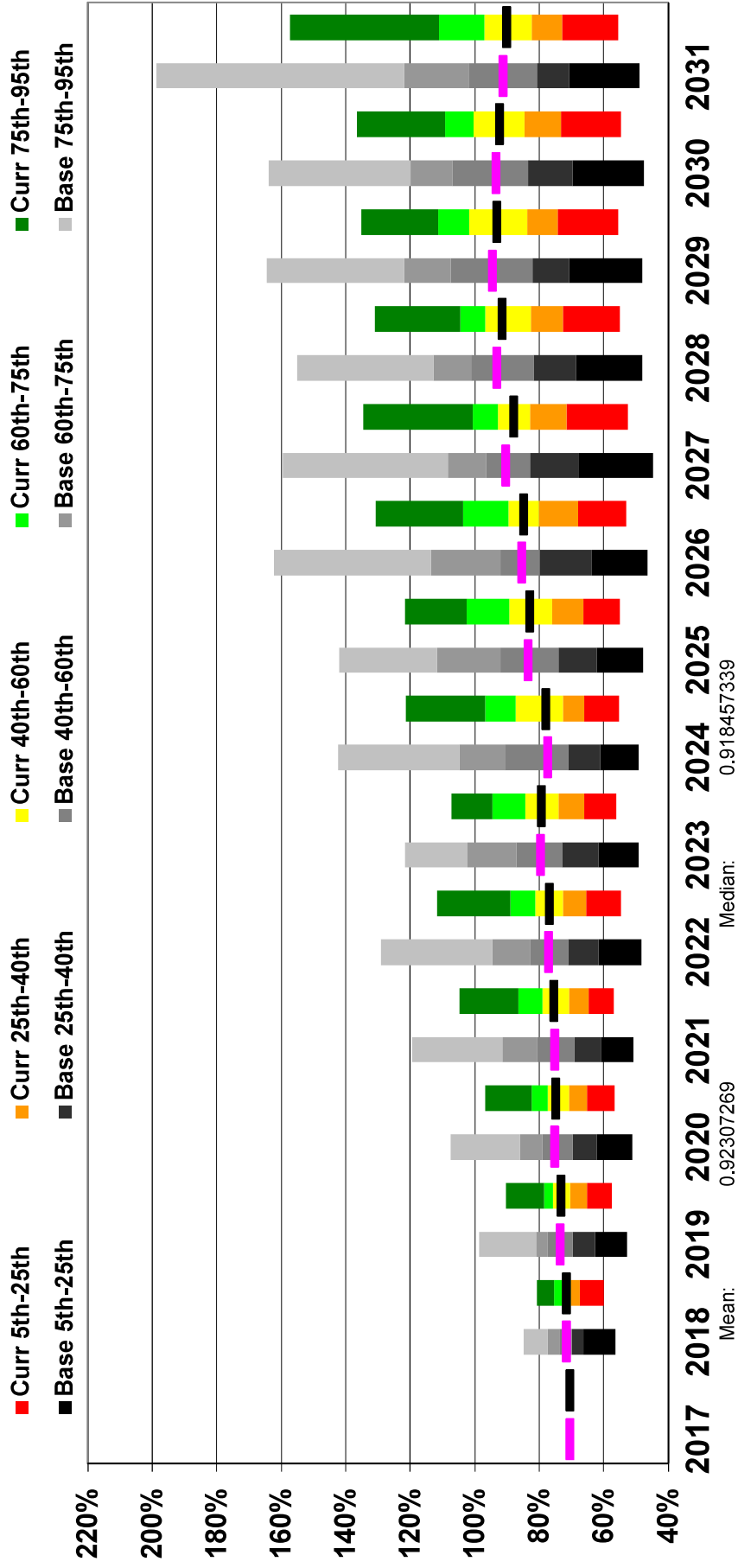
Classic Values, Innovative Advice

July 30, 2018

# Why is Stress Testing Important



## MVA Funding Ratio



Geometric Standard  
Return Deviation

Current	6.75%	10.00%	Complete
Baseline	6.75%	14.00%	Complete

## Why Is It Important?

- Without projections you have no idea if funding works
- Baseline projections are never right
  - Uncertainty increases over time
- Most pension plans today are mature
- Mature plans have negative cash flows
- Negative cash flow plans are most vulnerable
- Forward looking potential outcomes are important decision making factors

# Required Disclosures



The purpose of this presentation is to provide background and illustrations of the value of stress testing for retirement systems in testimony to the Pennsylvania Public Pension Management and Asset Investment Review Commission.

The presentation expresses opinions that pertain in general to retirement systems and have no specific bearing on the Pennsylvania State Retirement Systems. It represents general opinions and positions held by the Cheiron consultants, with the intent of demonstrating the importance of this measurement in monitoring and decision making regarding the management of risk typically experienced by all self-funded defined benefit retirement systems. To the best of our knowledge, this presentation and its contents have been prepared in accordance with generally recognized and accepted actuarial principles and practices which are consistent with the Code of Professional Conduct and applicable Actuarial Standards of Practice set out by the Actuarial Standards Board. Furthermore, as a credentialed actuary, I meet the Qualification Standards of the American Academy of Actuaries to render the opinion contained in this presentation. This presentation does not address any contractual or legal issues. We are not attorneys, and our firm does not provide any legal services or advice.

Cheiron's presentation was prepared solely for the Pennsylvania Public Pension Management and Asset Investment Review Commission for the purposes described therein. Other users are not intended users as defined in the Actuarial Standards of Practice, and Cheiron assumes no duty or liability to any other user.

Kenneth A. Kent, FSA, FCA, MAAA, EA  
Principal Consulting Actuary



Classic Values, Innovative Advice





# Pennsylvania Treasury Pension Fee Commission

Society of Actuaries Blue Ribbon Panel on Public Plan Funding  
Measuring and Managing Risk

Robert Stein  
Chairman

July 30, 2018

# Panel members and charge

## Panel Members

- Bob Stein, retired, Ernst & Young, chair
- Andrew Biggs, American Enterprise Institute
- Douglas Elliott, Brookings Institution
- Bradley Belt, former CEO, PBGC
- Dana Bilyeu, Executive Director, NASRA
- David Crane, Stanford University
- Malcolm Hamilton, retired, Mercer (Canada)
- Laurence Msall, The Civic Federation (Illinois)
- Mike Musuraca, Blue Wolf Capital Management
- Bob North, New York City Office of the Actuary
- Richard Ravitch, former Lt. Governor of New York
- Larry Zimpleman, Principal Financial Group

## The Panel's Charge

- Assess the changing funded status of public pension trusts
- Develop recommendations to strengthen plan funding going forward
- Primary recommendations
  - Enhance financial and risk management practices
    - Stress testing
    - Investment risk measurement
    - Aggregate risk measurement
  - Strengthen the actuary's role
  - Support system effectiveness

# Major risks

- Investment performance

  - PASERS investment return assumption

    - Prior to 2009: 8.5 %
    - 2009 - 2011: 8.0 %
    - 2012 - 2016: 7.5 %
    - 2017 +: 7.25%

  - Actual results, average annual return

    - 20 years ending 2017: 7.0%

    - 10 years ending 2017: 4.1%

- Contribution discipline

  - % of ARC paid, 10 years 2005 - 2014: 46.5%

- Member life-span, especially in retirement

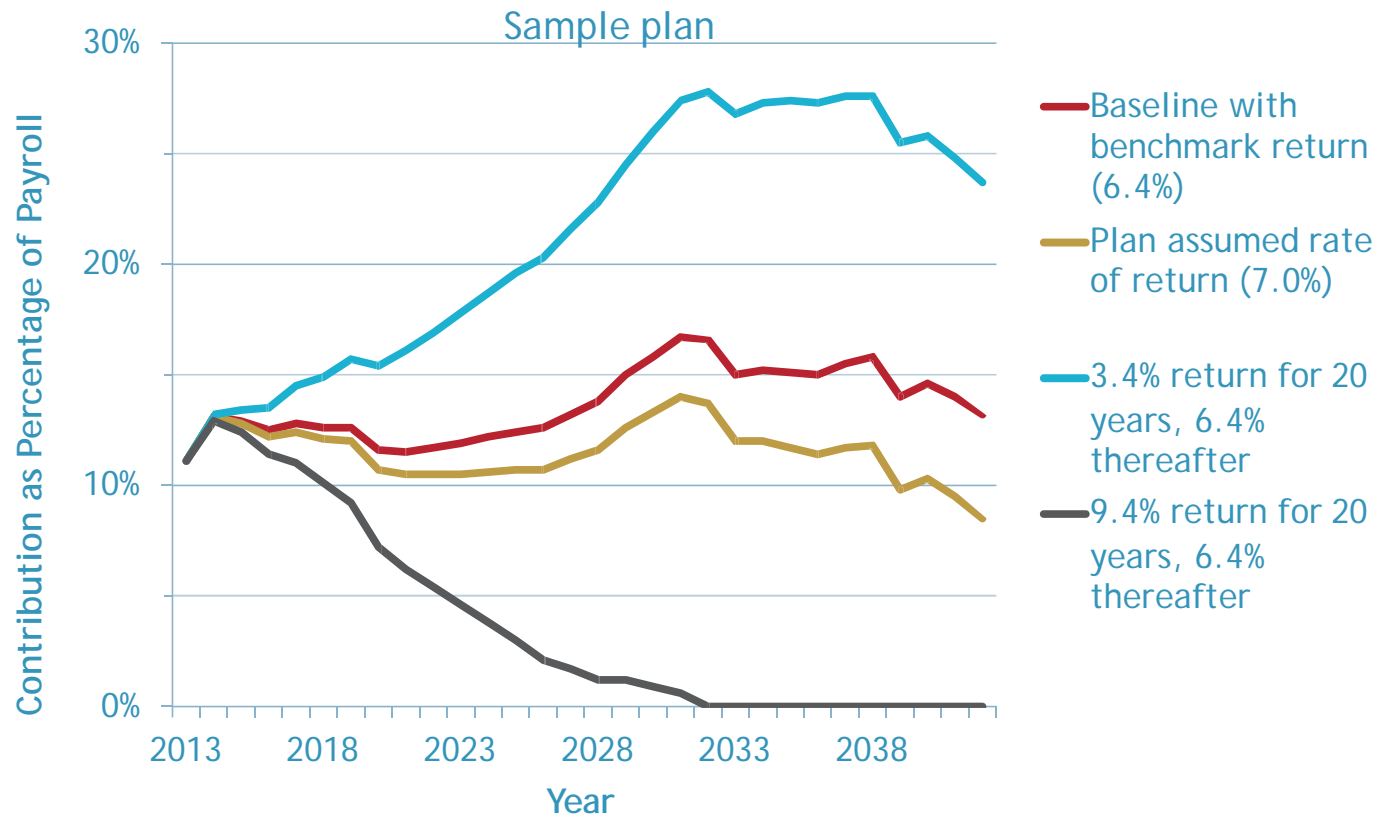
- Plan maturity - the balance between active and retired employees

*Scenario and stress testing can quantify the importance of these risks to the plan's financial soundness*

# Measuring risk: Stress testing

- Normal volatility, experienced 2/3 of the time
  - Volatility about the plan assumption
- 20 years of “stress”; financial outcomes projected 30 years
  - Plan assumptions
  - Baseline: BRP ‘standardized rate of return’
  - Measure year by year impact of the stress on contributions and funded status
- Severe stress (20 years)
  - Investment performance: returns 3% lower/higher than expected
  - Contributions: pay 80% of recommended contribution
- Other key assumptions - retiree mortality and the level of new hires - should also be tested

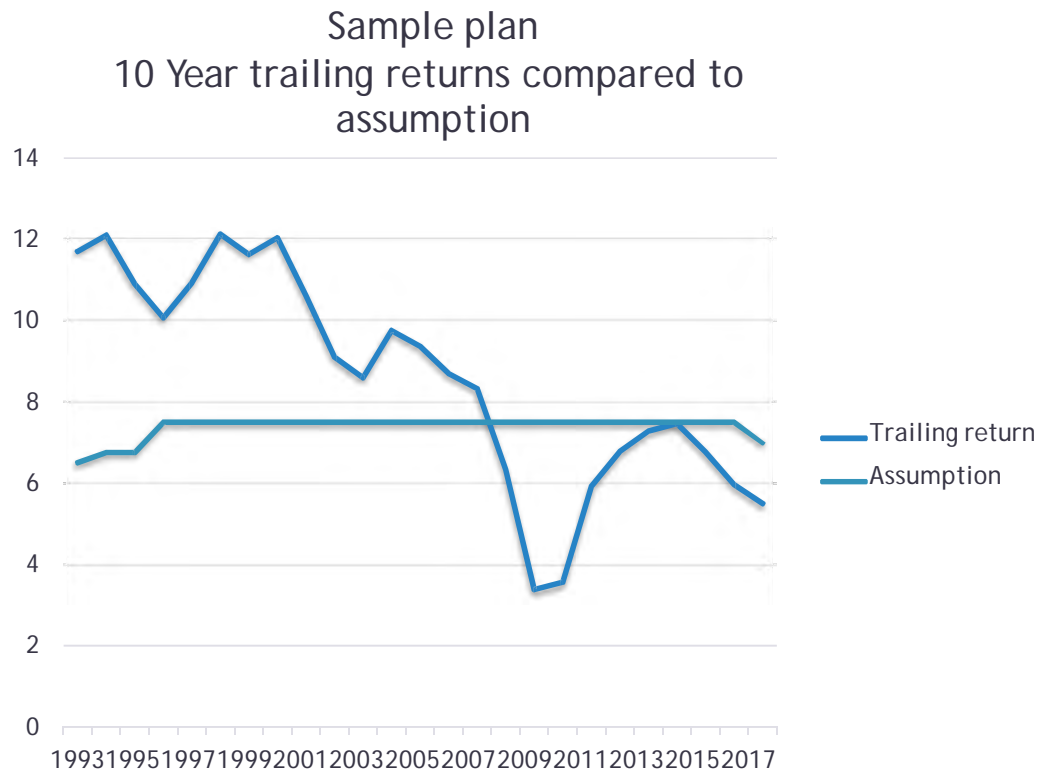
# Sample results: contributions as % payroll following investment return stresses



# Stress testing: Questions to be addressed

- How much risk should be taken?
  - Can the plan accept the likelihood that the funded ratio will fall below 60% over 50% of the time?
  - Can the plan accept that contributions will increase to X% of payroll 1/3 of the time?
- What asset allocation best supports our tolerance for adverse outcomes?
- What is the possible impact on contributions of proposed benefit changes?

# Risk measures: Investment return

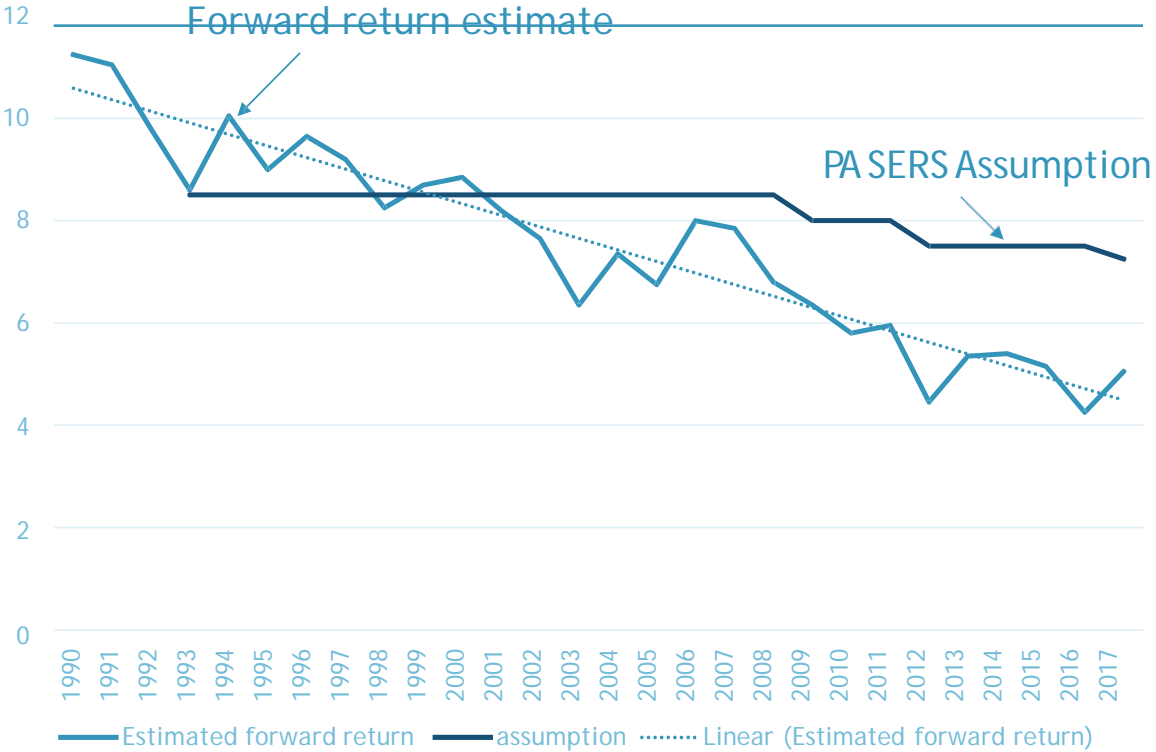


PASERS  
investment  
returns

20 years ending 2017: 7.0%

10 years ending 2017: 4.1%

# Risk measures: investment return



Forward returns estimated using BRP risk free rate + spread method



# Risk measures: investment return

## Plan liability and Contribution at risk free rate

- Measures magnitude of 'investment performance risk' assumed
- Uses plan assumptions and methods, except for assumed earnings rate
- Compare risk free liability and Contribution to plan calculations
  - Measures the size of the benefit obtained from the assumed investment return

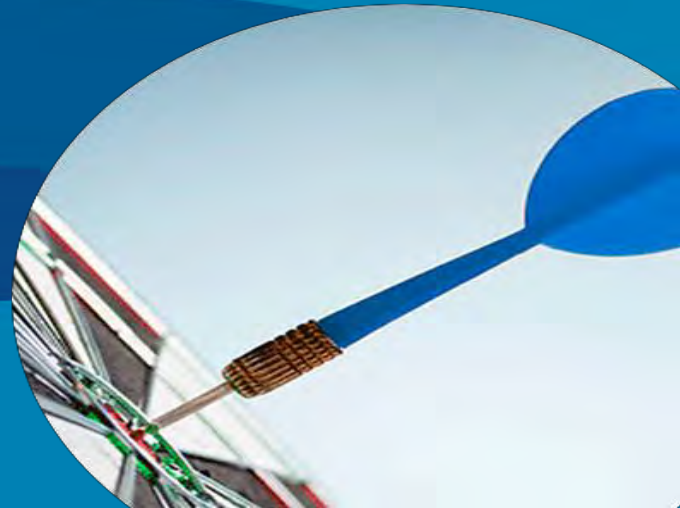
# Risk measures: total risk

## Standardized contribution

- Benchmarks plan's recommended contribution to assess funding risks
- Compares plan's contribution, using its assumptions and methods, to BRP recommended assumptions and methods
  - Forward-looking long-term rate of return based on risk free rate plus spread
  - Gain/loss amortization over 15 years
  - 5-year asset smoothing
- BRP assumptions are unbiased - set to be achievable 50% of the time

# Public Pension Management & Asset Investment Review Commission

July 30, 2018



# Stress Test

---

- A stress test, in financial terminology, is an analysis or simulation designed to determine the ability of a given financial instrument or financial institution to deal with an economic crisis or certain stressors.
  - In investment portfolio management, stress testing is also commonly used for determining portfolio risk and setting hedging strategies to mitigate losses.
  - Asset and liability matching stress tests can be used by companies to ensure proper internal controls and procedures.
  - Retirement and insurance portfolios also greatly utilize stress testing to ensure efficient streams of cash flow and payout levels.
- From Federal Reserve:
  - ***“The Comprehensive Capital Analysis and Review (CCAR) is an annual exercise by the Federal Reserve to assess whether the largest bank holding companies operating in the United States **have sufficient capital to continue operations throughout times of economic and financial stress and that they have robust, forward-looking capital-planning processes that account for their unique risks.”*****

[https://en.wikipedia.org/wiki/Stress\\_test\\_\(financial\)](https://en.wikipedia.org/wiki/Stress_test_(financial))

<https://www.investopedia.com/terms/s/stresstesting.asp>

<https://www.federalreserve.gov/supervisionreg/stress-tests-capital-planning.htm>

# Stress Test

---

- The purpose is not to feed gentle scenarios into the model to prove the System is “sustainable”.
- Likewise, the purpose is not to just find an extreme set of scenarios to prove it is not.
- The purpose is to learn where the stressors to the System **are** and to **optimize policies and procedures** (assumptions, funding procedures and methods, and perhaps even benefits) in order to improve sustainability and educate stakeholders of those potential risks.
  - The focus is not on the outcomes of the test.
  - The focus is on the decisions that should be considered, or improvements to the processes, based on the outcomes of the test.

# Questions that can be answered

---

- How will our funding policy react to different scenarios?
- Why do we have our current assumptions?
- Why do we have different assumptions and methods than our peers?
- How are our risks going to change over time?
- What procedures can provide discipline during good times to assist during a future crisis?
- Why did we make past decisions?

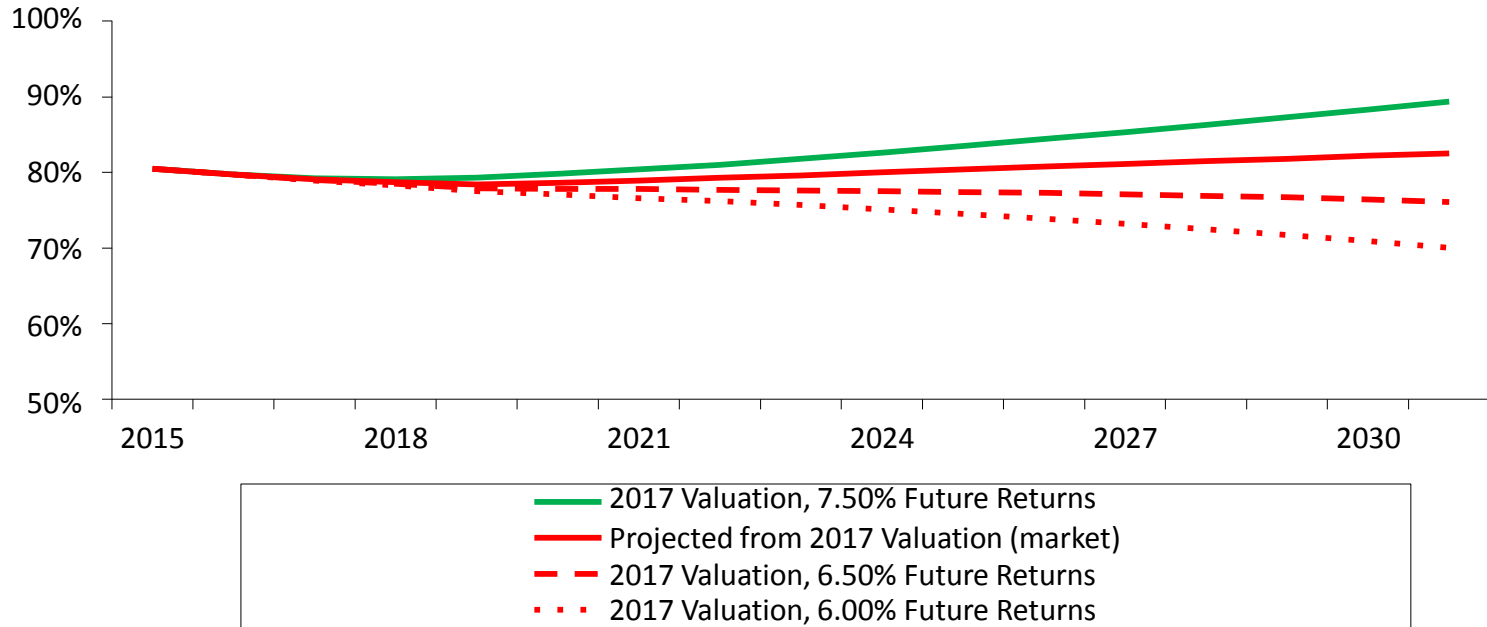
# Typical Procedures

---

- The way pension funds have typically been stressed is basically more or less as follows:
  - Project historical crisis crash-data into the future. Simulate what would happen and take a look at the consequences.
  - Test crash scenarios on basis of the question: What would happen if... (prices go down, S&P 500 collapses, etc., etc.).
  - Basically: Take several economic scenarios. Project them on your retirement system and see what happens.

# Projection of Funded Ratio

## Investment Return Sensitivity



All projections assume contribution policy outlined  
in statute continues indefinitely and no future changes to benefits

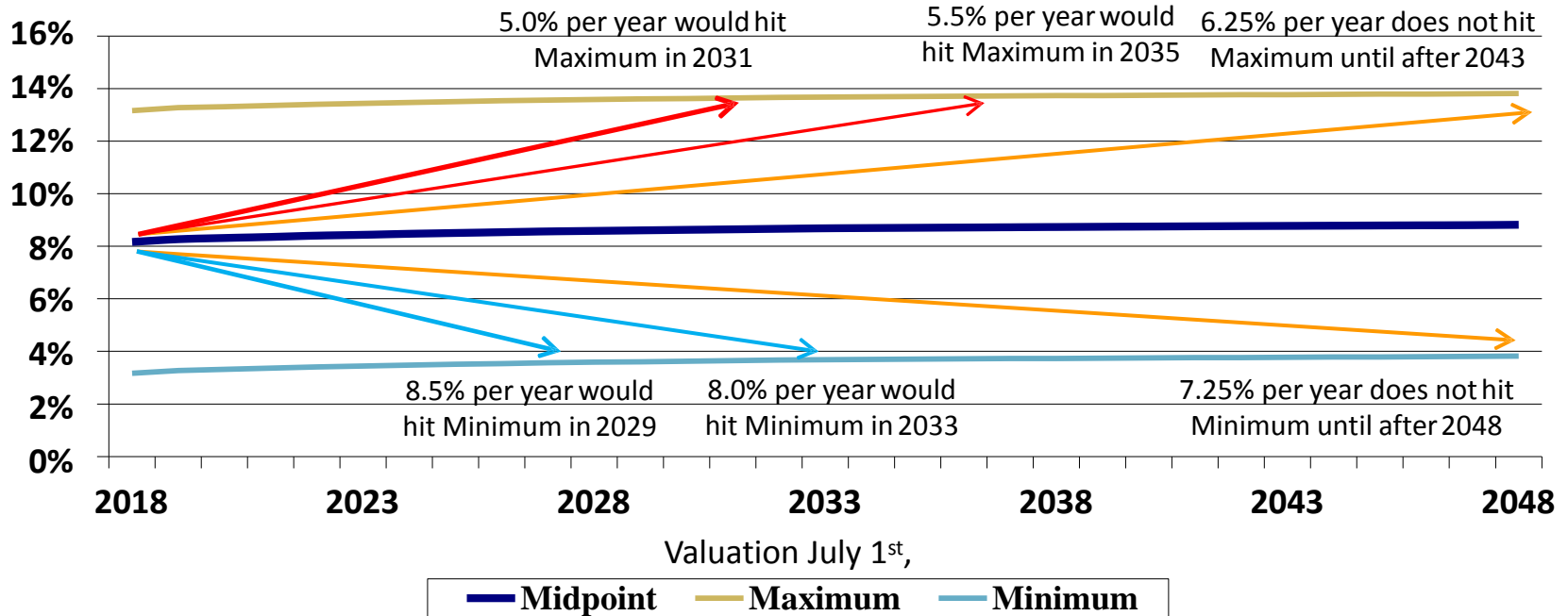


# A better approach?

---

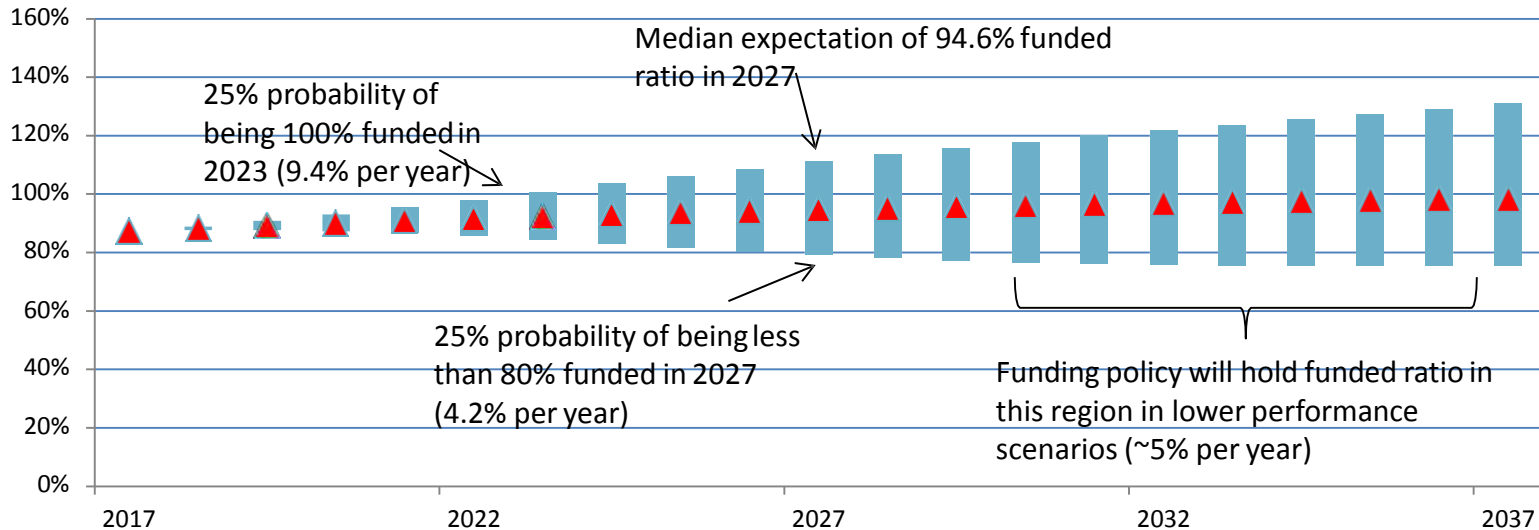
- It is possible that stress tests based on arbitrary scenarios can be gamed, as the test is really only as good as the scenarios that are analyzed.
- Many times, it can be beneficial to work backwards by defining the bad outcomes (anti-goals) and then develop scenarios that could lead to this unwanted financial situation.
- This also allows for scaling, or tracking, of tests over years to see trends of improvement (or not)

# Corridor Scenarios



Scenarios above assume stated returns achieved each year and all other assumptions exactly met

# Projected Funded Ratio

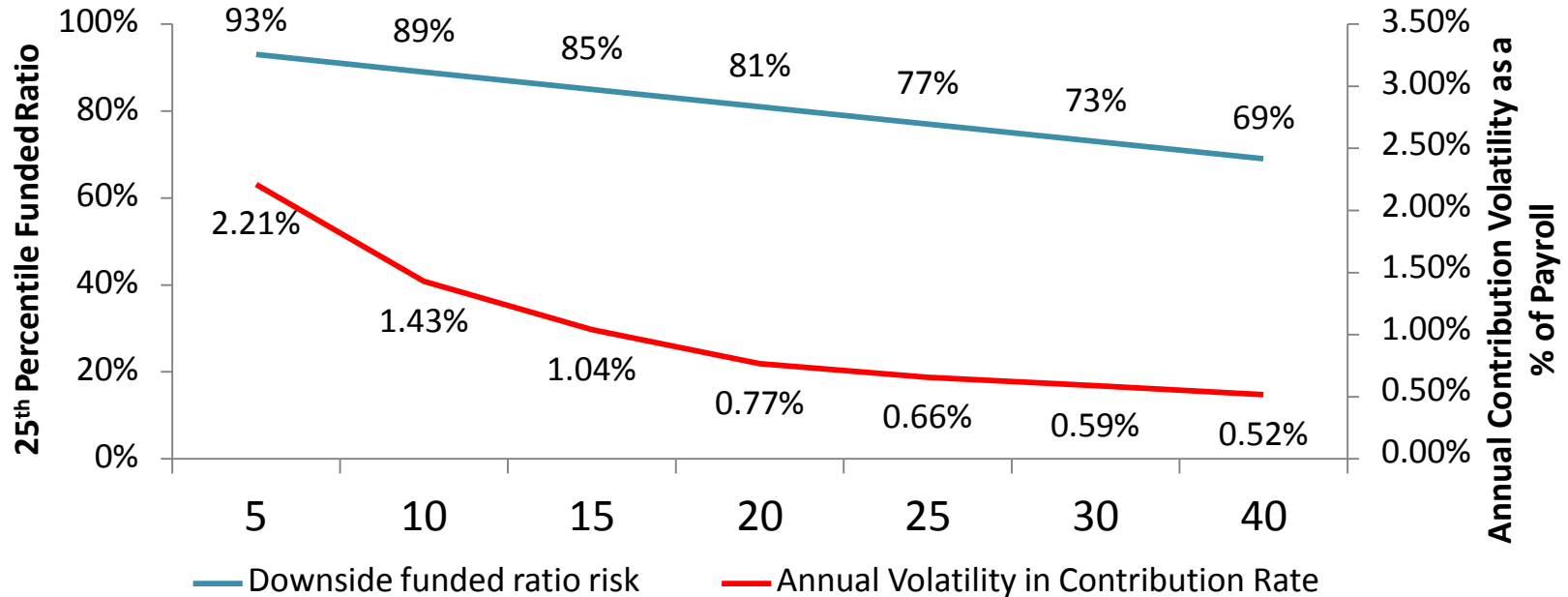


 Median Expectation

 25<sup>th</sup>-75<sup>th</sup> percentile of expectation

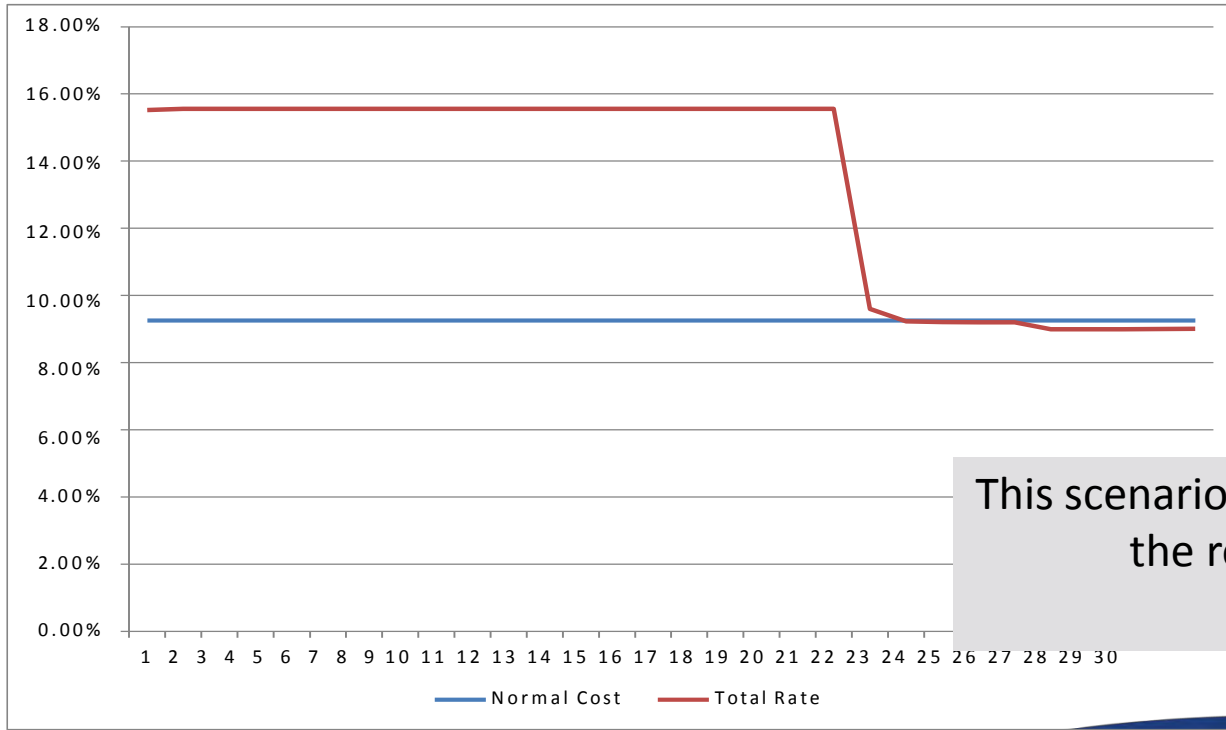
- Assumes ADEC met each year
- Assumes continuation of current amortization policy & payroll grows at 3.00% per year

# Risk vs Reward:



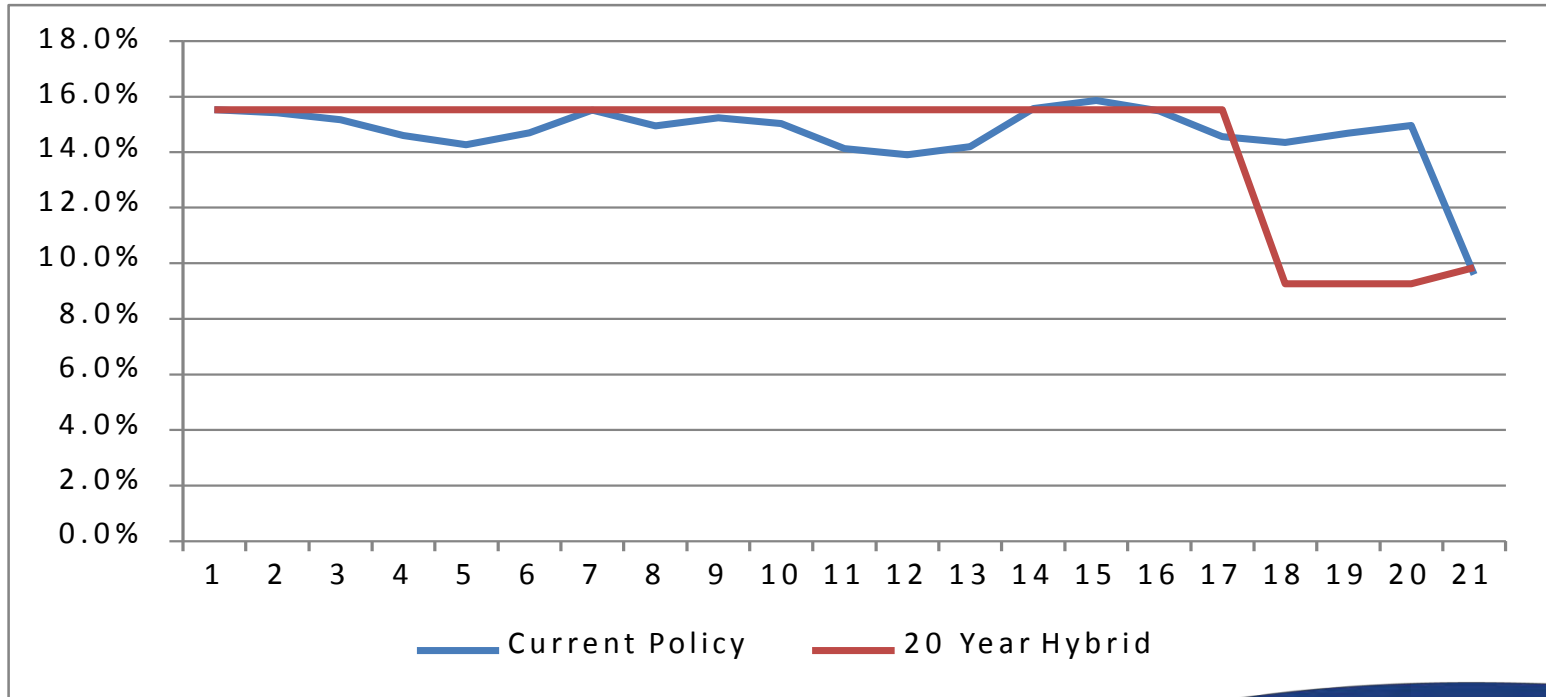
The downside funded ratio risk is the 25<sup>th</sup> percentile funded ratio based on the amortization period shown

# Current Policy: Perfect Scenario



This scenario does not exist in the real world!

# Which pattern?

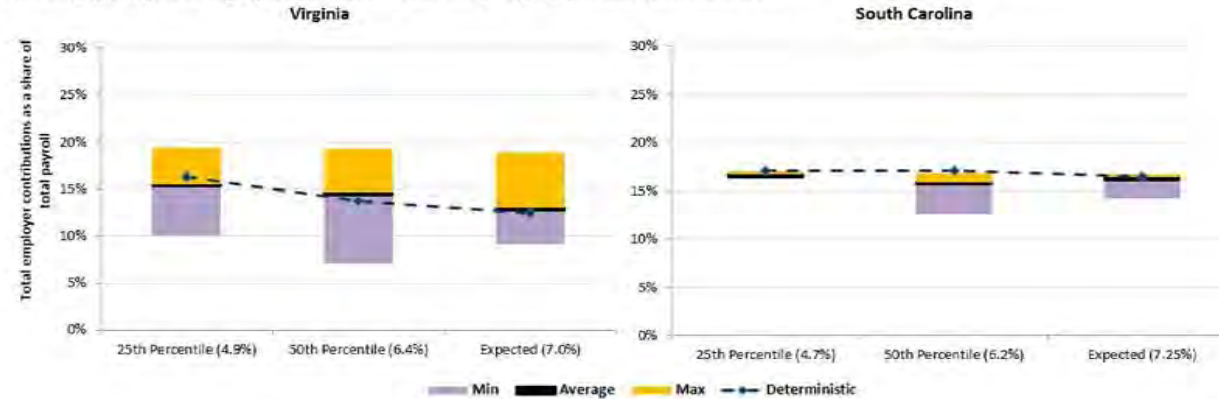


# Example of a Floating Funding Policy (South Carolina)

Figure 26

## Projected Impact of Volatility of Cost for Virginia Compared with South Carolina

Funding policy has significant impact on range of required contributions



- [https://www.hks.harvard.edu/sites/default/files/centers/mrcbg/files/AWP\\_92\\_final.pdf](https://www.hks.harvard.edu/sites/default/files/centers/mrcbg/files/AWP_92_final.pdf)
- SC's Funding policy: Until funding goal is reached: Actual contribution is the greater of the 20 year ARC and last year's Actual Contribution. Utah and Hawaii also use this strategy. Can be called Hybrid 20 or Floating 20.

# Other example of Summarized Tradeoffs

Policy	Current Contribution	Expected Annual Change beginning in year 6	Long term underperformance Value	Estimated Drawdown	Short term shock Value	Lifetime Contribution Factor
7.5% A	100	1.6% annual decline	113	-25%	148	21.3
6.7% A	112	4.3% annual decline	104	-25%	152	19.1
6.0% A	128	4.4% annual decline	97	-20%	142	21.4
6.0% A with Hedge	128	4.4% annual decline	97	-10%	142	21.4
6.0% B with Hedge	100	1.5% annual decline	103	-10%	120	24.1

- Long term underperformance was based on the contribution in 2031 based on actual 5% annual earnings
- Short term shock had a 2 year drawdown, followed by 8 year rebound to achieve the stated expected return for the portfolio.
- Lifetime Contribution Factor is the sum of all future expected employer contributions divided by the first contribution in the 7.5% A (100 equivalent)

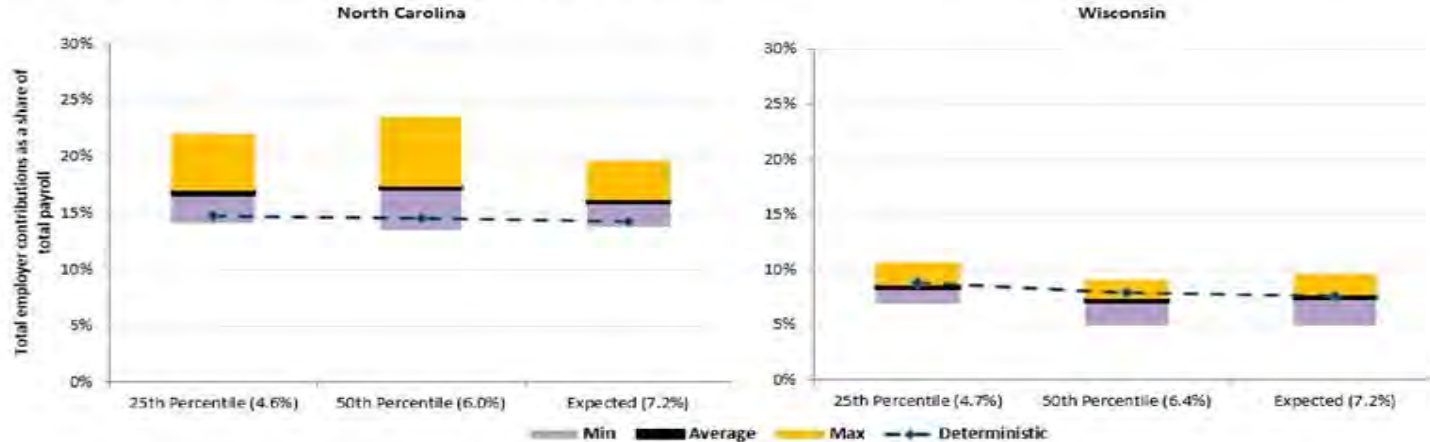


# Impact of Contingent Benefit Provisions

Figure 27

## Projected Impact of Volatility of Cost for North Carolina Compared with Wisconsin

*Risk-sharing provisions limit cost volatility for Wisconsin*



➤ [https://www.hks.harvard.edu/sites/default/files/centers/mrcbg/files/AWP\\_92\\_final.pdf](https://www.hks.harvard.edu/sites/default/files/centers/mrcbg/files/AWP_92_final.pdf)

# Constructive Ideas that have Come from various forms of 'Stress Testing'

---

- Funding policies that are not designed to respond to market downturns have substantial risk as there is no mechanism to create changes when necessary.
- Funding policies that enforce discipline in year to year contribution levels and employ some form of direct rate smoothing (hold rates up when the funding formula would suggest a decrease in the rate may be appropriate) appear to have a profound positive impact on contribution rate volatility.
- Funding policies based on too short an amortization period, and no allowance for offsetting gains and losses, will face substantial budget volatility.
- Benefit provisions that allow for some contingency in the liability show to be able to withstand significant adverse experience. The COLA is by far the most powerful tool for this.

# Final Takeaways on Stress Testing

---

- All Systems face substantial downside risk.
- For any System, a scenario can be created that will make that System look unsustainable.
- Focus should be on decision making and constructive observations, not specific outcomes.
- Stress tests need to be careful not to interchange potential bad outcomes as the expected or most likely outcomes.
- Systems with poor funded ratios, but recent reforms to increase funding appropriately, will typically show to have less “risk” than well funded plans, meaning a narrower range of outcomes and less contribution volatility.
  - Risk has been traded for Reality.
- A well formulated funding policy has substantial impact on the outcomes.
  - There needs to be an appropriate balance between protecting funded ratios and contribution volatility. Contribution volatility itself is a significant risk factor.
- Benefit packages that have some allowance for contingencies will appear far more sustainable under scenario or stress testing.
- Viewing the results in context of the objectives of the program will allow for better decision making.

# **Pennsylvania Public Pension Management and Asset Investment Review Commission (PPMAIRC)**

Preliminary Analysis – Fees, Costs, Asset Allocation, Performance

Second Hearing, September 20<sup>th</sup>, 2018

Dr. Ashby Monk

(Novarca International – Fees and Costs)

(Independent Consultant – Performance and Asset Allocation)

Harrisburg, PA

# PPMAIRC Second Hearing

---

## **Asset Allocation and Performance Preliminary Analysis**

(Data obtained from Public Pensions Database – Center for Retirement Research)

# Background & Scope

---

**Challenges:** Conducting peer analysis on performance and strategy is difficult because of the idiosyncrasies amongst plans.

**Peer Group Selection:** Funds for the Peer Group were selected against three main criteria elements:

- **Size:** funds with assets comparable to SERS and PSERS
- **Discount Rate:** funds with similar discount rate to SERS/PSERS
- **Asset Allocation:** funds with similar asset allocations comparable to SERS/PSERS

**Time Range:** Data was collected for fiscal years 2008-2017 (i.e. for the years ending June 30<sup>th</sup> 2008 and June 30<sup>th</sup> 2017).

**Key Areas of Analysis:** Initial analysis was scoped to cover asset allocation and investment performance for each fund in the peer group across the 10-year time horizon.

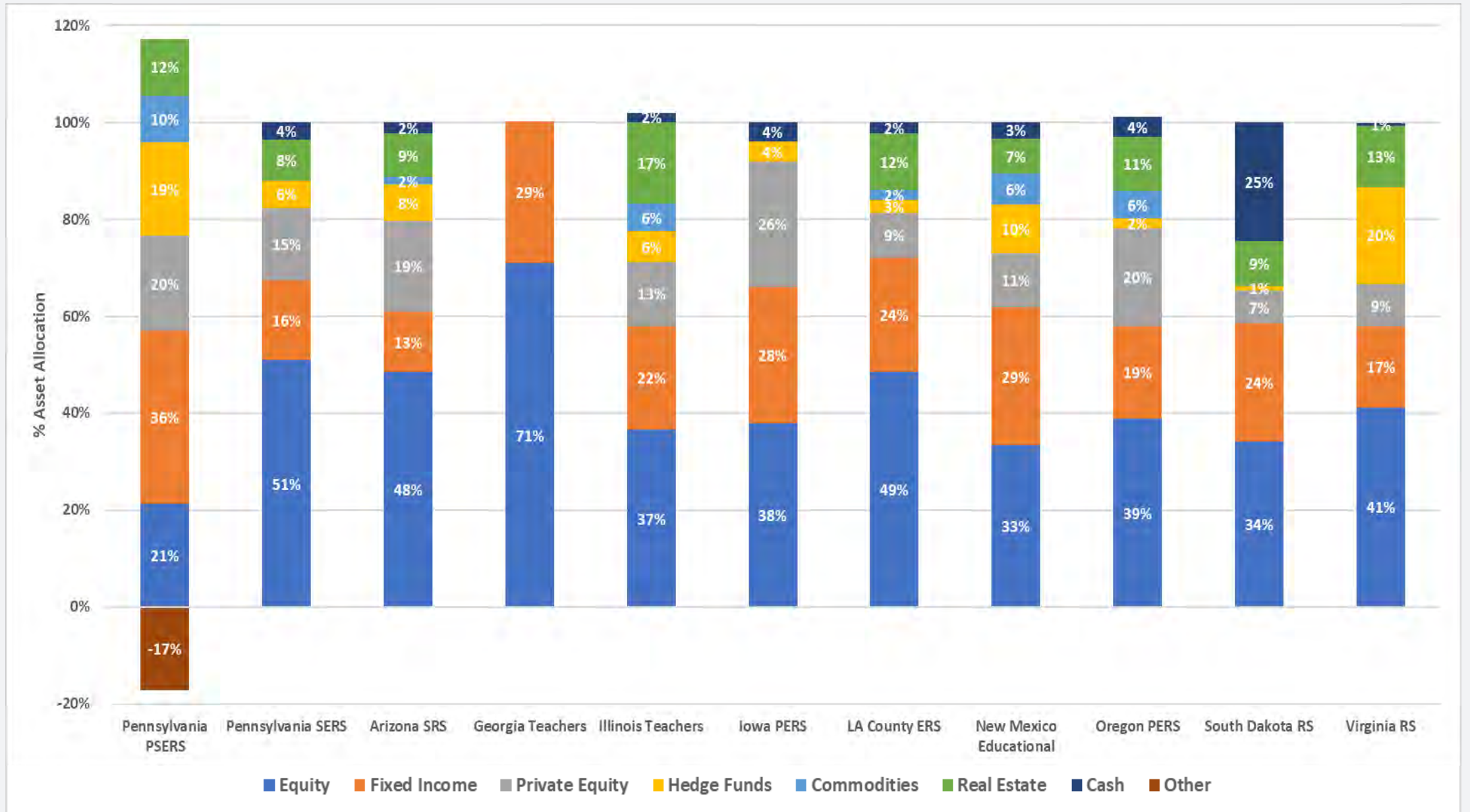
- Asset allocation variations over the period
- Benchmark Performance (as recorded in Annual Reports)
- Annualized investment returns at the fund and asset class level against benchmarks.

# Peer Group FY17

Plan	Net Assets FY17 (000s)	FY17 Discount Rate	Funded Ratio	Fiscal Year End Date
Georgia Teachers	\$71,340,972	7.50%	74%	June 30 <sup>th</sup>
Virginia RS	\$70,159,680	7.00%	77%	June 30 <sup>th</sup>
Oregon PERS	\$66,371,703	7.20%	75%	June 30 <sup>th</sup>
Pennsylvania PSERS	\$53,155,336	7.25%	56%	June 30 <sup>th</sup>
LA County ERS	\$52,225,457	7.38%	80%	June 30 <sup>th</sup>
Illinois Teachers	\$49,375,665	7.50%	40%	June 30 <sup>th</sup>
Arizona SRS	\$36,202,756	7.50%	71%	June 30 <sup>th</sup>
Iowa PERS	\$30,779,116	7.00%	81%	June 30 <sup>th</sup>
Pennsylvania SERS	\$27,934,000	7.25%	59%	December 31 <sup>st</sup>
New Mexico Educational	\$12,509,356	7.25%	63%	June 30 <sup>th</sup>
South Dakota RS	\$11,644,039	6.50%	100%	June 30 <sup>th</sup>

Source; Public Plans Database; Q2 FY17 Data included for Penn SERS to control for different fiscal year end date, sourced from investment report provided by SERS

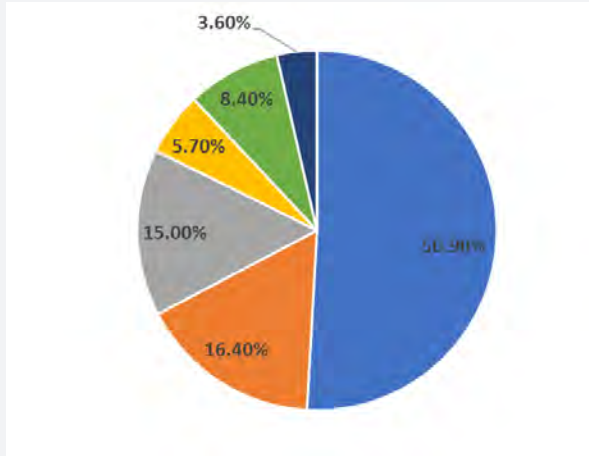
# 2017 Asset Allocation | Peer Group



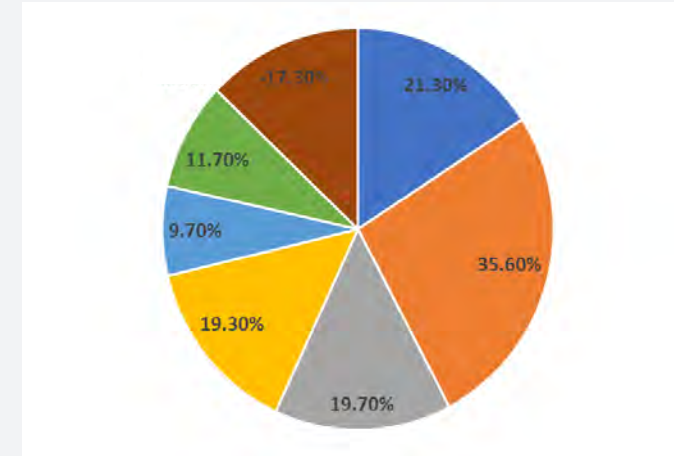


# 2017 Asset Allocation | Peer Group

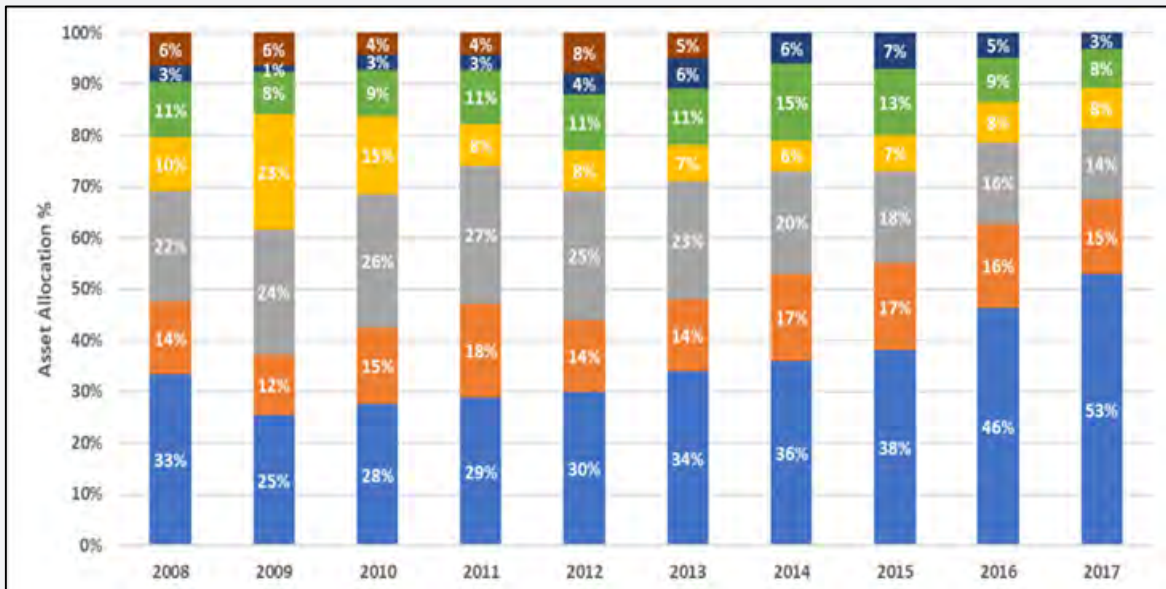
## SERS 2017 Asset Allocation



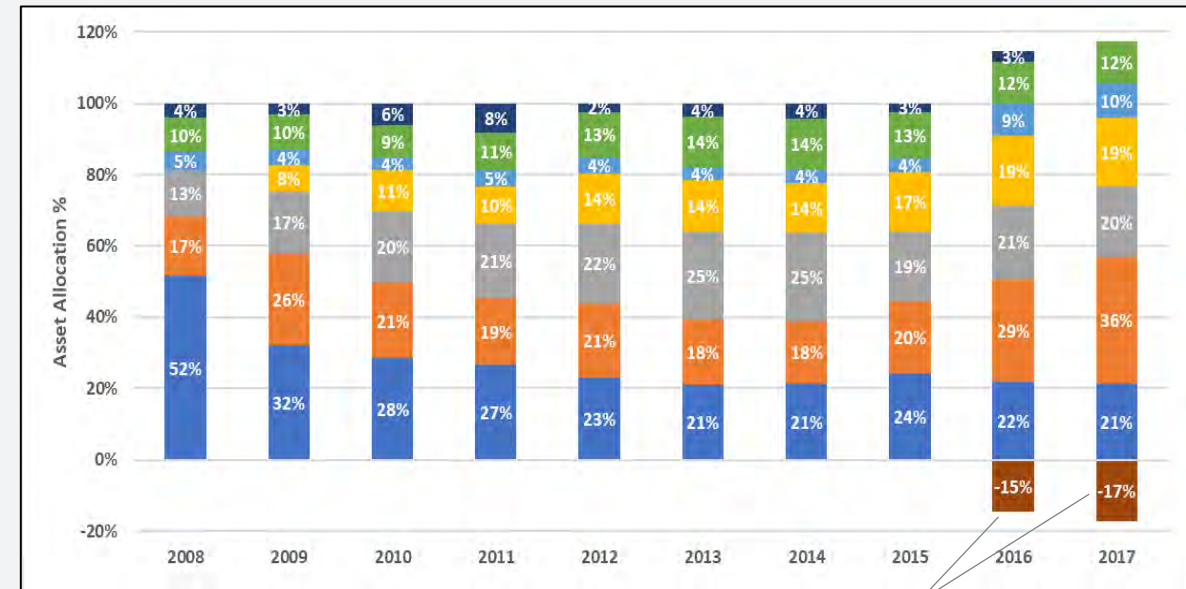
## PSERS 2017 Asset Allocation



## SERS 2008-2017 Asset Allocation



## PSERS 2008-2017 Asset Allocation

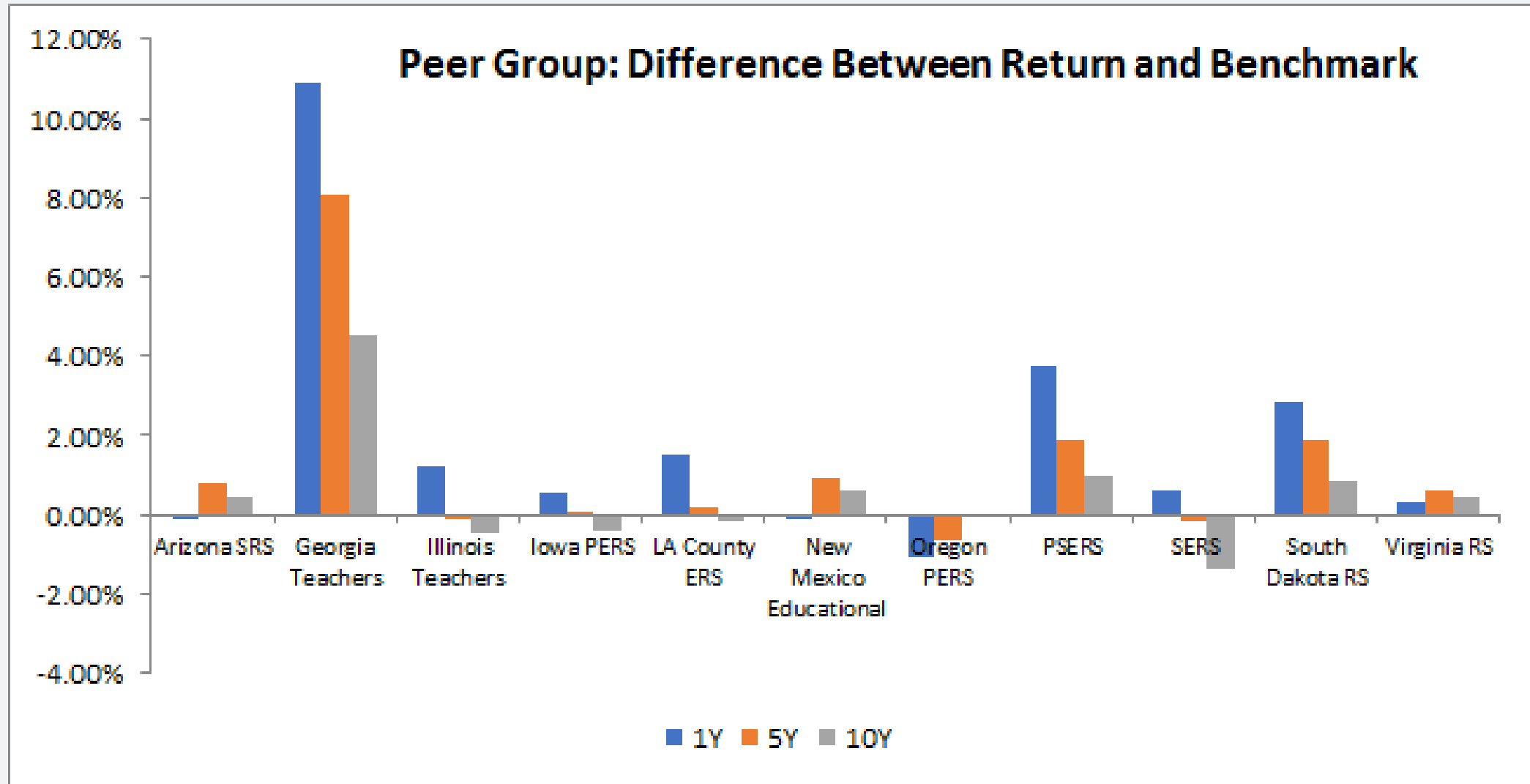


Leverage Financing

# 2017 Benchmark Performance | Total Portfolio

Peers	FY17 Discount Rate	2017 Benchmark Performance			
		Total Portfolio 1Y	Total Portfolio 3Y	Total Portfolio 5Y	Total Portfolio 10Y
Arizona SRS	7.50%	14.00%	4.80%	8.80%	5.20%
Georgia Teachers	7.50%	1.60%	0.90%	1.30%	1.60%
Illinois Teachers	7.50%	11.40%	6.10%	9.30%	5.30%
Iowa PERS	7.00%	11.17%	5.79%	8.61%	6.28%
LA County ERS	7.38%	11.20%	5.90%	8.80%	5.40%
Oregon PERS	7.20%	13.02%	6.59%	9.85%	N/A
Pennsylvania PSERS	7.25%	6.39%	3.49%	5.47%	2.80%
Pennsylvania SERS	7.25%	11.70%	5.10%	8.10%	5.30%
South Dakota RS	6.50%	10.96%	5.24%	9.07%	5.31%
Virginia RS	7.00%	11.80%	5.70%	8.50%	4.50%
New Mexico Educational	7.25%	12.10%	5.40%	7.80%	4.60%
Peer Group Average		10.49%	5.00%	7.78%	4.63%

# 2017 Absolute Performance | Peer Group



# 2017 Absolute Performance | Peer Group

Plan (2017)	Category	Total Portfolio		
		1Y	5Y	10Y
Arizona SRS	Return	13.90%	9.60%	5.60%
Georgia Teachers	Return	12.50%	9.40%	6.10%
Illinois Teachers	Return	12.60%	9.20%	4.80%
Iowa PERS	Return	11.70%	8.65%	5.89%
LA County ERS	Return	12.70%	9.00%	5.20%
Oregon PERS	Return	12%	9.19%	5.37%
PSERS	Return	10.14%	7.35%	3.80%
SERS	Return	12.00%	7.90%	3.90%
South Dakota RS	Return	13.81%	10.97%	6.14%
Virginia RS	Return	12.10%	9.10%	4.90%
New Mexico Educational	Return	12.00%	8.70%	5.20%

# Performance Consistency Across Time Periods and Peer Groups

- The performance ranking of PSERS and SERS when compared against a wider set of pension funds appears to show similar results.
- For all pension funds in the PPD of size >\$10bn (52 funds), the following rankings were obtained for net performance (6/30/2017):

	Overall Rank			
	1 Year	3 Year	5 Year	10 Year
SERS	***40/52	***45/52	***45/52	***49/52
PSERS	***48/52	***43/52	***49/52	***50/52

- Our peer group performance results are also confirmed by the plan's consultant reports for peer performance, which show consistently below median performance.
- This would suggest that PSERS and SERS have consistently low performance compared with US public pension plans, irrespective of peer grouping and over various time periods over the last 20 years.

# PPMAIRC Second Hearing

---

**Fees and Costs Preliminary Analysis**  
(In Partnership with Novarca International)

# Fees and Costs Preliminary Analysis – Initial Notes

---

- The primary focus of this analysis lies on Public Equity mandates; We have thus analysed all the SERS/PSERS Public Equity mandates for now.
- The **objective** was **to analyse the appropriateness of terms for public equity mandates** – fee levels, shared scale benefits, length of mandates, benchmarks.
- Despite having asked for un-redacted contracts and limiting our request to public equity, to date we have not received these contracts for SERS. The analysis, specifically on SERS, is thus based on assumptions and average rates that found in consultant reports.
- Due to the lack of data provided by the plans, it is difficult to make a statement of the potential overcharges.
- The data on performance used at time of producing this report is per end of June 2017 for PSERS and Dec 2017 for SERS.

# Fees and Costs Preliminary Analysis – Executive Summary

---

## SERS mandates:

- Many passive mandates, which seem generally to be priced fairly.
- There are four primary candidates for in depth review and potential renegotiation:
  - SERS Mandate 1: Agreement almost 9 years old, returns (3y ending June 2017) are poor.
  - SERS Mandate 7: Very expensive for Developed World Small Cap.
  - SERS Mandate 8: Agreement 8 years old.
  - SERS Mandate 11: Agreement 5 years old.
- MFN clauses don't guarantee best terms! And in fact, over time they tend to serve the asset manager more than the asset owner.
- For most investors Private Equity is the most expensive asset class, potential cost savings from Private Equity can therefore be substantial. However they need to be captured on longer time horizon than other asset classes, as fees can only be renegotiated upon new investments, after typically 7-10 years.



# Fees and Costs Preliminary Analysis – Executive Summary

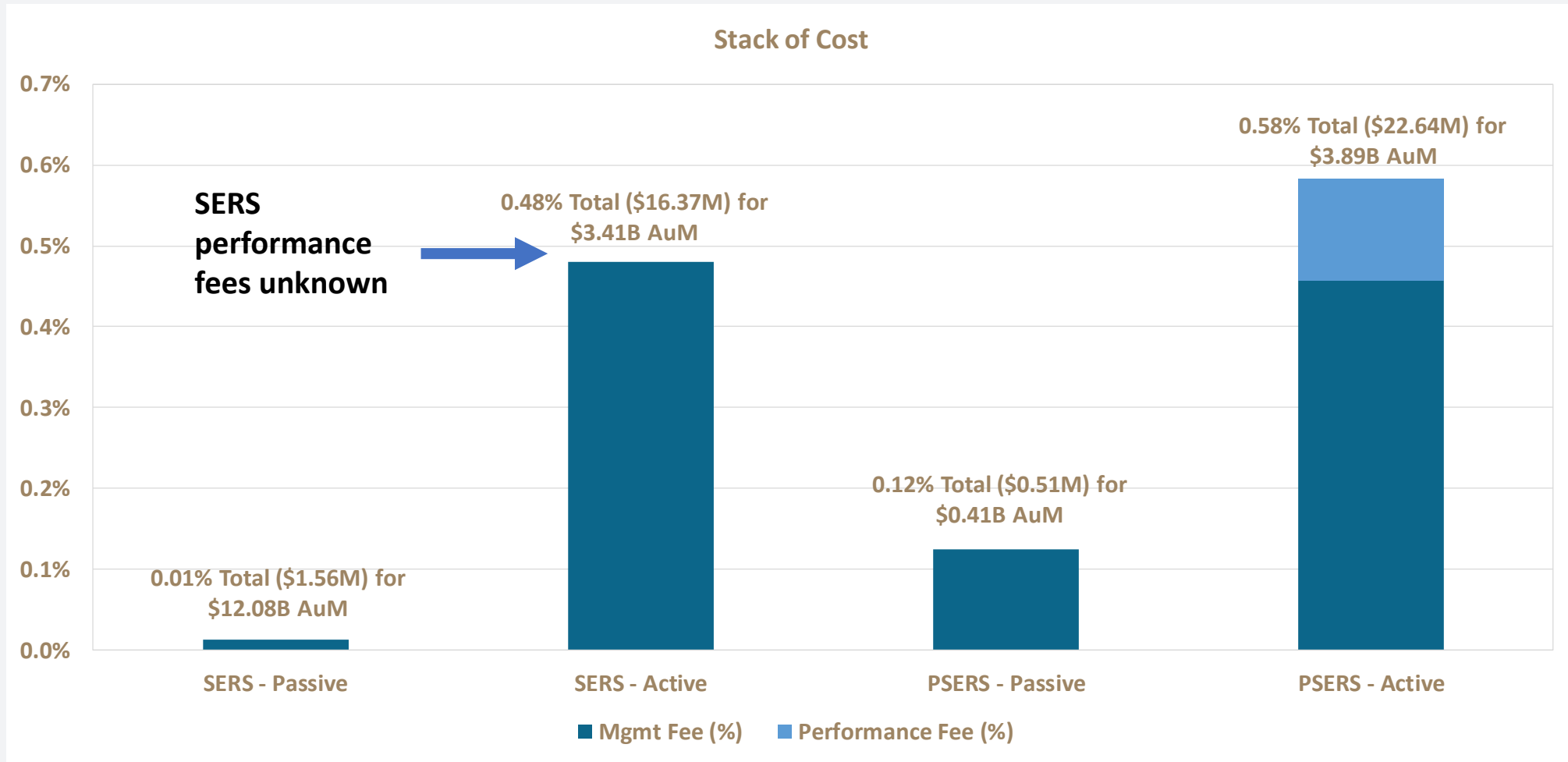
---

## PSERS mandates:

- More expensive mandates don't guarantee better returns.
  - The cheapest out of 5 mandates in 'Intl. All Cap Equities', has enjoyed the best returns.
  - This cheapest mandate is priced at 44bps, the average of the other four is 81.75bps.
- There are several primary candidates for potential renegotiation:
  - All of the five International Equities Small Cap mandates.
  - PSERS Mandate 2, as SERS pays lower fees for the same.
  - PSERS Mandate 4: Absence of tiers above \$200M is not in line with best practice.
  - PSERS Mandate 5: Worst performer in category, despite highest fixed fee.
- For most investors Private Equity is the most expensive asset class, potential cost savings from Private Equity can therefore be substantial. However they need to be captured on longer time horizon than other asset classes, as fees can only be renegotiated upon new investments, after typically 7-10 years.

# Overview - Cost Stack

The “Cost Stack” shows the total cost of ownership for all Public Equity mandates.



## Notes:

(1) **Total Costs:** are under-estimated as we do not have contracted fee schedules from SERS, or details about operating expenses from any of the managers for either SERS or PSERS. Consequently, this review does not include other components making up the Total Cost of Ownership (incl. Holding Costs, Transaction Costs, Other Operating Expenses and 2<sup>nd</sup> Tier Fund costs).

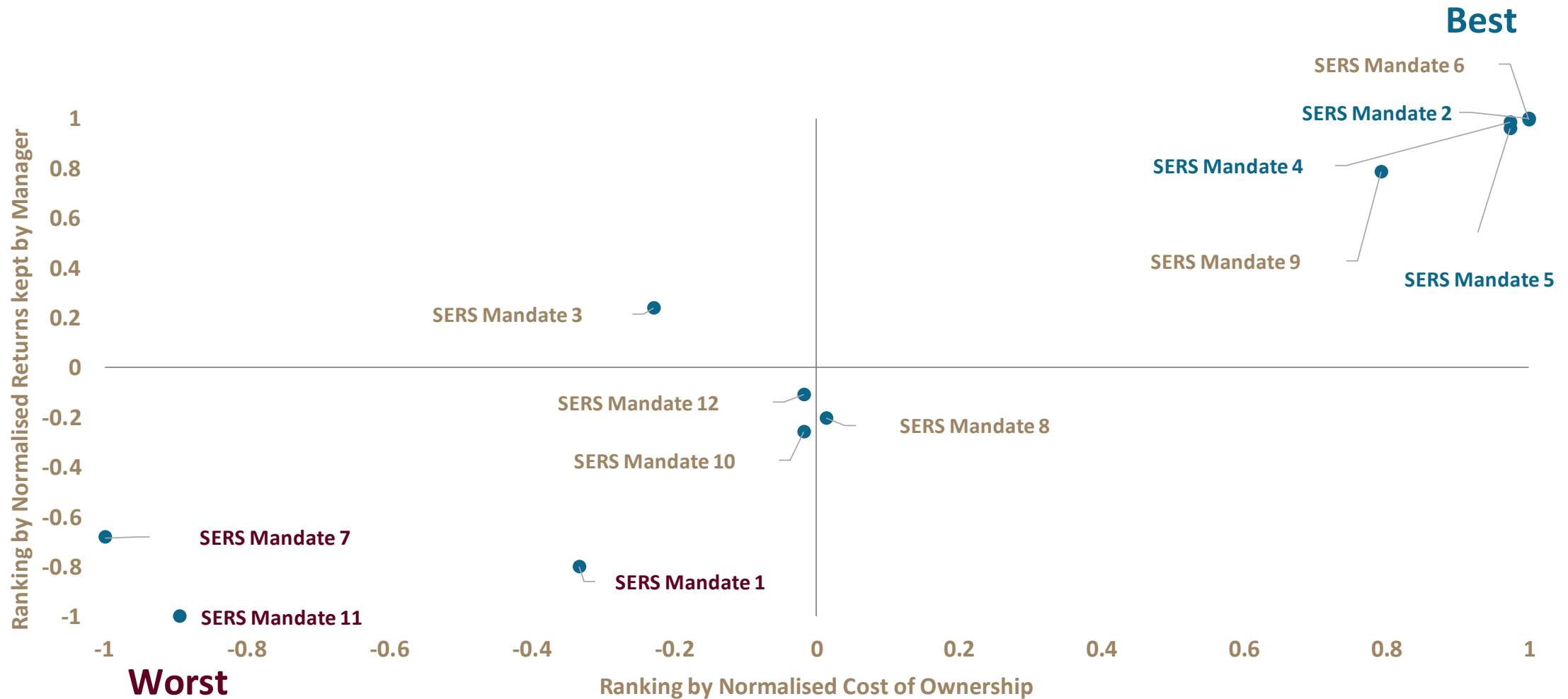
(2) **Public Equity :** Only external public equity mandates are included here.

# Overview - Active Mandates: Cost and Performance

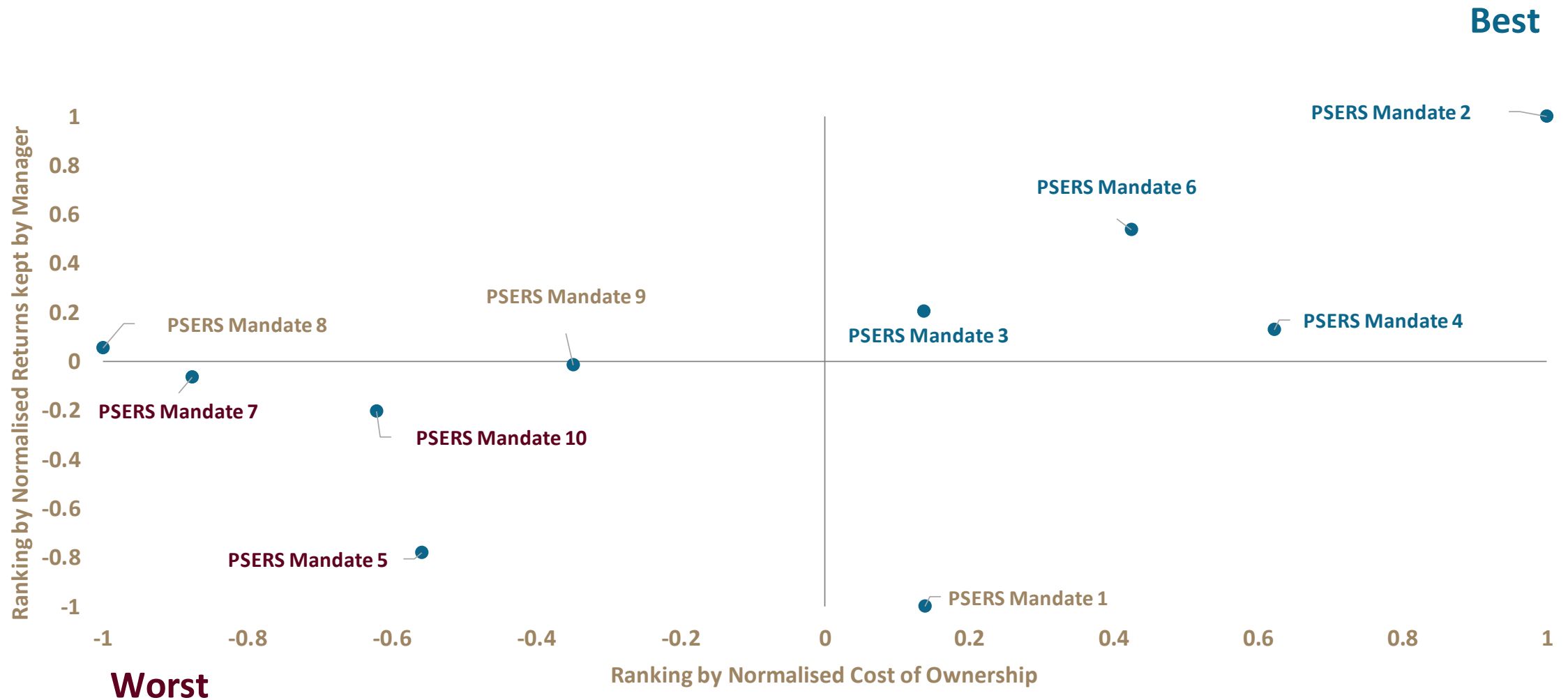
The benchmarks for SERS' active mandates are more granular than PSERS' active mandates. If performance fees are being introduced, then a more granular choice of benchmarks for PSERS may be appropriate.

	Manager	Share of AuM	Total Cost of Ownership	Gross Return	Benchmark	Benchmark Return	Alpha	As Of Date
<b>SERS</b>	SERS Mandate 1	14.24%	0.49%	7.89%	Russell Mid Cap Index	9.58%	-1.69%	31-Dec-17
	SERS Mandate 3	18.64%	0.46%	25.86%	Russell 2000 Grth Index	21.81%	4.05%	31-Dec-17
	SERS Mandate 7	18.40%	0.68%	12.08%	MSCI Wrld Ex US Sm Cap Index (Net)	12.96%	-0.88%	31-Dec-17
	SERS Mandate 8	25.57%	0.39%	11.79%	MSCI World Index (Net)	9.30%	2.49%	31-Dec-17
	SERS Mandate 10	10.07%	0.40%	11.20%	MSCI Emg Mkts Index (Net)	9.10%	2.10%	31-Dec-17
	SERS Mandate 11	3.02%	0.65%	9.05%	MSCI Emg Mkts Sm Cap index (Net)	8.44%	0.61%	31-Dec-17
	SERS Mandate 12	10.07%	0.40%	14.00%	MSCI Emg Mkts Index (Net)	9.10%	4.90%	31-Dec-17
	<b>Aggregate (Active only)</b>	<b>100.00%</b>	<b>0.48%</b>	<b>13.99%</b>		<b>12.28%</b>	<b>1.71%</b>	
	Manager	Share of AuM	Total Cost of Ownership	Gross Return	Benchmark	Benchmark Return	Alpha	As Of Date
<b>PSERS</b>	PSERS Mandate 1	7.74%	0.59%	1.30%	70% M1EFSC/15% M1EF/15% M1FEM	0.28%	1.02%	30-Jun-17
	PSERS Mandate 3	27.36%	0.59%	5.94%	MSCI AC World ex USA (Net)	0.80%	5.14%	30-Jun-17
	PSERS Mandate 4	26.79%	0.33%	3.07%	MSCI AC World ex USA (Net)	0.80%	2.27%	30-Jun-17
	PSERS Mandate 5	14.28%	0.79%	2.06%	MSCI AC World ex USA (Net)	0.80%	1.25%	30-Jun-17
	PSERS Mandate 6	6.15%	0.44%	6.58%	MSCI AC World ex USA Small Cap (Net)	3.31%	3.27%	30-Jun-17
	PSERS Mandate 7	6.60%	0.85%	6.02%	MSCI AC World ex USA Small Cap (Net)	3.31%	2.72%	30-Jun-17
	PSERS Mandate 8	4.76%	0.88%	7.70%	MSCI AC World ex USA Small Cap (Net)	3.31%	4.39%	30-Jun-17
	PSERS Mandate 9	2.31%	0.74%	5.92%	MSCI AC World ex USA Small Cap (Net)	3.31%	2.61%	30-Jun-17
	PSERS Mandate 10	4.02%	0.80%	4.24%	MSCI AC World ex USA Small Cap (Net)	3.31%	0.93%	30-Jun-17
	<b>Aggregate (Active only)</b>	<b>100.00%</b>	<b>0.58%</b>	<b>4.32%</b>		<b>1.36%</b>	<b>2.96%</b>	

# SERS Mandates: Ranking by Costs and Returns Retained



# PSERS Mandates: Ranking by Costs and Returns Retained



# SERS Mandates: Key points from Preliminary Analysis

---

- As mentioned, SERS have not provided un-redacted contracts. By not being transparent on asset managers' contractual details serves only one party's interest: that of the asset managers.
- From experience, whenever clients are told that contractual terms are trade secret of the manager, it is an indication that these should be reviewed.

From an RVK report (SERS' consultant) we have taken the average fees paid on Public Equity and used this for the analysis:

- Passive mandates seem generally fairly priced.
- One of the two active mandates in International Developed Equity, SERS Mandate 7, seems very expensive.

## Private Equity:

This report is not focused on Private Equity, but we have learned that there is a large number of individual PE investments in SERS' portfolio. Such a large volume of small PE investments is by definition difficult to manage / monitor and should be looked at in more detail for potential cost savings.

# PSERS Mandates: Key points from Preliminary Analysis

---

- Two managers capture a (too) large portion of the alpha generated, PSERS Mandate 5 (38% in 2017, 3y rolling) and PSERS Mandate 1 (45% in 2017, 3y rolling).
- International Small Cap mandates show large price differences, ranging from 44bps to 88bps (on similar sizes). Interesting side note: the cheapest is the best performer in recent years \*.
- 30% out of mandates' fee schedules have not been revised in 5 years or more.
- SERS is paying lower fees on same PSERS Mandate 2 product, despite SERS' smaller investment size.
- PSERS does not seem to have a sufficiently granular choice of benchmarks for their active managers. Albeit this helps in overall comparison it could be problematic where performance fees are or have been introduced as one needs to make sure the benchmark properly reflects the risk of the investment.

*\* Note that the performance data available upon production of this report ends June 2017.*

# Self-Assessment of the Plans (1/2)

As part of the review, the plans were asked to participate in a self-assessment on their investment cost. Here is a shortened version and excerpt of the answers provided.

1. On a scale from 1-10, where do you think your management fees are placed in the market (1 being least competitive, 10 being most competitive)	
PSERS	SERS
10	10
Both plans justify this (self assessed) ranking, by the fact of having MFN clauses in place.	
2. What is the average age of the fee schedules in your portfolio ?	
PSERS	SERS
Not tracked	Not tracked
3. What is the average age of investment mandates in your portfolio ?	
PSERS	SERS
Not tracked	Not tracked
4. What percentage of your asset managers have confirmed in writing that <u>they don't receive</u> commissions, rebates, retrocessions and the likes associated with your investment ?	
PSERS	SERS
"PSERS does not maintain this information"	See comment
SERS has not directly answered the question, however indicates that this is addressed as part of their Due Diligence.	



# Self-Assessment of the Plans (2/2)

5. What percentage of your asset managers have confirmed in writing that they don't pay and have not paid any commissions, introduction fees or the likes associated with your investments ?

PSERS

SERS

"PSERS does not maintain this information"

See comment

SERS has not directly answered the question, however indicates that this is addressed as part of their Due Diligence. SERS also mentions that they do not directly work with placement agents and requires the fund sponsors to attest that no placement agent fees have been paid to attract SERS' investment.

6. Does your plan operate under a fee budget for investment managers ?

PSERS

SERS

No

No

7. In negotiating investment costs, does the Plan have a process for determining the best alternative to the investment under consideration ?

PSERS

SERS

Yes

Yes

8. Do your brokers, or those of your managers, make use of bundled brokerage ?

PSERS

SERS

Yes, in some cases

Yes, several of them

9. Are you conducting regular transaction cost analyses on equities, fixed income and FX ?

PSERS

SERS

No

Yes, quarterly

# PPMAIRC Second Hearing

---

**Thank You**

# Appendix

---

- Absolute Investment Performance SERS & PSERS (Table)
- Absolute Investment Performance Peer Group
- Consultant Peer Performance Results
- Peer Group Selection Process
- Main Data Caveats and Analysis Considerations
- PSERS High Yield/Opportunistic Initial Analysis

# 2017 Absolute Performance | SERS & PSERS

## PSERS

Category	Total Portfolio			Asset Class																									
				Equity			Fixed Income			Private Equity			Hedge Funds			Commodities			Real Estate			Cash				Other			
	1Y	5Y	10Y	1Y	5Y	10Y	1Y	5Y	10Y	1Y	5Y	10Y	1Y	5Y	10Y	1Y	5Y	10Y	1Y	5Y	10Y	1Y	3Y	5Y	10Y	1Y	3Y	5Y	10Y
Return	10.14%	7.35%	3.80%	21.30%	12.56%	5.20%	5.22%	5.17%	7.36%	12.04%	8.51%	5.97%	8.09%	2.06%	2.51%	-3.48%	-4.62%	-3.42%	8.38%	11.18%	0.66%	No Benchmark in Annual Report				-	-	-	-
Benchmark	6.39%	5.47%	2.80%	19.91%	12.92%	5.59%	3.09%	2.83%	6.10%	3.05%	3.96%	3.61%	5.17%	2.73%	3.34%	-6.41%	-6.49%	-5.08%	2.92%	8.59%	5.20%					-	-	-	-
Difference	3.75%	1.88%	1.00%	1.39%	-0.36%	-0.39%	2.13%	2.34%	1.26%	8.99%	4.55%	2.36%	2.92%	-0.67%	-0.83%	2.93%	1.87%	1.66%	5.46%	2.59%	-4.54%					-	-	-	-

## SERS

Category	Total Portfolio			Asset Class																									
				Equity			Fixed Income			Private Equity			Hedge Funds			Commodities			Real Estate			Cash				Other			
	1Y	5Y	10Y	1Y	5Y	10Y	1Y	5Y	10Y	1Y	5Y	10Y	1Y	5Y	10Y	1Y	5Y	10Y	1Y	5Y	10Y	1Y	3Y	5Y	10Y	1Y	3Y	5Y	10Y
Return	12.00%	7.90%	3.90%	20.40%	11.40%	3.20%	2.70%	3.10%	5.00%	11.10%	9.20%	8.40%	6.40%	2.80%	2.00%	-	-	-	1.20%	8.40%	2.10%	1.20%	0.80%	0.60%	1.00%	-	-	-	-
Benchmark	11.70%	8.10%	5.30%	19.00%	10.70%	3.90%	-0.30%	2.20%	4.50%	21.60%	16.60%	10.80%	9.40%	6.90%	5.40%	-	-	-	6.40%	10.90%	4.50%	0.50%	0.20%	0.20%	0.60%	-	-	-	-
Difference	0.30%	-0.20%	-1.40%	1.40%	0.70%	-0.70%	3.00%	0.90%	0.50%	-10.50%	-7.40%	-2.40%	-3.00%	-4.10%	-3.40%	-	-	-	-5.20%	-2.50%	-2.40%	0.70%	0.60%	0.40%	0.40%	-	-	-	-

# 2017 Absolute Performance | Peer Group

Plan (2017)	Category	Total Portfolio		
		1Y	5Y	10Y
Arizona SRS	Return	13.90%	9.60%	5.60%
	Benchmark	14.00%	8.80%	5.20%
	Difference	-0.10%	0.80%	0.40%
Georgia Teachers	Return	12.50%	9.40%	6.10%
	Benchmark	1.6%	1.3%	1.6%
	Difference	10.90%	8.10%	4.50%
Illinois Teachers	Return	12.60%	9.20%	4.80%
	Benchmark	11.40%	9.30%	5.30%
	Difference	1.20%	-0.10%	-0.50%
Iowa PERS	Return	11.70%	8.65%	5.89%
	Benchmark	11.17%	8.61%	6.28%
	Difference	0.53%	0.04%	-0.39%
LA County ERS	Return	12.70%	9.00%	5.20%
	Benchmark	11.20%	8.80%	5.40%
	Difference	1.50%	0.20%	-0.20%
Oregon PERS	Return	12%	9.19%	5.37%
	Benchmark	13.02%	9.85%	N/A
	Difference	-1.10%	-0.66%	N/A
PSERS	Return	10.14%	7.35%	3.80%
	Benchmark	6.39%	5.47%	2.80%
	Difference	3.75%	1.88%	1.00%
SERS	Return	12.00%	7.90%	3.90%
	Benchmark	11.71%	8.10%	5.30%
	Difference	0.30%	-0.20%	-1.40%
South Dakota RS	Return	13.81%	10.97%	6.14%
	Benchmark	10.96%	9.07%	5.31%
	Difference	2.85%	1.90%	0.83%
Virginia RS	Return	12.10%	9.10%	4.90%
	Benchmark	11.80%	8.50%	4.50%
	Difference	0.30%	0.60%	0.40%
New Mexico Educational	Return	12.00%	8.70%	5.20%
	Benchmark	12.10%	7.80%	4.60%
	Difference	-0.10%	0.90%	0.60%

# Consultant Peer Performance Analysis

Higher the Percentile, the lower the ranking

Performance Analysis					
PSERS					
Year	Report (Population of funds)	1 yr	3yr	5yr	10 yr
2014	Hewitt ennisknupp (304, 287, 289,163)	81st percentile	74h Percentile	62nd Percentile	29th Percentile
2015	Aon Hewitt (342, 321, 303, 179)	53rd Percentile	88th Percentile	74th Percentile	53rd Percentile
2016	Aon Hewitt (398, 384, 366, 240)	25th Percentile	55th Percentile	62nd Percentile	79th Percentile
2017	Aon Hewitt (386, 366, 356, 283)	82nd Percentile	62nd Percentile	87th Percentile	97th Percentile

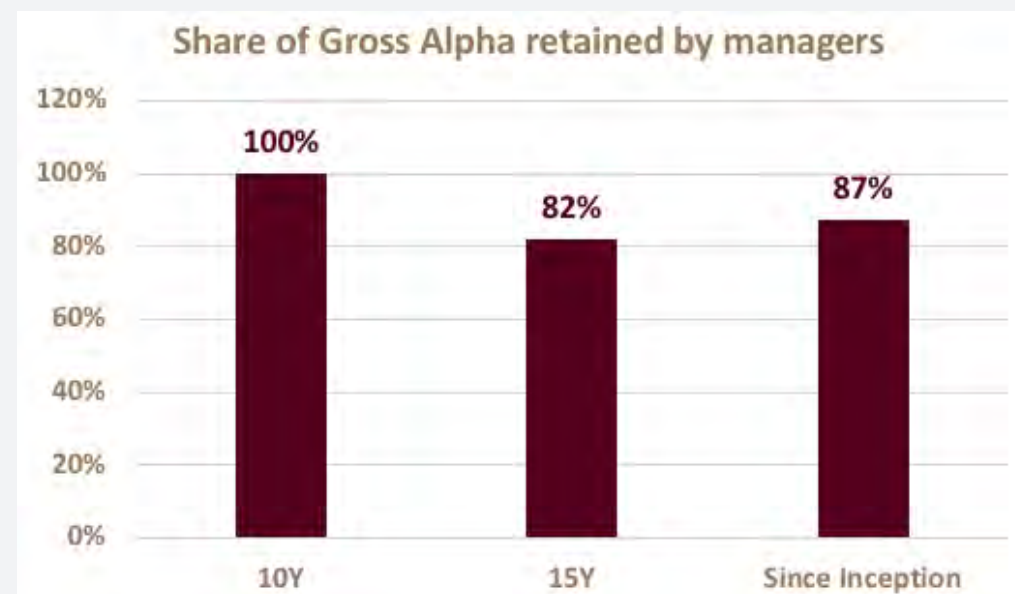
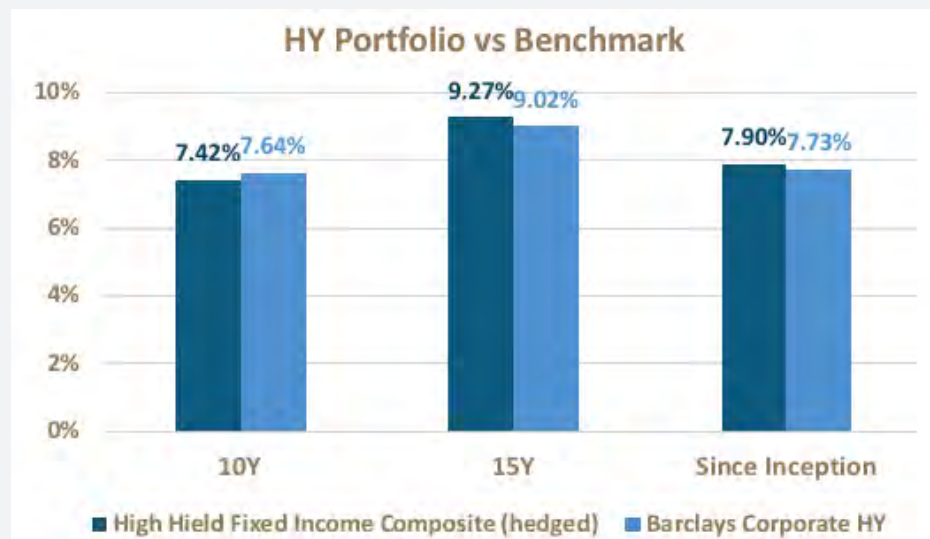
SERS (gross returns)					
Year	Report (Population of funds)	1 yr	3yr	5yr	10 yr
2013	RVK (71, 69, 67, 59)	70th Percentile	70th Percentile	99th Percentile	6th Percentile
2014	RVK (78, 71, 68, 61)	60th percentile	53rd percentile	68th Percentile	10th Percentile
2015	RVK (78, 73, 71, 66)	31st Percentile	57th Percentile	57th Percentile	14th Percentile
2016	RVK (85, 84, 81, 73)	49th Percetile	46th Percentile	38th Percentile	55th Percentile
2017	RVK (79, 77, 77, 72)	54th Percentile	54th Percentile	59th Percentile	78th Percentile

# PSERS Mandates: Key points from Preliminary Analysis

## High Yield / Opportunistic:

- PSERS investments of \$4.46B in this asset class are in, essentially, Private Debt Limited Partnerships. There are classified under Mezzanine HY, Opportunistic HY, Real Asset HY and Senior Loans HY. These investments are benchmarked against Barclays US Corp High Yield Index.
- The performance of each allocation within are wildly different though. The range being 40% wide p.a. over last 3 years. But as an aggregate, long term performance has been similar to the benchmark. 10 year net value add was -0.22% p.a.
- As per the report “Response to PSERB Resolution 2017-41 Re: Management Fees – July 2018”, the aggregate fees paid by PSERS is 114.08bps.

- Assuming same costs historically, this implies a gross return of 8.56% p.a. over 10 years and a gross alpha of 92bps. The net alpha is -22bps (as stated above), so the entire alpha is being paid to the asset managers. This is besides the cost of an internal team to select and manage these (currently, 37) allocations.
- Novarca has experience in negotiating multiple HY active mandates with allocations that were less than a tenth of PSERS in this asset class. These mandates cost about 25-30bps (compared to 114.08bps here).
- Additionally, if the aim is to generate similar long-term returns as the asset-class benchmark, then an even cheaper passive mandate should be considered. This will have negligible internal costs compared to a team managing Private Debt LPs.



# Main Data Caveats & Analysis Considerations

---

- **There is no single established process or methodology for performing asset allocation and investment performance assessments** – Conversations with industry experts illustrated that there is no single or established process/methodology for performing asset allocation and investment performance assessments for pension funds. Both the process and methodology must be tailored to respond to the hypotheses being tested, the scope of the project, and the data that is readily available to support insight generation. Industry experts highlighted that in addition to data availability, another major challenge involves the rationalization and standardization of asset classes across peers to achieve a relative "apples to apples" comparison.
- **Pension funds often have different fiscal year end dates and reporting cycles** – Pension funds have different fiscal year end dates and therefore different reporting cycles (e.g. PSERS fiscal year end is June 30 and SERS is December 31), which entails that comparisons across fiscal years could cover diverse timeframes across peers. To help minimize the impact of these diverse timeframes, we selected the last year (2017) for which all peers have generated final reports and established a specific comparison time frame from 2008-2017 to accommodate the (1, 3, 5, and 10 year annualized) data requirements for investment performance. In addition, we applied an additional criteria category for the peer group and ensured that only peers that had a June 30 end date would be included. Given that SERS has a December 31<sup>st</sup> end date, the project team leveraged a 2017 Q2 investment report (June 30) provided by SERS for this project to control for the time difference
- **Data transparency and availability varies widely across pension funds** - The type and level of data that pension funds publish varies widely, not only between pension funds, but also for the same fund across time (e.g. a pension fund can change how they categorize or report on a certain asset class across different years). Moreover, the data gathering process is highly manual as data points need to be extracted from individual annual reports. To help overcome these challenges, we leveraged the Public Pensions Database (PPD), which is developed and maintained by the Centre for Retirement Research at Boston College. This database is maintained by an impartial institution, has been used widely for academic research, and contains a large part of the data required for the assessment. To further strengthen confidence in the data, an extensive audit was carried out of the PPD data against annual reports and data gaps and discrepancies were addressed accordingly
- **Discrepancies exist in how funds categorize asset classes** – The discrepancies that exist between how funds categorize asset classes was flagged at the beginning of the project. Pension funds often invest in similar assets but categorize them differently. For example, Nevada PERS categorizes investments in Private Equity and Real Estate as "Private Markets", while other funds report on them independently. Another example is how Mississippi PERS breaks down Equity into US Equity, International Equity, and Global Equity. In contrast, other funds report US Equity and International Equity, while others simply have a single Equity category. An additional challenge faced across most funds is that some report "Cash" allocations within Fixed Income, while others report in separately. Those that roll-up Cash into Fixed Income, often only do so for asset allocation, but limited information is made available on benchmarks and investment returns. To help overcome this challenge, we leveraged the 9 common asset classes used by the Public Pensions Database and audited information against annual reports to ensure consistency across the analysis



# Disclaimer

---

This document has been produced in part by Novarca International, its advisers and its affiliates (together, “Novarca”).

The findings, ratings and/or opinions expressed herein are the intellectual property of Novarca and are subject to change without notice. They are not intended to convey any guarantees as to the future performance of the investment products, asset classes or capital markets discussed. Past performance does not guarantee future results. The future value of investments may rise and fall with changes in the market. This document does not constitute or form part of any offer to issue or sell, or any solicitation of any offer to subscribe or purchase, any securities nor shall it or the fact of its distribution form the basis of, or be relied on in connection with, any contract thereof. Potential investors should consult their advisers to discuss the suitability and implications of the underlying products and instruments referred to therein.

Information contained herein has been obtained from a range of third party sources and from conversations held with stakeholders. While the information is believed to be reliable and Novarca have used their best efforts in collecting the information, Novarca has not sought to verify it and has not been subject to an Audit. As such, Novarca makes no representations or warranties as to the accuracy of the information presented.

The work presented in this report represents our best efforts and judgments based on the information available at the time this report was prepared. No guarantee or warranty is made as to the reasonableness of the assumptions or the accuracy of the models or market data used by Novarca. Similarly, all the calculations made are non-binding for Novarca. Estimates contained in this Report are based upon information and assumptions that we consider reasonable, subject to uncertainties as to circumstances, and are subject to material variation. The information contained herein has not been independently verified and no representation or warranty, express or implied, is made to and no reliance should be placed on the fairness, accuracy, completeness or correctness of the information or opinions contained in this document. Novarca shall not have any liability whatsoever for any loss whatsoever arising from use of this document, its contents or otherwise arising in connection with this document.

The document has been provided by Novarca exclusively for the use of the selected recipient and shall not be altered in any way, transmitted to, copied or distributed, in part or in whole, to any other person or to the media or reproduced in any form.

This document cannot be considered to meet all decision requirements the recipient may have. The latter is therefore not exempt to conduct its own analysis and due diligence it deems appropriate to make an investment decision.

By accepting this presentation and not immediately returning it the recipient warrants, represents and agrees that to have read and agreed and to comply with the contents of this disclaimer.

**Public Pension Management and Asset Investment Review Commission  
Public Hearing - September 20, 2018**

**Opening Remarks**

**Dr. Ashby Monk, Executive and Research Director, Stanford Global Projects Center**

Thank you Chairman Tobash, Vice Chairman Torsella and the Commissioners of this Public Pension Management and Asset Investment Review Commission for giving me this opportunity to present to you today.

As you know, this commission has been created by the legislature to study the two Pennsylvania plans and develop recommendations to reduce pension-related expenditures. Specifically, the mandate of this Commission is to focus on fee and cost transparency with a view to generating actuarial savings of \$1.5bn, per plan, over 30 years.

That's why we are here. But the reason why *I am* here is easy: I've been focused on fees and costs for over a decade. I believe they are an entry point to broader discussions of governance, organizational design, management and even strategy. I think it's an incredibly important topic, albeit at times uncomfortable for many parties.

For the last two decades, I've been focused on helping the world of pensions and other beneficial long-term investors. Yesterday, I was in Des Moines working on a project with their State pension. Last week, I was in Mongolia helping that country think with their resource revenues. Today, I'm in Harrisburg. These are wildly different places with different contexts, but I've gone to these places with a similar objective: To help the governments design or improve the investment organizations that are required to meet their specific and often idiosyncratic social obligations.

I've dedicated so much of my life to this topic because our societies increasingly rely on these investment organizations to pay for pensions, to fund education, to fund medical research, to create inter-generational equity, and so on. Pension Funds. Sovereign Funds. Endowments. Foundations. Our social welfare literally relies on these funds and their ability to execute at a high level. And so, they have to be the best they can be.

If we can help these plans operate more effectively, and generate higher returns, we can literally keep the cost of our social programs down. It's simple math: Higher returns means lower contributions and / or higher benefits. So, higher returns mean cheaper pensions.

As such, we – in America and around the world - have asked these organizations to generate higher returns. The Boards of pensions, and their consultants and actuaries, pushed staff into riskier investment strategies – and often more expensive asset manager relationships – in the pursuit of *cheaper* pensions.

This was, and is, not problematic on its own, as the returns for some funds have been remarkably strong. The problem was, and is, that most Americans did not fully understand this decision and the new approach to taking more risk via external managers in complex strategies. And most people surely did not grasp the sheer scale of compensation our pensions would pay – and today are paying - to external asset managers. Nor did they appreciate the additional consequences of taking this approach for the plans own operations.

In sum, the pension funds took this approach without explaining all aspects of it clearly to their stakeholders. And, in my view, this lack of understanding was a recipe for stakeholder conflict and loss of trust. I'll come back to this. But before I get into the heart of this presentation, I'd like to make two key points: One, I want to talk about why there is a lack of understanding of the fees and costs among stakeholders. And, two, I want to offer some sense for the secondary and tertiary consequences of this lack of understanding.

1) Why: There is a lack of understanding among stakeholders about the external costs because much of the compensation data has been buried in fund footnotes, hidden in net asset value calculations, waived away as profit sharing or ignored by pensions under the false protection of an MFN provision. (I'll come back to the problems with MFNs later.) And the information was thus not reported. Not measured. Not tracked. And not managed.

It was hidden away because the staff in many plans across the country were afraid that the public – armed with true fee and cost information – would prevent them from investing in the complex and high cost asset classes that the plans thought they needed to generate higher returns. As staff at these organizations saw it, these strategies were strengthening the pension promise by reducing the cost of the benefits. “So what”, they thought, “If the cost of the investment is astronomical... the pensions are more secure!”

So, a deal was struck: pension funds would protect managers from scrutiny so long as the returns kept coming, which is why there's so much hiding of fee data today.

2) Consequences: I don't think the pensions understood the secondary and tertiary consequences of the deal they made. Because those high, hidden fees created new advantages for the managers – economies of scale – which they in turn wielded back against the pension plans at the negotiating table. The gap in skills, capabilities and resources between public pension funds and private managers grew, without much understanding as to the reasons since the fees weren't being tracked! This reinforced the asymmetries of information, skill and ultimately power in favor of the managers. And the managers could thus demand more and more of those hidden fees... and they did.

Today, asset managers often set the terms for pension participation in their funds, with endowments and pension plans literally pleading and thanking their GPs for granting them – the people with all the money – a chance at an allocation in their funds. The agents are disciplining the principals, which is a perversion of the principal agent theory that is so fundamental to capitalism functioning correctly. Principals, we know, must discipline the agents. The opposite is

now increasingly common in the investment business, due to a lack of fee and cost transparency right from the beginning.

As you might be starting to understand, I think the major consequence of hiding fees and costs was pension fund under-resourcing. Please recall, the responsibility of a pension fund Board and senior management team is often as much about building professional and effective investment organizations as it is actually picking things to invest in. It's the Board that should help ensure their plans remain the principals in this complex chain of principal agent relationships.

But in order to properly resource an investment organization for success, to remain the principal, one has to first assess the true cost of producing a target return – whether those returns are produced internally or externally is not the issue. The issue is how much it costs to generate a certain amount of return per unit of risk.

By minimizing the importance of fees and costs and keeping them a secret from the public, we've allowed our pension organizations to go under-resourced. And we've allowed the for-profit asset management industry to enjoy an incredible advantage at the expense of this critical social welfare institution: the American public pension plan.

I think it ironic that in trying to bolster the solvency of our most important social institutions, we have unwittingly created more billionaires on Wall Street than in any other industry in America. Today, you are twice as likely to become a billionaire by setting up an investment business and managing pension fund capital than you are starting a technology company.

In short, hiding the fees may have allowed the pensions to pursue riskier and higher returning strategies, but it also prevented the Boards from properly resourcing and thus overseeing and holding accountable their pension organizations and the associated strategies. The principals have found themselves increasingly subservient to their own agents.

And while this all might have seemed – at least in the short run – a way to optimize a portfolio given the obvious governance constraints – yes. I've heard that story many times; 'we did this in spite of the Board not because of them' – what this has actually done is weaken the plans operating capabilities and created an incredibly precarious position with stakeholders.

Here's the good news: Pennsylvania has, with this Commission, joined other courageous States to tackle this issue head on. There are new reporting regimes in places like California. We've seen funds such as CalPERS own up to past failures on fees, in terms of monitoring, and work to remedy their processes. The SEC has investigated fees and costs of alternative managers, and they uncovered a startling amount of over-charging. Newspapers around the world are now putting fee and cost numbers on their front pages.

Transparency is now on a path to inevitability. And I think that's healthy and will hopefully lead to a realignment between our pension funds and Wall Street.

But this change will probably be painful. It may require some change for how the plans are managed. Boards. Staff. Managers. Consultants. Service providers of all kinds. All of these players may see roles change after the true cost of managing a plan is revealed.

I've seen this around the world: the process of achieving fee and cost transparency is one of the most powerful catalysts I've seen for Boards to become re-invigorated and re-empowered to consider, from first principles, how they should design their own organization to achieve their investment objectives. And, for some, that's why this Commission and its work are so scary.

But, in my view, to bring our public pension funds into the modern era of finance – and level the playing field with external managers – we really do need fee and cost transparency. We need to spark change in the way we manage these plans, for the benefit of these plans.

I'd personally rather see a few less billion in the hands of investment professionals on wall street and few more billion in pension fund coffers. But we don't get there by ignoring this issue and pretending status quo is working.

Now, to be clear, I'm not arguing that any fund should seek to minimize costs at the expense of all else. I'm simply saying that funds should aggressively minimize fees *in order to maximize returns*. I don't mind if you pay a manager high fees, so long as they've actually earned it. But the problem is, they often haven't.

And so that's why I'm here today. To help your plans get a better deal. Make more money. Take home more of the money that their managers make. And we have been commissioned to write a report that will document some ideas to help these plans, and help the state save 3 billion over the years.

Over the next 25 minutes or so that remain in my presentation, I'll offer some of our preliminary findings from our work. I will seek to get into some objective data and local context. I have been asked here today to give you a sense of two specific things: the relative investment performance of PSERS and SERS; and the fee and cost performance of the funds. But before I get into these sections, let me note two caveats of importance about my analysis:

- 1) Performance is very challenging to measure, particularly for comparisons. The context of the performance is often so important in understanding whether a fund is generating strong risk-adjusted returns. To be honest, this is partly why I have tried to spend so much of my time focusing on the fees and costs of the funds, as it's easier to compare processes and mandate-specific terms to judge how a plan is performing than to look at performance. If you have the data, you can measure exactly what a fund has been paid and compare that directly to other funds with the exact same strategy and sometimes manager. Performance, on the other hand, can be manipulated, but the fees and costs – which you can think of as the exhaust coming out of the tailpipe of running these pension machines at high speed. This exhaust tends to offer a very useful way of assessing whether plans are running well.

- 2) I am genuinely sorry to say that we have not been given sufficient data to do the fee and cost analysis correctly... no private equity data. SERS failed to provide public equity contracts; the data we needed was often redacted, hidden away once again from public scrutiny. To be fair, this is a common position among some investors, such as US endowments, but, even still, the lack of data here struck me as... abnormal. This data was requested by a Commission set up by the State Legislature for oversight. The fact that it was not shared seems noteworthy. And so, I'm noting it on the record.

Notwithstanding these two constraints, we persevered and went about conducting the two key areas of analysis on the two plans to the best of our ability. The first analysis was to compare the asset allocation and performance of the two funds with a peer set of funds. The second was to examine the fees and costs of the two funds with regards to their external managers.

For the peer analysis on performance, data was obtained from the Public Plans Database of Boston College. The data from this database was audited against individual fund annual reports to ensure data accuracy. Furthermore, it is our understanding that both SERS and PSERS have validated the data from the PPD database, but I'm sure JP Aubry who is here from BC's CRR will elaborate on this in his presentation later on today.

For the analysis on fees and costs, data was obtained from the two pension plans themselves but as stated, was significantly withheld. The reason given was that the data was confidential and contained trade secrets. We will elaborate on why this reasoning is problematic in the analysis, but this is exactly the type of reasoning that has resulted in the situation I have highlighted already – it serves the interests of asset managers and weakens the pensions and systems they support over time. Notwithstanding, the fees and costs analysis presented here thus focuses predominantly on the public equity mandates where we could obtain reliable data.

[Refer to PowerPoint slides from here forward]

# Private equity investing

Tim Jenkinson

Professor of Finance & Director, Private Equity Institute

Saïd Business School, University of Oxford

Evidence to the Pennsylvania Public Pension Management & Asset Investment  
Review Commission, 20 September 2018

# Agenda

This presentation addresses three questions:

- Why invest in private equity (when it costs more)?
- What are the trends in the performance of private equity, relative to public equity?
- How well have the Pennsylvania pension funds' private equity investments performed?



# Why invest in private markets?

- There are two broad reasons, which really apply to any asset:

diversification and returns

# Diversification

- Public markets have been changing significantly
- In the last 20 years the number of U.S. public companies has fallen by 50% - to around 3600 today
  - Similar trends in many other countries: e.g. UK listed companies have also fallen by around 50%
- US stock market capitalization is at about the same level – but as a ratio of GDP is about 20% lower
- Small firms have been disappearing from stock markets – proportion of listed firms with market cap < \$100m has halved
- Average market cap of listed firms in US has tripled – to \$6bn

# Equity

- Economic growth ultimately pays pensions
- Equity allocations are therefore key
- Public equity gets you access to a sample of more mature companies in particular sectors and countries
- Private equity – buyouts, growth and venture capital – can access many other sources of economic growth
- Increasingly, investors think of private equity as just another way to get equity exposure, rather than an “alternative asset”

# The world's largest public equity manager...

- ... is "expanding its private investment abilities"
- Blackrock poached Mark Wiseman, former CIO of the Canadian Pension Plan, who says "most investors are heading in that direction [towards private market investments] because the liquid public markets are shrinking"



# Returns

- The case for private equity investing ultimately depends on the net returns relative to public equity – but why might private equity generate attractive returns?
- Private equity is best thought of as a different form of corporate governance
  - Ownership and control reside in the same hands
  - Focus on medium term (3-5 year) value creation – often with significant investment, transformation, growth
  - Very sharp economic incentives for management
  - Efficient use of leverage to increase equity returns while managing risk

# Talent

- Being in the C-suite of a public company has become less attractive over the years, with increased regulation and scrutiny following each crisis/scandal
- Many new innovative businesses stay private for as long as possible, often over a decade after inception
- Private equity has attracted many talented people – working both for the funds and the portfolio companies
  - However, such people do not come cheap, and there are certainly issues with the fee structures of funds

# Measuring returns

- The industry tends to focus on internal rates of return and investment multiples
- But these are influenced by macro trends in markets
- Of more relevance are private equity returns relative to public market returns
- This allows one to address the question: “is it worth allocating funds to private equity when there is a low cost diversified alternative – namely passive indexed funds?”

# Focus on net returns

- Clearly, what matters to investors is the net return – net of all fees charged by the fund manager (to the fund or the portfolio company), as well as any profit shares
- This is precisely what I am going to present evidence on for private equity
- For public equity, I will use gross index returns, but the fees charged are low
  - One should, in principle, allow for both the fees charged by index funds and the additional costs of running a private equity program. Over recent years the former have almost certainly exceeded the latter, so ignoring both biases the results somewhat against PE



# Private vs public equity returns

- Public market equivalent (PME) returns compare the returns gained from private equity funds to the returns that would have been earned had the same cash-flows been invested (and divested) in a public market index at the same time
  - PMEs can be thought of as market-adjusted multiples
  - If  $PME > 1$  private equity beat the public market index
  - If  $PME < 1$  the public market index beat private equity
- So a PME of 1.2 implies that the investor ended up with 20% more wealth from private equity than if they had made similarly timed investments (and divestments) to public markets

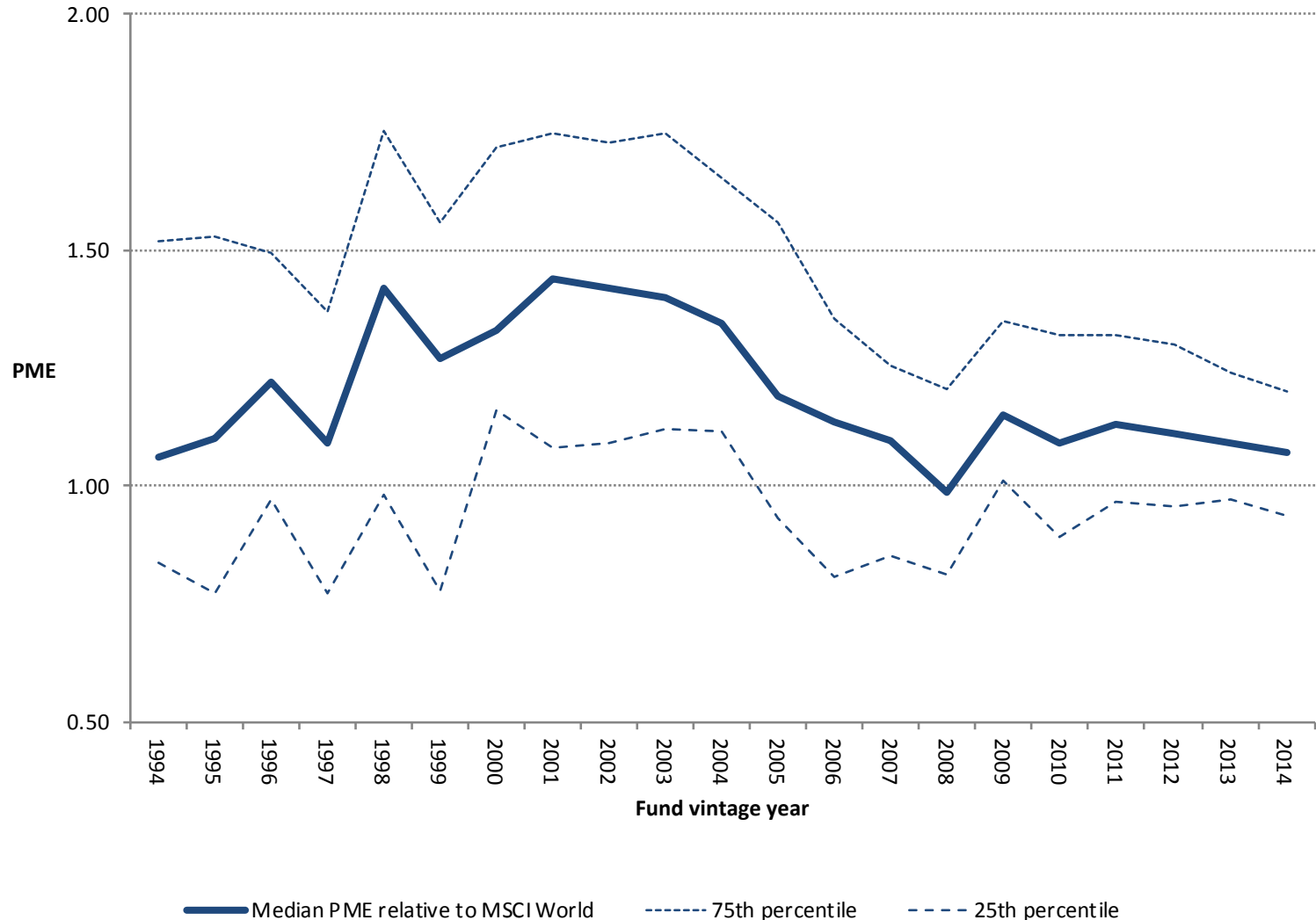
# Complexities

- It matters which public index you choose as a benchmark, even within a country (see the appendix slides)
- It matters even more when you consider international investments, where currency is also an issue
- Standard PME's essentially assume that the risk of each PE portfolio is similar to the market, which may not be the case
- The private equity portfolio is a long-term commitment that cannot easily be traded, unlike a public equity portfolio which has high liquidity

# Data

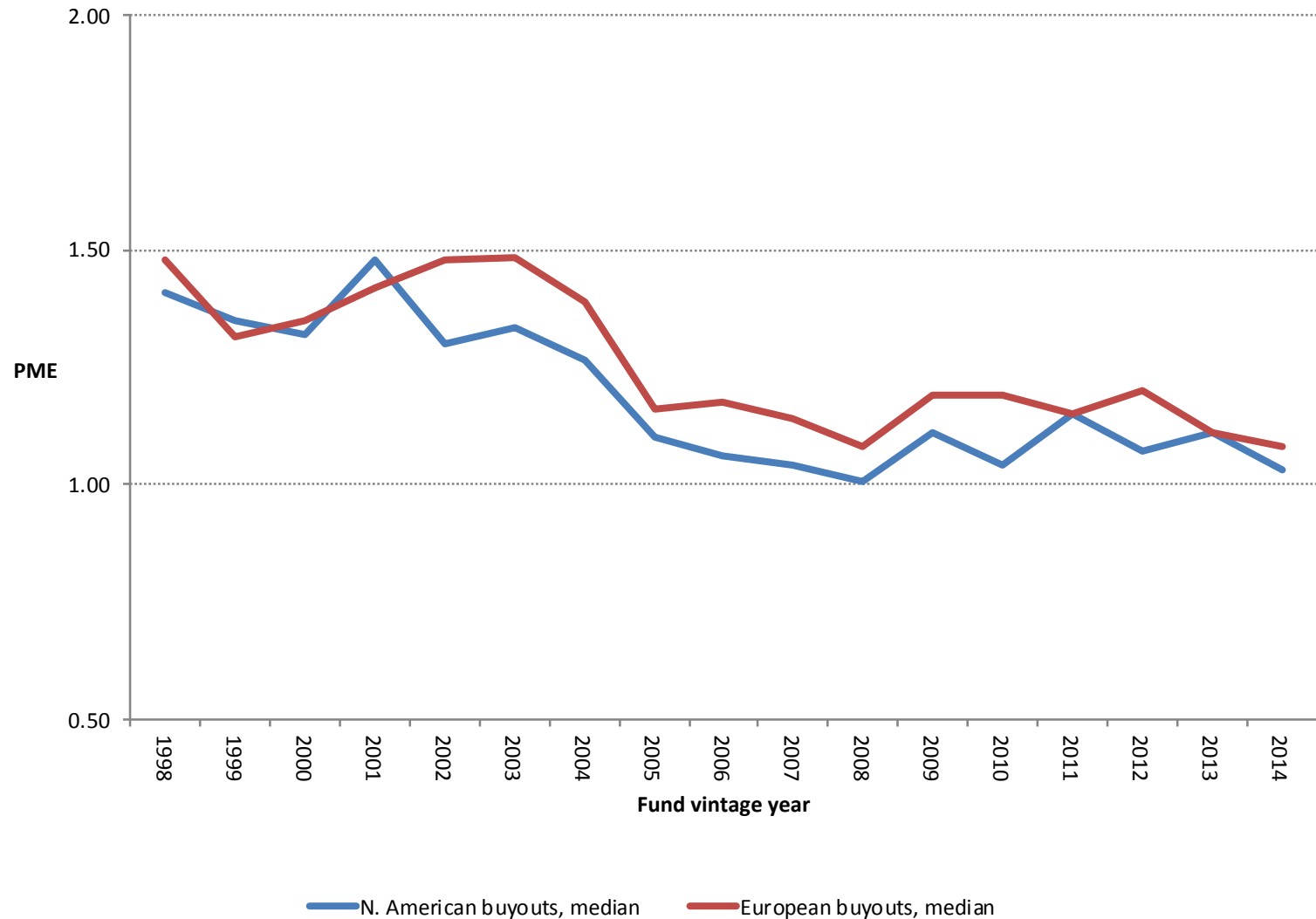
- I am using the latest 2018Q1 update to the Burgiss data
  - This is recognized as the best database for analyzing private equity, as the data is derived entirely from investors
  - Both PSERS and PA SERS use Burgiss
  - Includes the complete transactional history for > 8,000 private capital funds representing around \$6 trillion in committed capital
  - I focus on buyout and VC funds
  - Database includes 2,009 buyout funds and 2,250 VC funds
  - I focus on vintage years up to 2014, more recent funds are too immature
  - The more recent vintages will be largely un-realized, but I use the latest asset valuations

# Globally, median buyout funds have beaten the MSCI World index, but there is high variability in performance



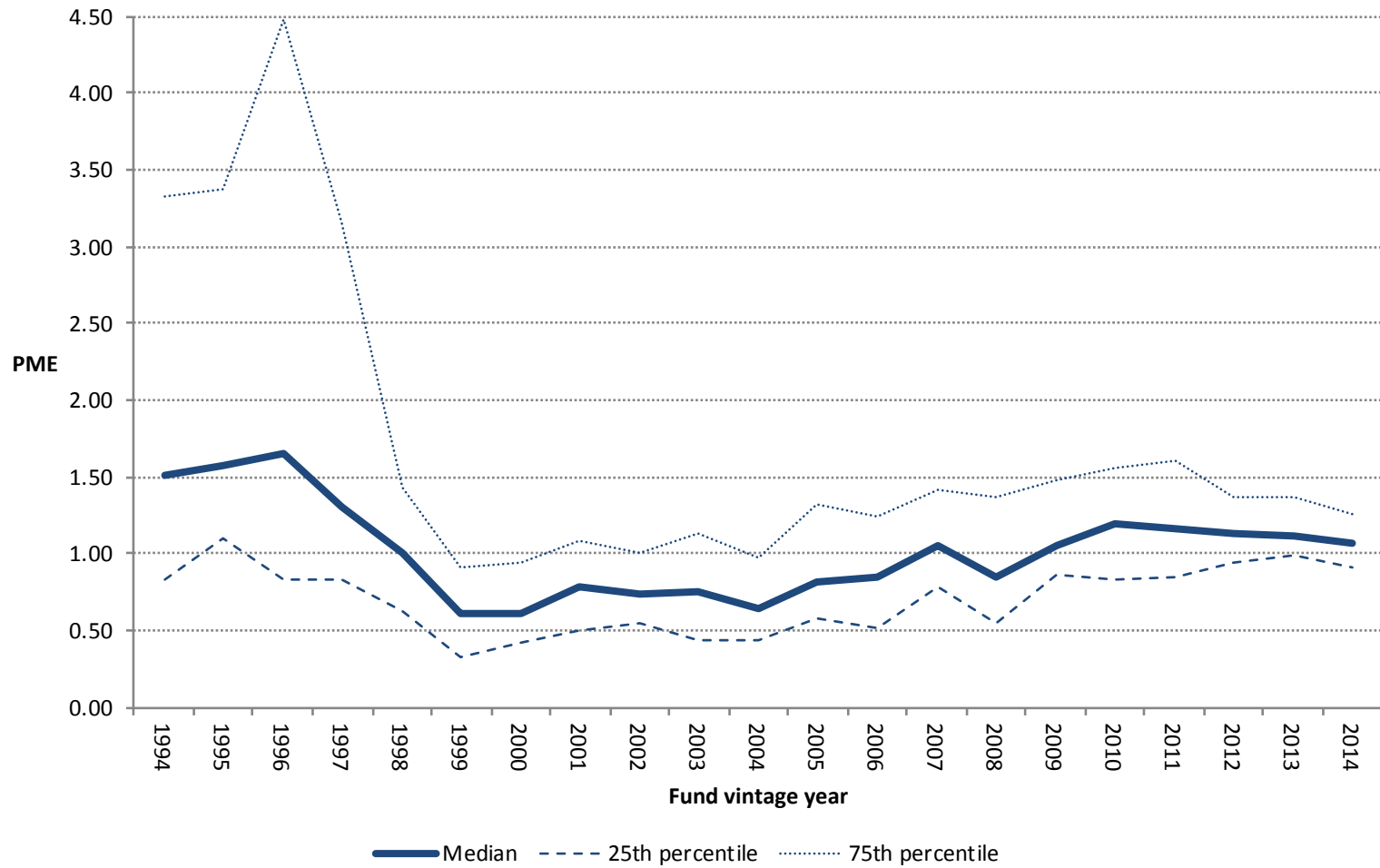
Source: Burgiss Private iQ, global buyouts  
Cash-flows and NAVs up to 2018Q1,  
PMEs measured relative to MSCI World

# Buyouts have beaten local public markets ... but the premium has fallen over time



Source: Burgiss Private iQ. N. American PMEs measured relative to S&P 500 in \$; European PMEs relative to MSCI Europe in euros. Cash-flows and NAVs up to 2018Q1. Comparison starts in 1998 as there were few European PE funds before that date

# VC returns were disappointing after the dot-com period, but have been steadily improving

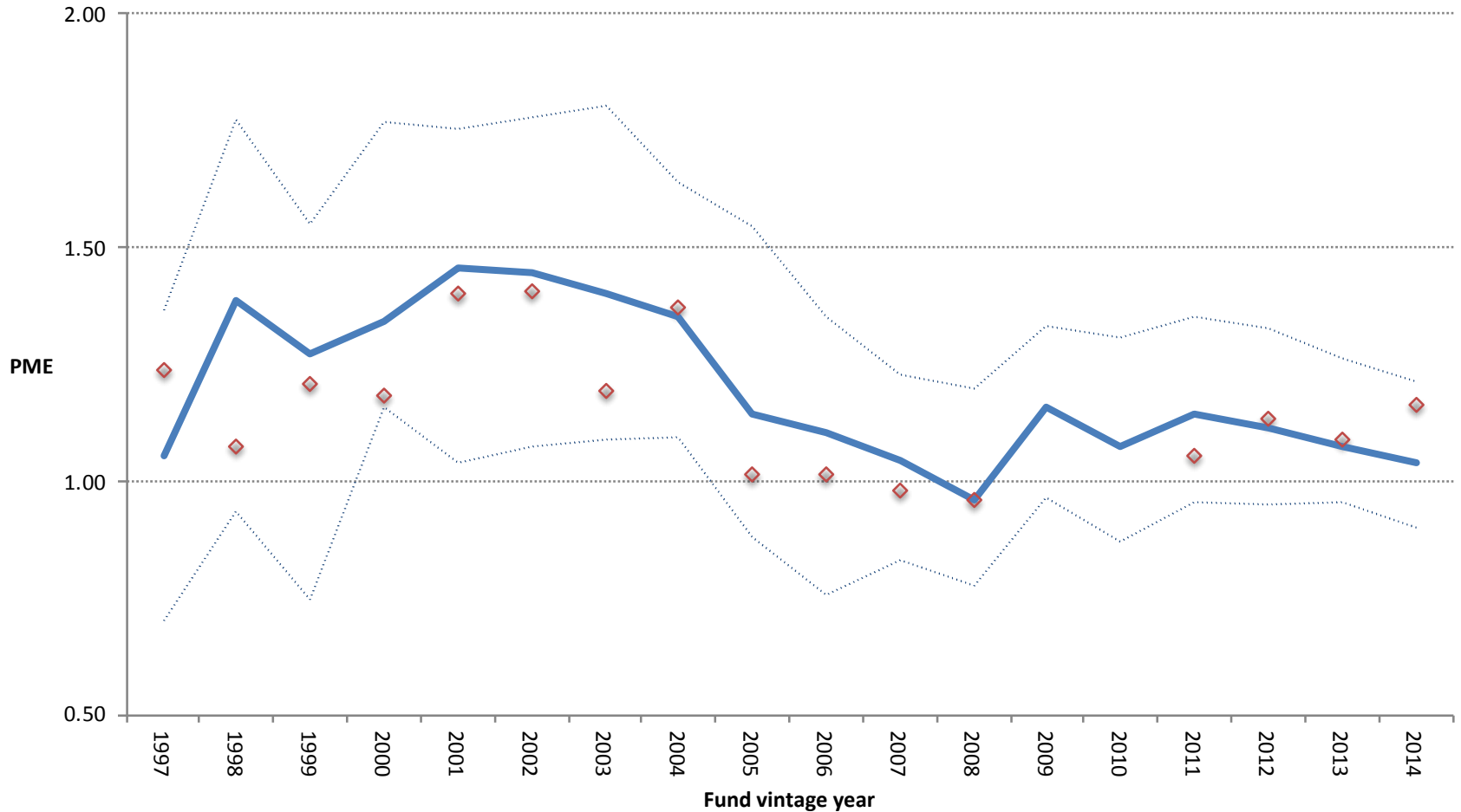


Source: Burgiss Private iQ, global VC funds.  
Cash-flows and NAVs up to 2018Q1,  
PMEs measured relative to MSCI World

# The performance of the PA schemes: PSERS

- PSERS have invested about \$20bn in buyouts, \$3bn in VC and \$5bn in 'special situation' funds
- They started a co-investment program for buyouts in 2012
- They invest internationally, and use a blended benchmark of 70% Russell 3000 and 30% MSCI World ex USA IMI
- I created a vintage year PME for their fund investments and co-investments weighted by capital contributions
  - I include special situation funds with buyouts
- I then compare this to the global fund returns using the same benchmark

# PSERS buyout performance



— Median PME    ◆ PSERS    ..... 25th percentile    ..... 75th percentile

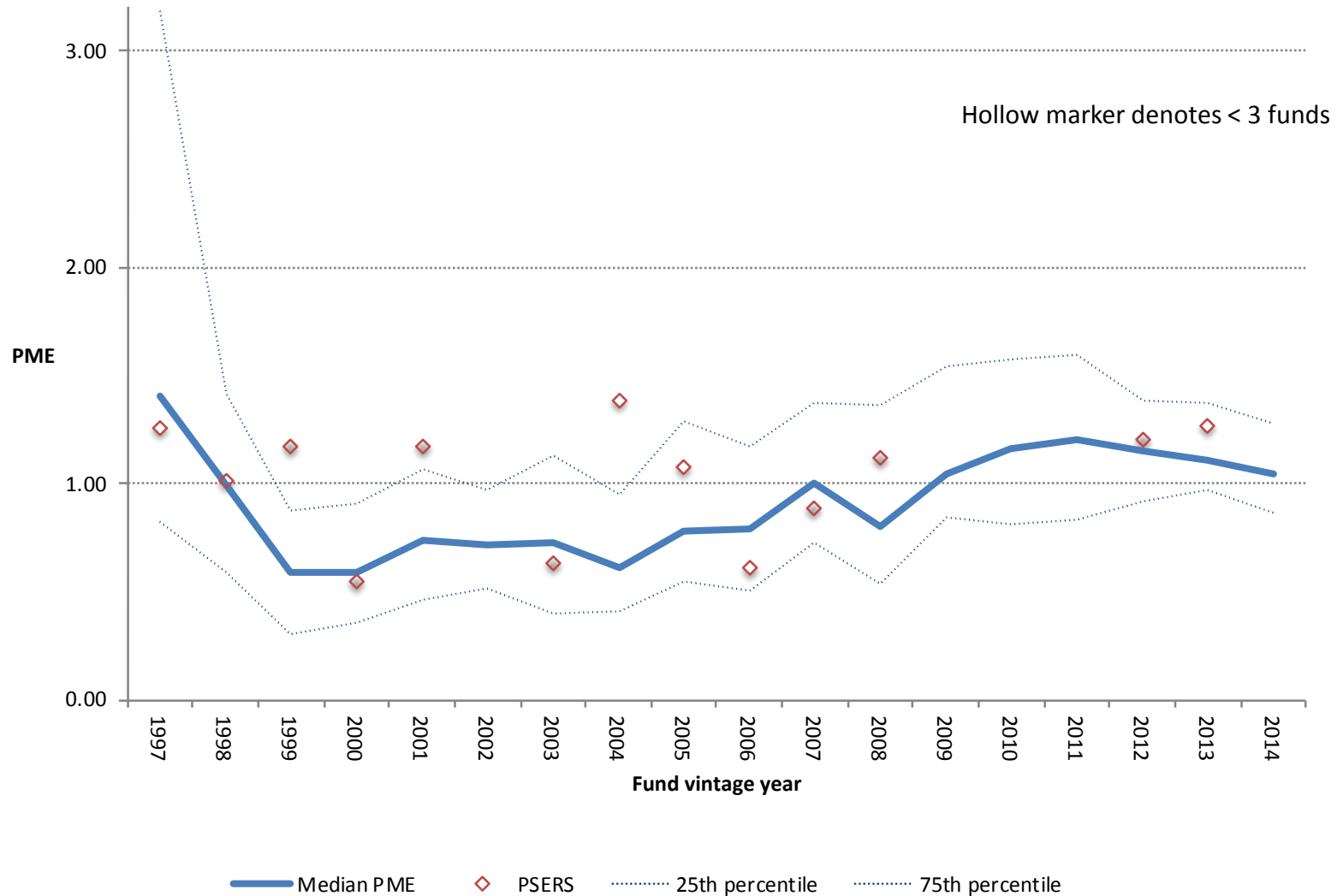
Source: Burgiss PrivateIQ, global buyouts. PMEs measured relative to index of 70% Russell 3000 / 30% MSCI World ex US IMI Cash-flows and NAVs up to 2018Q1. Vintage year weighted average PMEs for PSERS include special situations funds



# PSERS buyout performance

- Before the financial crisis, PSERS buyout performance was generally below that of the median fund
- But performance still exceeded public market returns in most years
- Since the financial crisis, when allocations to the PE program resumed, the performance has been in line with median returns
  - Co-investments (started in 2012) have contributed positively
- Performance has exceeded public market returns, but by less than in early years, as the private equity premium has fallen

# PSERS VC performance



Source: Burgiss PrivateIQ, global VC funds. PMEs measured relative to index of 70% Russell 3000 / 30% MSCI World ex US IMI. Cash-flows and NAVs up to 2018Q1. Vintage year weighted average PMEs for PSERS VC funds

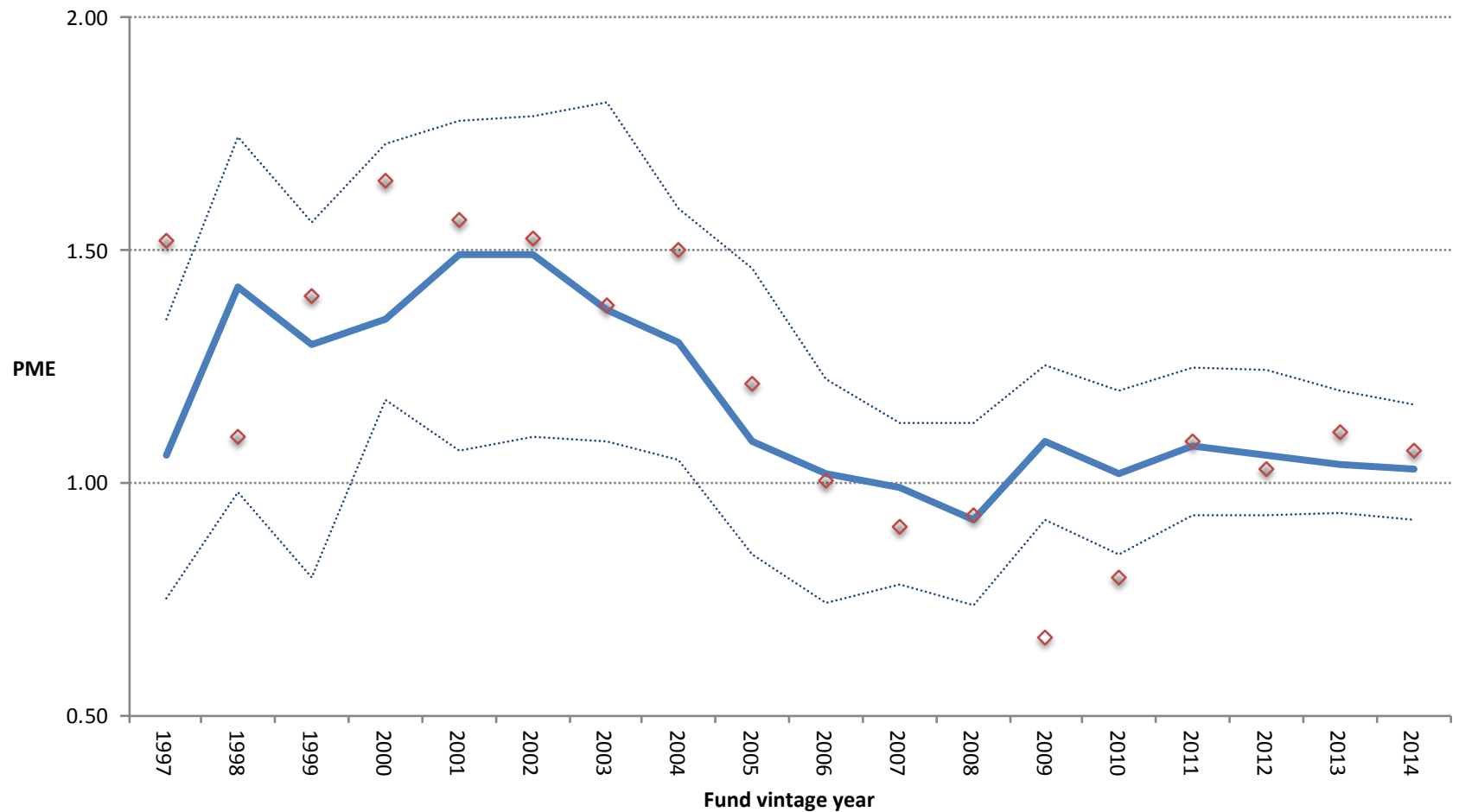
# PSERS VC performance

- PSERS have made far fewer VC investments
  - In some years there was just one fund commitment
- In general, PSERS' VC returns have exceeded median fund returns, and were sometimes into the top quartile
- As a result, PSERS VC returns have exceeded public market returns in 8 of the 13 vintage years when there were investments

# The performance of the PA schemes: PA SERS

- PA SERS have invested about \$10bn in buyout funds, \$3.3bn in VC funds, and \$2.5bn in special situation funds
- Returns are measured relative to the S&P 500 – which I use as the benchmark
- As with PSERS, I include special situation funds with buyouts and create a capital weighted average return by vintage year
- Be aware that the VC program has been limited since the financial crisis, with only 6 funds after 2008

# PA SERS buyout performance



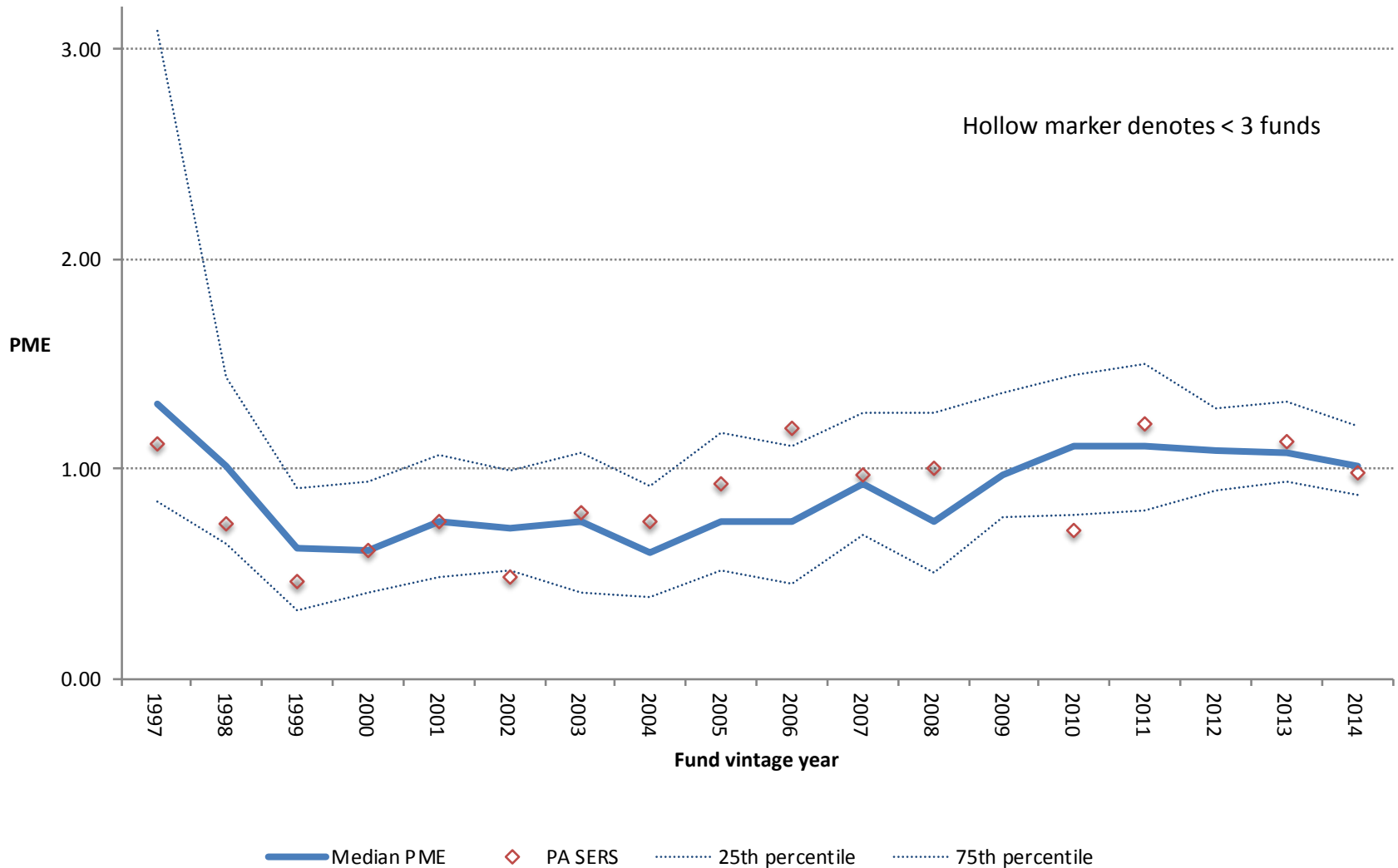
— Median PME    ◆ PA SERS    ..... 25th percentile    ..... 75th percentile

Source: Burgiss Private iQ, global buyouts. PMEs measured relative to S&P 500. Cash-flows and NAVs up to 2018Q1. Vintage year weighted average PMEs for PA SERS include special situations funds

# PA SERS buyout performance

- PA SERS buyout performance has generally been at or above that of the median fund
- 2009 and 2010 are obvious exceptions to this, but only limited investments were made in these years (8 funds totaling \$150m across these vintages)
- PA SERS does not have a direct co-investment program
- Private equity fund performance has exceeded public market returns in all vintages except 2007-2010, but (as with PSERS) the premium has fallen

# PA SERS VC performance



Source: Burgiss Private IQ. Global VC funds. PMEs measured relative to S&P 500. Cash-flows and NAVs up to 2018Q1. Vintage year weighted average PMEs for PA SERS VC funds

# PA SERS VC performance

- From 1997-2002 performance of the PA SERS venture capital portfolio was at or below median
- From 2003-2008 performance was above median
- Investment in VC funds was largely wound down after 2008 - but at this point the median returns in the sector finally started to exceed public markets



# To conclude

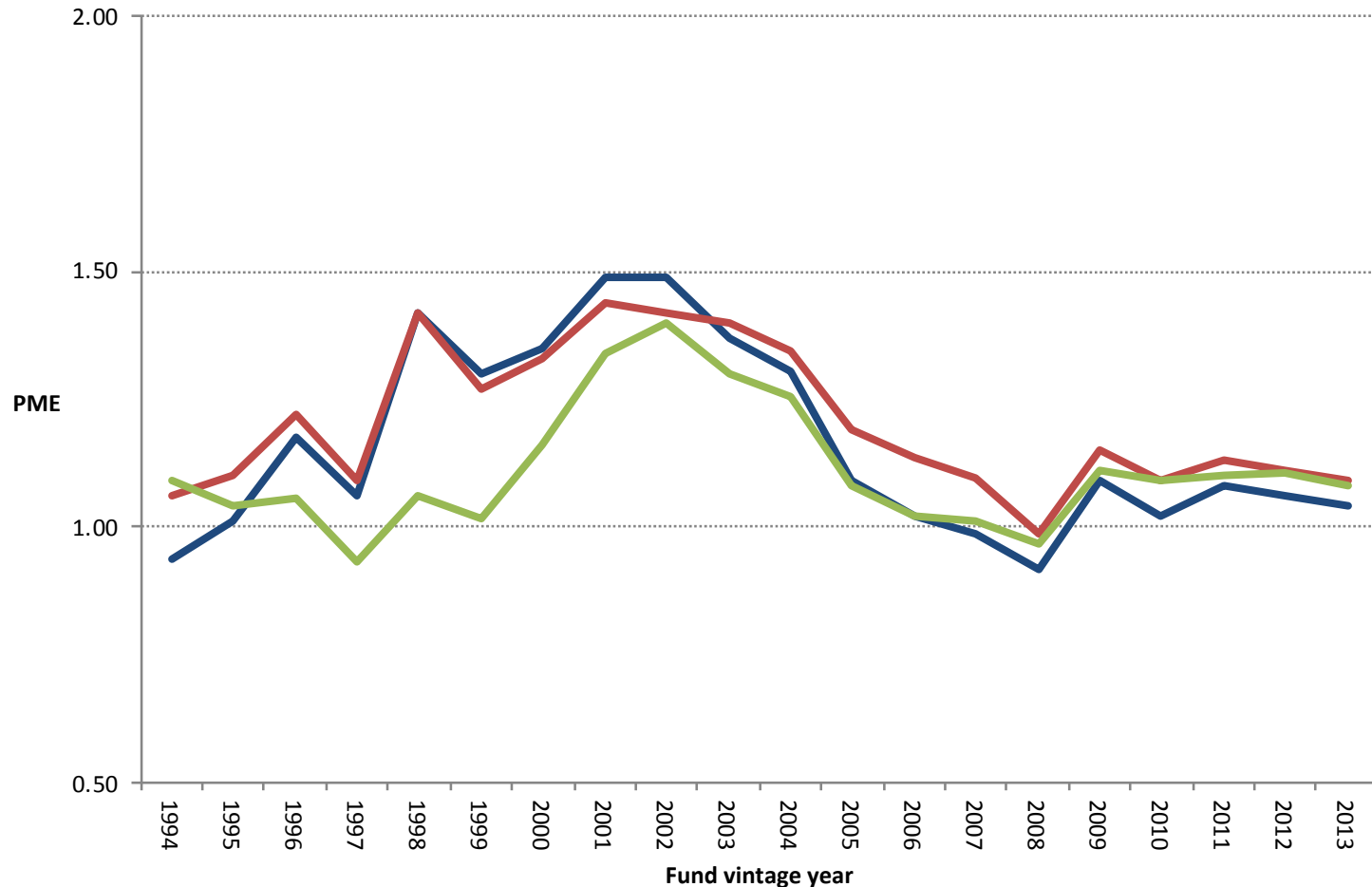
- Most large institutional investors include a significant part of their portfolio in private assets – including private equity – to access a larger proportion of global economic growth
- Net returns on buyouts have been attractive, relative to public market returns, and despite the high costs associated with private equity; VC returns have been more variable
- These market trends are reflected in the actual returns earned by the Pennsylvania funds
- The private equity premium has been falling as the sector has grown and matured, but strategies like co-investment programs can help to increase returns, if done at scale

# More?

- Google Tim Jenkinson, Private Equity
- Or go to SSRN.com where all my papers are available
- See, in particular
  - Private equity performance: What do we know? (with Bob Harris and Steve Kaplan), *Journal of Finance*, 2014
  - How do private equity investments perform compared to public equity? (with Bob Harris and Steve Kaplan), *Journal of Investment Management*, 2016
  - How persistent is private equity performance? Evidence from deal-level data (with Ingo Stoff and Reiner Braun), *Journal of Financial Economics*, 2017
  - Financial intermediation in private equity: how do funds of funds perform? (with Bob Harris, Steve Kaplan and Rudiger Stucke), *Journal of Financial Economics*, 2018
  - Adverse selection and the performance of private equity co-investments (with Reiner Braun and Christoph Schemmerl). Working paper, December 2017.

# Appendix slides

# Alternative indices for buyout PME



— Median, relative to SP500    — median, relative to MSCI World    — median, relative to R2000

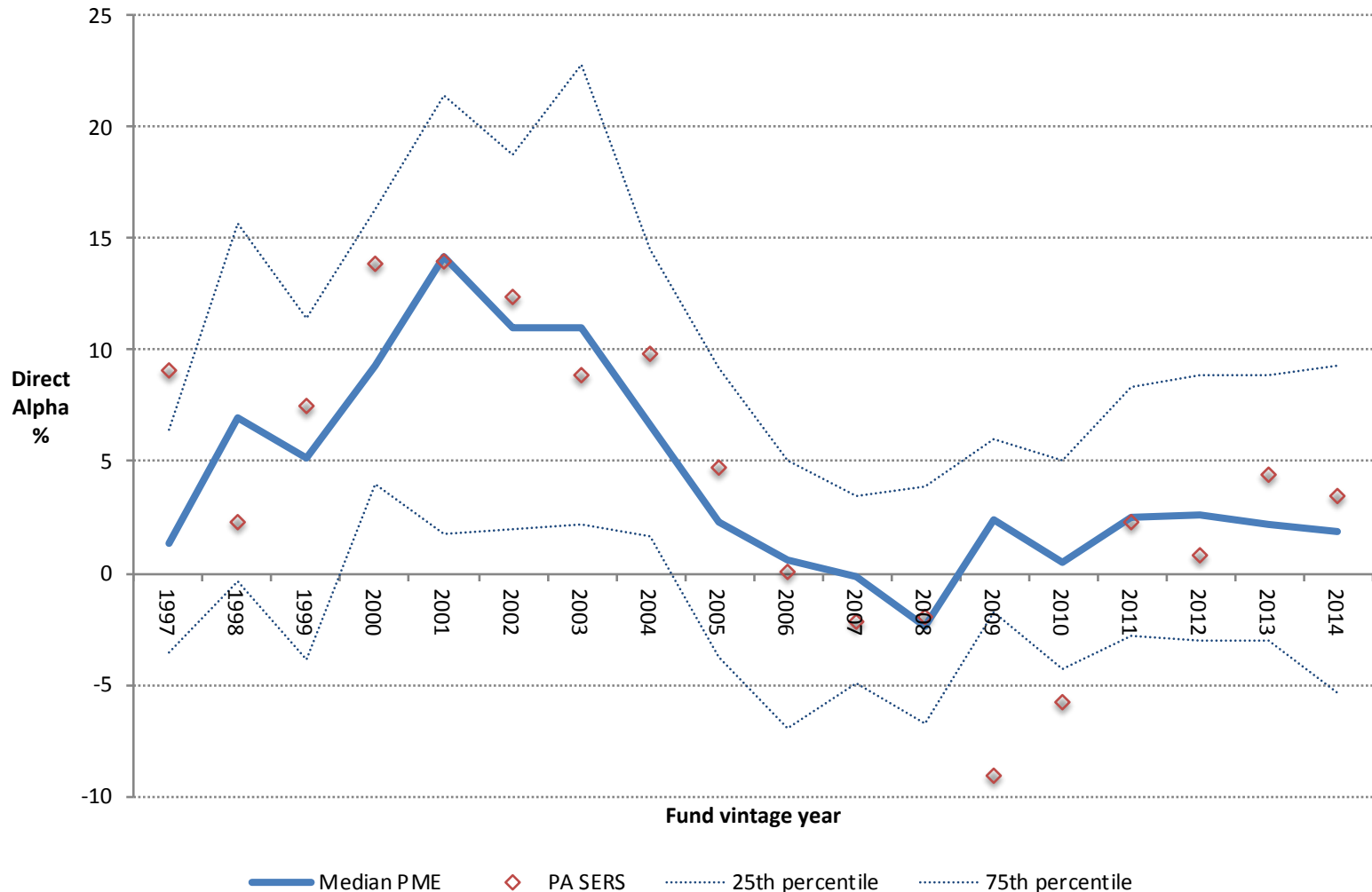
Source: Burgiss Private iQ. Global buyouts. PME's measured relative to S&P 500, MSCI World and Russell 2000. Cash-flows and NAVs up to 2018Q1

# Alternative indices for VC PME



— Median VC PME relative to S&P 500 — ... relative to Russell 2000  
— ... relative to MSCI World — ... relative to Russell 3000

# Alternative relative performance measures: Direct alpha for PA SERS buyouts



Source: Burgiss Private iQ. Global buyouts. Direct alphas measured relative to S&P 500. Cash-flows and NAVs up to 2018Q1. Vintage year weighted average Direct Alphas for PA SERS include special situations funds



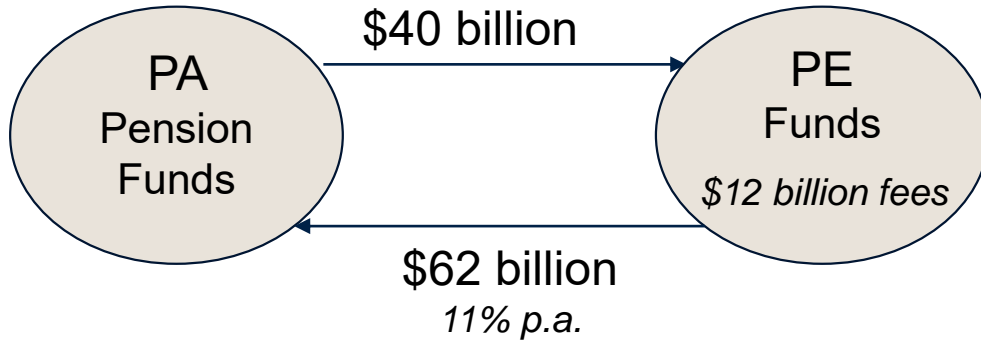
# Private Equity & The Pennsylvanian Public Pension Funds

Ludovic Phalippou

University of Oxford

20.09.2018

# PA pension funds & PE funds



Last ten years reported PE fees: \$2.2 billion  
*Estimated* actual PE fees: \$6 billion



# Should PE funds deliver excess return?

- Why don't they increase their fees?
- Why isn't there money flowing in, up to the point where it's gone?
- Usual response: it is an illiquid investment, hence PE funds have to share excess returns with those willing to provide them with capital
  - If you are someone who does not mind this, go for it, you'll get the reward and won't mind the cost.
  - But need enough people to care out there, for a compensation to exist

# Could be worse (in theory)

- If, due to absence of rules/regulation, PE fund managers can window dress their track records, then
  - Too much money might be allocated to PE
- If people find it fun, then
  - Too much money might be allocated to PE

# Or better (in theory)

- There might be diversification benefits, might do better than have with fund selection abilities etc.
- Conclusion: The case for investing in PE is (in theory) a lot less trivial than commonly accepted, but perfectly plausible

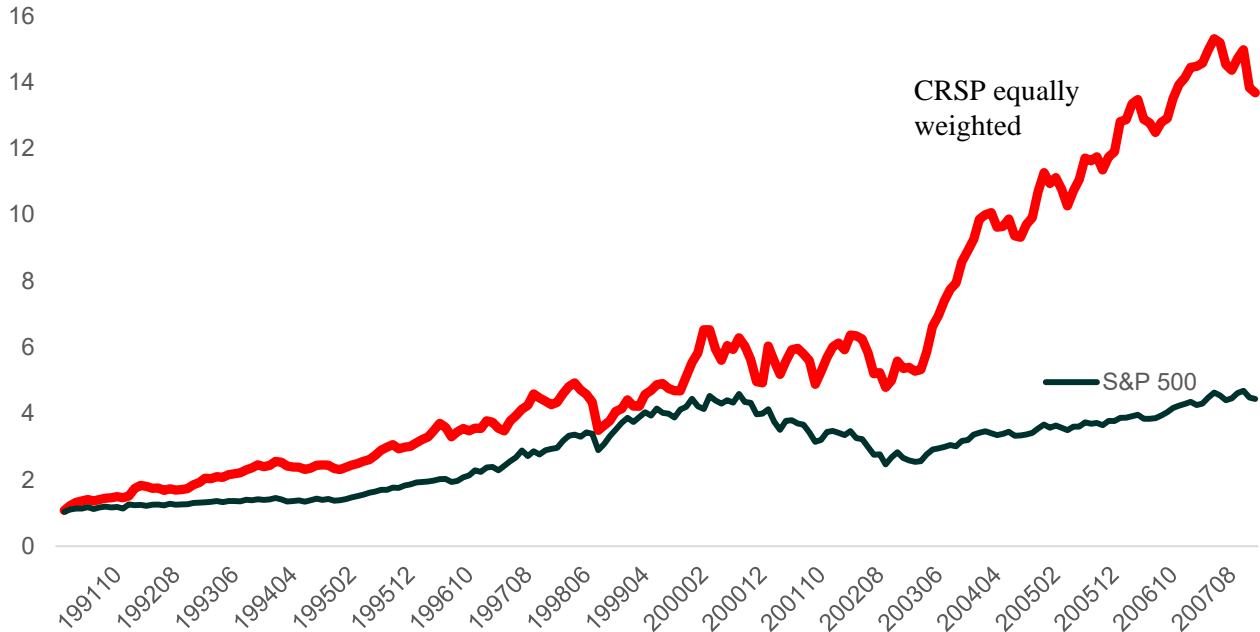
# Empirical evidence

- Forget about war stories, no one earned 30% in PE, or even 20%, these figures popping up frequently in presentations and marketing material are all IRRs and not true rates of returns

# Proper measurement

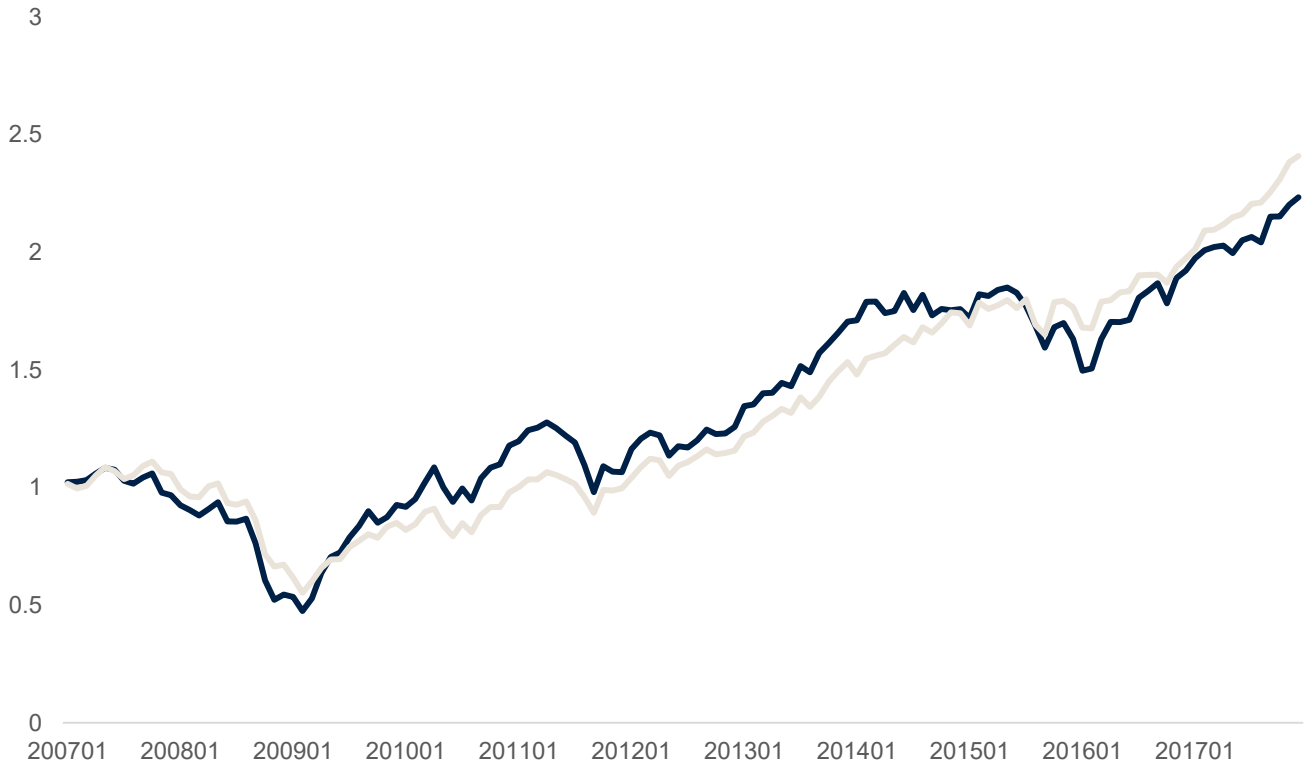
- Shows that PE returned about 10-12% p.a. over the last two decades
  
- Decade 1: 1998-2007
  - US large stocks do poorly, S&P 500, Russell indices etc. have low returns, PE outperform them by 3% p.a.
  - The average stock returns as much as PE
  
- Decade 2: 2008-2017
  - US large, mid-cap, small, value, growth stocks perform similarly, PE performs the same
  - Emerging market stocks do poorly though, PE outperforms global indices (e.g. MSCI world)

# The S&P 500 index versus the average US stock, 1991-2007, Annualized spread in performance: 3%



LBO funds outperform S&P 500 by 3% p.a.

# And then, these two indices from 2007 to 2017



LBO funds performance equal to that of S&P 500

# How about expected returns

- Gross of fees PE returned 18% p.a., twice as much as S&P 500 returns
- If returns are lower going forward and PE still earns twice what public equity earned, then
  - Fees are such that it will be more difficult for PE to outperform public equity returns
  - E.g. 10% gross of fees would generate a 5% net of fees



# Conclusion

- Past returns are alright
- They do not seem to be anything to write home about though
- Fees are high and fee structure is such that outperformance is less likely in a low return environment
- Private markets are the future, public markets are probably doomed, hence
  - ➔ need a new model
  - ➔ transparency and honesty can only help the many great professionals working in PE, but will probably hurt not so good ones

# Shall we care about fees that were paid?

- Typical answer: If you liked the soup, no need to know the recipe
  
- I object because:
  - Just mentioned that knowing fee structure gives insight in future returns because fees are certain, performance is not
  
  - Fairness/Ethical issue?

# Analysis of the Penn Public PFs

- Together gave \$40 billion to PE funds
- Received \$50 billion back, and non-exited investments are worth \$12 billion
- Same return as CalPERS and average PE fund, about 11% p.a.
- Estimated fees paid for this (net-of-fees) return: **\$12 billion**
- Note: PE is an expensive investment strategy, this is not the profit made by fund managers (but about half of it is the performance-related fee they personally received)

Testimony of Dr. Ludovic Phalippou, Professor of Finance  
Saïd Business School, University of Oxford

“Private Equity & the Pennsylvania Public Pension Funds”

Hearing of the Public Pension Management & Asset Investment Review Commission

September 20, 2018

Thank you for having me. I will talk about the costs and benefits of investing in Private Equity funds. Private Equity funds are investment vehicles. The two PA pension funds invested 40 billion in them over the last 25 years. They received 62 billion back, that is, a rate of return of about 11% p.a., and they paid an *estimated* fee of 12 billion.

Fees have not always been fully reported to pension funds. This may *partly* explain why no pension fund has reported the actual fee it has paid. And this is why 12 billion is an *estimate*. And this is why despite this estimate being probably on the low side, 12 billion is much higher than the *officially* reported amount. For instance, over the last ten years, total fees *reported* for Private Equity by the PA pension funds sum up to \$2.2 billion, while I *estimate* the actual amount to be \$6 billion. Again, this is an estimate. It is based on extensive academic research I have conducted in the past, but I had access to only very limited data on the PA pension funds. People at the treasury have requested a number of documents to the PA pension funds that would have helped to compute a more accurate number, but these requests have all been denied.

This situation is common to *all* the pension funds in the world, it is not unique to the PA pension funds at all. And this point has been made by many other people as well. For instance, this excellent cartoon appeared in a magazine called Institutional Investors and illustrates that very point. However, some pension funds, most notably in the Netherlands, are now required to report the *actual* total fee they pay. Public pension funds in California and some other American states have also recently been required to report more of the fees they pay (but still not all of the fees).

Many people argue that the amount of fees paid is actually irrelevant, because Private Equity funds deliver high returns after all of the fees. I have been hearing this argument since I started researching this field -- 15 years ago!

To evaluate this argument, it might be useful to start with fundamental theory. A large body of research in Financial Economics has taught us that you should always get what you pay for. There are very few if any ‘good deals.’ Good deals are investments paying you more than the fair return.

The idea that an entire industry could offer a good deal for more than fifteen years puzzles any financial economist, who necessarily reason that: If Private Equity fund managers can generate high returns, why would they not keep the excess return to themselves? In other words: Why would fund managers not just increase their fees to the point where excess returns are gone? There's always a level of fees high enough to turn a great investment into a fair one. And even if fees do not move, there's always a level of capital flows that is large enough to push up prices to turn a great investment into a fair one.

The usual response to this theoretical argument is that Private Equity funds need to share excess returns with their investors to compensate for Private Equity investments illiquidity and higher risk. If an investor is more tolerant to the illiquidity and risk of Private Equity funds than the average investor out there then it should invest in Private Equity because it will earn these compensations while it does not care much about the associated drawbacks. Virtually all the Pension funds, Endowments and Sovereign Wealth funds I know of argue that they have a long horizon and as a result do not care about illiquidity and higher risk, and as a result, reason that they should invest significantly in Private Equity.

But if such a massive amount of capital does not care about compensation for illiquidity and risk, then it is *less* likely that these features would be rewarded with higher returns. An excess return can only be rewarded if enough people care about associated drawbacks.

There are two other important theoretical arguments that would make matters worse. First, there were basically no rules for presentation of Private Equity funds' track records, and there are still very few rules. As we know from extensive research on mutual funds, it is relatively easy to window dress past performance, to make it look better than it actually is. Research on investment consultants from prominent scholars such as Professor Jenkinson at Oxford, and some observations of fundraising prospectuses from Private Equity funds, indicates that it is a widespread phenomenon. If investors are influenced by window-dressed numbers, then there would be excessive capital flowing into Private Equity funds, which can push returns below fair value.

Second, it is a lot more interesting to invest in Private Equity than in any other asset class. Private Equity is a fascinating hands-on investment approach. It is highly rewarding to travel to visit actual investments and hear from very clever people who invest and run actual companies. Investing in bonds and stocks is very boring in comparison, especially if it is done via so-called passive strategies. As a result, at the margin, investors may over-allocate to Private Equity, which might also push expected returns down.

This said, Private Equity may offer important diversification benefits, especially when one considers the reduction in number of publicly listed stocks. In addition, if an investor is able to select above-average fund managers, then this investor can obtain excess returns of course. More generally, there are many different types of private equity funds and investments, each with different costs and benefits. It may also be worth pointing out that ESG initiatives, for example, are more impactful if executed via private equity. Hence, overall, I think that the case for investing in Private Equity can be made in theory, but it is not a simple case. The usual argument saying: I need high returns, therefore I invest in Private Equity because I will earn an illiquidity premium, lacks theoretical soundness.

How about empirical evidence of excess returns?

First, we need to avoid window-dressed figures. The industry is nearly always showing so-called Internal Rates of Returns (IRRs), which are presented as rates of returns. But IRRs are close to rates of returns only in some very specific cases. Therefore, we should ignore the recurrent claims that some investors or funds earn 30% p.a., or more, over long periods of time. These numbers are all IRRs.

For example, Yale Endowment is world famous for its investments in Private Equity funds and it is often said that it earned a spectacular 30% p.a. in Private Equity. Its latest annual report shows that its investments in LBO funds (which is the largest type of Private Equity funds) returned 9% p.a. over the last ten years and 13% p.a. over the last twenty years. While it is clear that *some* LBO fund managers became spectacularly rich over the last twenty years, it is less clear that investors have had an equally spectacular fortune across their entire portfolio, at least as far as LBO funds are concerned.

How much did investors earn overall by investing in LBO funds? The landmark study on this issue is that of Bob Harris, Tim Jenkinson and Steve Kaplan, published in the Journal of Finance. Data are as of 2008 and they find that US LBO funds outperform by 3% p.a.

First note that this is the most accurate estimate we have as of 2008 and it is likely to be slightly optimistic because investors who gave the data consented to the data being shared for research, these investors might be more advanced than the average investor in PE, data are backfilled, it is a US-only sample, but hopefully, these biases are negligible. Either way, this is the best data academics have access to.

Second, note that some costs are not included: due diligence, legal advice, currency management, illiquidity and credit line management, higher investment risk, higher governance risk due to the lack of control on underlying investments and on the ultimate fees and expenses charged by fund managers, etc. All of these are costs for the pension funds that are not included. But, maybe they are all negligible.

Third, note that back in 2005-2008, most investment presentations, be it for gold or for PE was using the S&P 500 index as a benchmark. Coincidentally perhaps, the S&P 500 was one of the worst performing stock indices back then. It was not the only one: Russell 3000 and 2000 indices also had poor returns and were also popular benchmarks.

Interestingly, the average stock in the US outperformed the S&P 500 index. It did so by 3% p.a. That is, the average stock in the US had the same return as the average Private Equity fund, and both did better than the S&P 500 index.

Let's now move to more recent history. Over the last 10 years, using the same comprehensive dataset as that used by Harris, Jenkinson and Kaplan, I find that Private Equity funds have had basically the same returns as the S&P 500 index. Similar results have been derived using other data sources by other people (e.g. Pitchbook, CEM). One interpretation of the finding that Private Equity has returned as much as listed equity is that too much capital has gone into Private Equity over that time period and that returns have compressed as a result. It is possible.

There is another possible explanation though: from 2008 to 2017 the return on the S&P 500 index has been EXACTLY equal to the return of the average listed stock. Hence, over the last ten years, just like over the ten years before that, Private Equity matched the returns of the average listed stock.

As an aside, over the last four years, the S&P 500 index has disappeared from many investment presentations and the MSCI world index has appeared instead. Coincidentally perhaps, the MSCI world index is one of the worse performing indices over the last 10 years, mainly due to underperformance of emerging markets. Hence, beware of strategically chosen benchmarks.

But let's accept that Private Equity funds returned 18% p.a. gross of fees, charged an estimated 6% p.a., to return 12% p.a. and that public equity returned 9% p.a. Let's also assume that Private Equity will continue to deliver twice as much as public equity before fees going forward. I guess it is not controversial to assume that expected returns are currently lower than past returns for any asset class. If public equity would deliver 5% p.a. and Private Equity funds therefore deliver 10% gross

of fees, then after fees this 10% becomes 5% net (simply applying the average fee structure that has been agreed to).

To sum up, even if Private Equity will deliver twice as much as public equity before fees, in a low-return environment, given existing fee structures, investors might earn as much with Private Equity as they would with listed equity after fees.

The bigger point is: the enduring belief of great past performance -- mostly based on a misleading return metric -- means that a lot, and perhaps too much, capital has gone into Private Equity AND any serious conversation about reducing fee levels and having better interest alignment has not occurred. Perhaps as a consequence, many large asset owners have aggressively pursued various alternative strategies to access private market investments, which basically consist of reducing the reliance on traditional Private Equity funds.

To conclude on the empirical evidence: Past performance has not been bad, overall, but it has not been this large outperformance many people invoke when justifying Private Equity investments. Yet private markets have an important role to play in asset owner portfolios, not least because of the decaying role played by public equity. But, if people base their investment decision on false information and statistics they will not obtain what they are hoping for out of private markets. This is why transparency and honesty are paramount.

As mentioned earlier, many people actually argue that if we like the soup, we do not need to know the recipe. Fees are therefore irrelevant, performance net of fees is all that matters. I disagree. First, because future performance is uncertain but most of the fees are certain, knowing how fees are computed better informs us about expected net of fees returns, which what we ultimately care about. More accurate expectations should lead to more balanced negotiations and better outcomes.

Second, we may care about fairness. In this case, we would like to know how much was paid in total to Private Equity funds, to compare it to what they have delivered. In the case of the PA pension funds it is, at least, \$12 billion that was retained by Private Equity funds to deliver 11% p.a. Some will find this fair, some not, but there cannot be a debate and an endorsement without knowing the actual figure.

It is my belief and opinion that we ought to care about how much fees are paid, and about how good past performance has really been. There ought to be a transparent and honest conversation.



Active mutual fund managers for years argued that no one should look into their fees and potential for conflicts of interest because investors should only look at the net of fees returns. An active mutual fund today who would use this argument would be shown the door anywhere, and very quickly. For the health of private markets, of the many great Private Equity fund managers out there, and the many pension funds who want to do the best they can for the pensioners, I believe that we ought to apply the same standards of transparency and performance reporting to private market managers as we do to public market managers.

# The Growth of Passive

## What is happening, and why?

**Craig J. Lazzara, CFA**  
**Aye M. Soe, CFA**

September 20, 2018

**S&P Dow Jones**  
**Indices**

A Division of **S&P Global**

**“Active investing has been subjected to increasing abuse, particularly by those whose opinions are driven by the persistent accumulation of hard data and logical arguments.”**

– Charles D. Ellis, “In Defense of Active Investing,”  
*Financial Analysts Journal*, 2015

# One of the most significant developments in modern financial history...

- The first institutional index fund launched in 1971.
- First S&P 500 mutual fund tracker launched (barely) in 1976.
- The first ETF (also tracking the S&P 500) launched in 1993.
- Passive assets were negligible for many years.
- Today – 20+ percent of U.S. equity capitalization is held in passive portfolios.

# The Rise of Passive

- Evidence
- Explanations
- Controversy

# Evidence

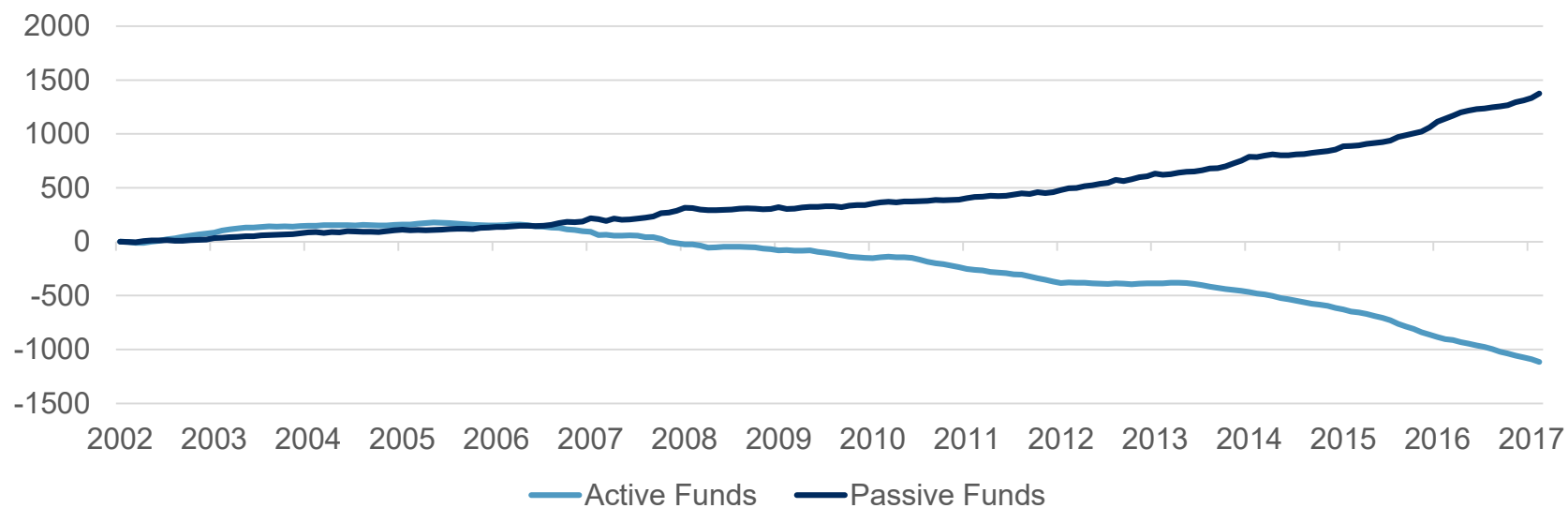
# Some Early Observations

“Contrary to their oft articulated goal of outperforming the market averages, investment managers are not beating the market: The market is beating them.” – Charles D. Ellis, “The Loser’s Game, *Financial Analysts Journal*, 1975

“A respect for evidence compels me to incline toward the hypothesis that most portfolio decision makers should go out of business – take up plumbing, teach Greek, or help produce the annual GNP by serving as corporate executives.” – Paul A. Samuelson, “Challenge to judgment,” *Journal of Portfolio Management*, 1974

# Divergence in Asset Flows....

## US Equity Net Fund flows (\$bn)

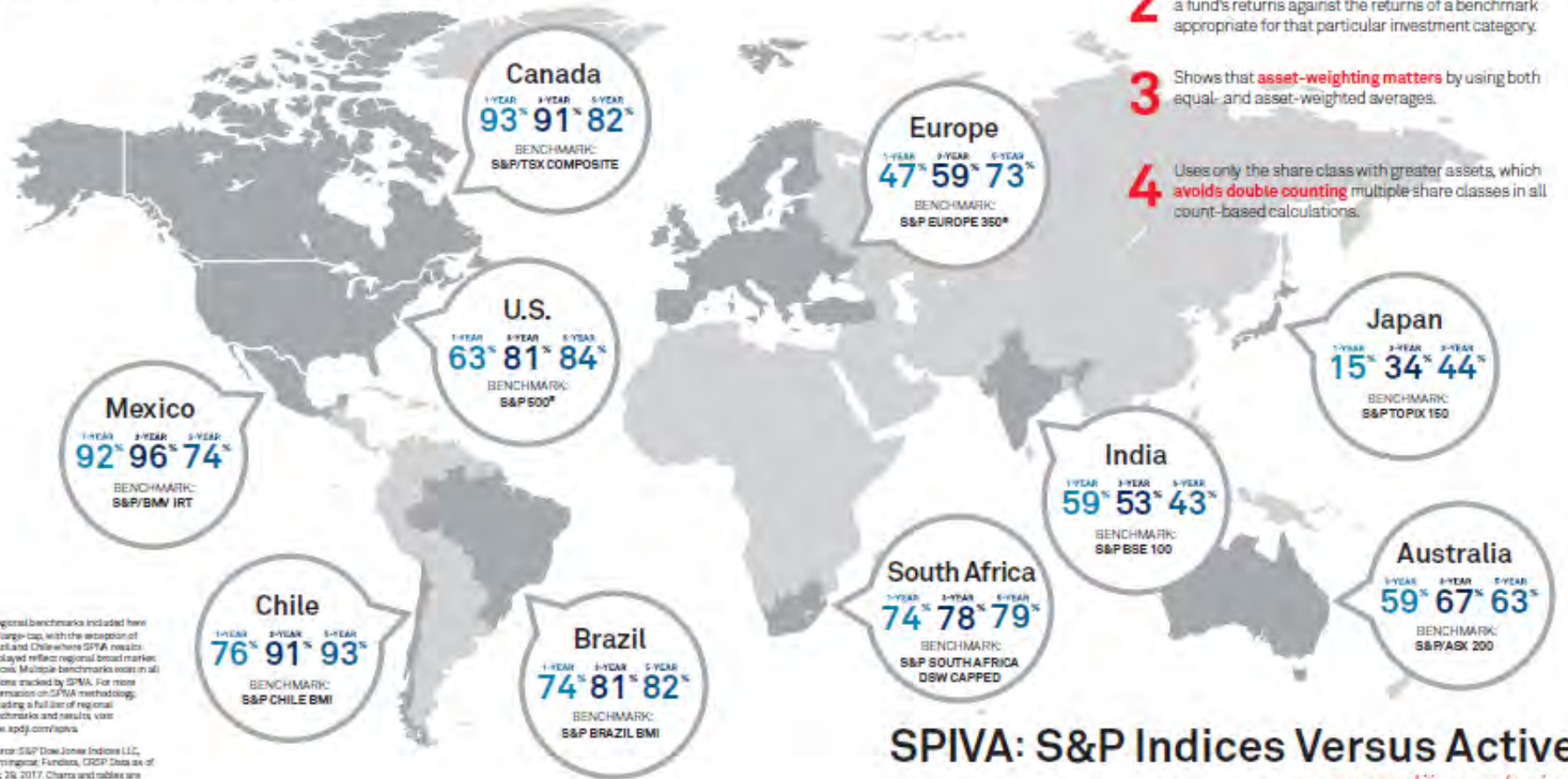


Category	Active			Passive		
	Estimated Net Flows Jan 2018 (\$M)	1 Year (\$M)	Assets Jan 2018 (\$B)	Estimated Net Flows Jan 2018 (\$M)	1 Year (\$M)	Assets Jan 2018 (\$B)
U.S. Equity	(24,028)	(211,217)	4,479	41,126	233,238	3,855
Sector Equity	87	(16,706)	438	7,930	45,778	512
International Equity	14,998	49,485	2,135	27,178	214,195	1,339
Allocation	(2,753)	(25,966)	1,329	1,128	4,789	70
Taxable Bond	25,413	194,333	2,633	22,608	210,626	1,109
Municipal Bond	7,824	32,600	670	388	5,191	291
Alternative	2,662	4,550	177	2,699	6,853	57
Commodities	1,240	2,516	311	1,023	2,760	696
All Long Term	25,442	29,595	12,172	104,079	723,432	7,928



# SPIVA® Around the World

Percentage of active funds outperformed by benchmarks\* over 1-, 3-, and 5-year periods



\*Regional benchmarks included here are large-cap, with the exception of Brazil and Chile where SPIVA results displayed reflect regional broad market indices. Multiple benchmarks exist in all regions tracked by SPIVA. For more information on SPIVA methodology including a full list of regional benchmarks and results, visit [www.spdji.com/spiva](http://www.spdji.com/spiva).

Source: S&P Dow Jones Indices LLC, Morningstar Funds, CIBC Data as of Dec 31, 2017. Charts and tables are provided for illustrative purposes. Past performance is no guarantee of future results.

## The SPIVA Difference

- 1 Accounts for the entire opportunity set—not just the survivors—thereby **eliminating survivorship bias**.
- 2 Applies an **apples-to-apples comparison** by measuring a fund's returns against the returns of a benchmark appropriate for that particular investment category.
- 3 Shows that **asset-weighting matters** by using both equal- and asset-weighted averages.
- 4 Uses only the share class with greater assets, which **avoids double counting** multiple share classes in all count-based calculations.

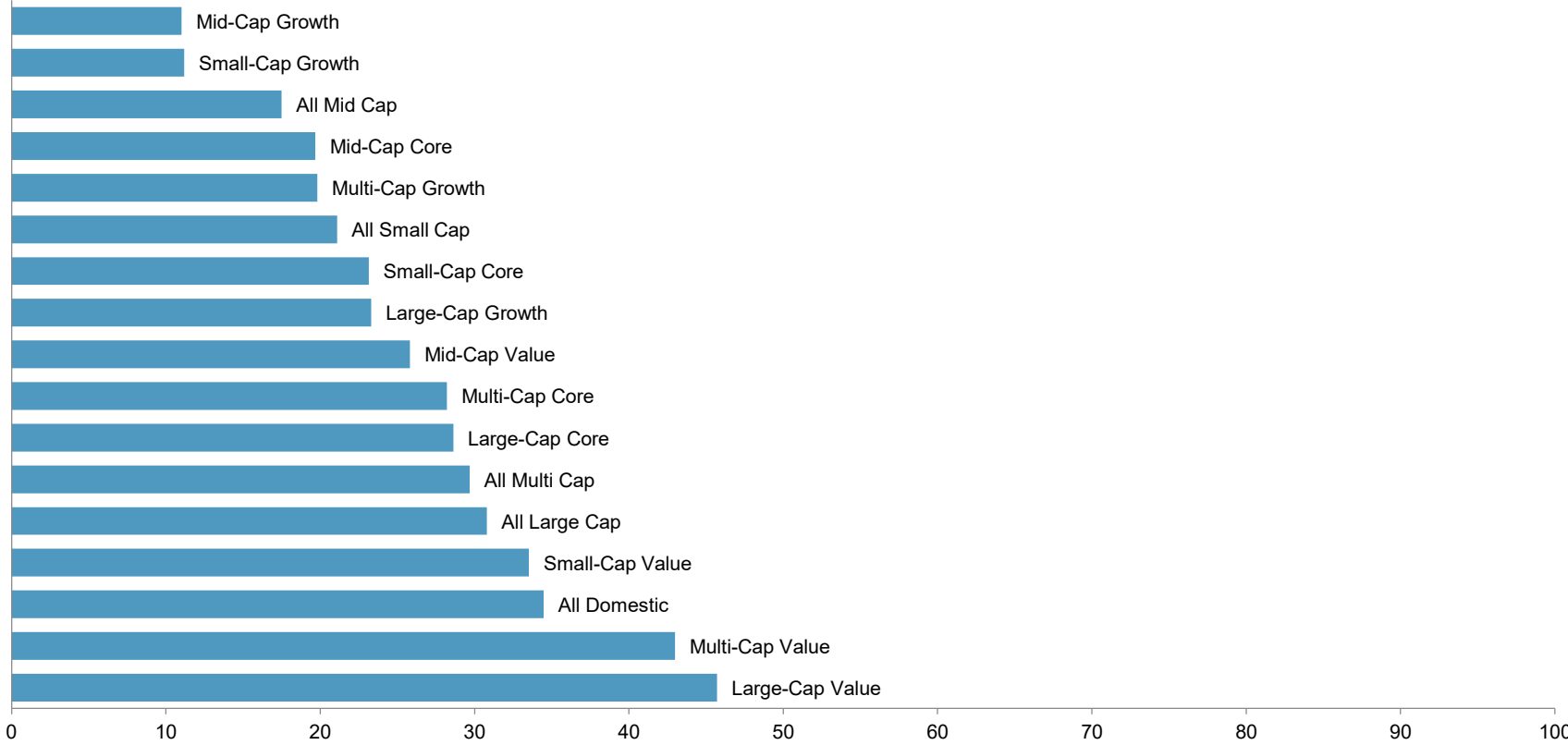
SPIVA: S&P Indices Versus Active

[www.spdji.com/spiva](http://www.spdji.com/spiva)

S&P Dow Jones Indices

A Division of S&P Global

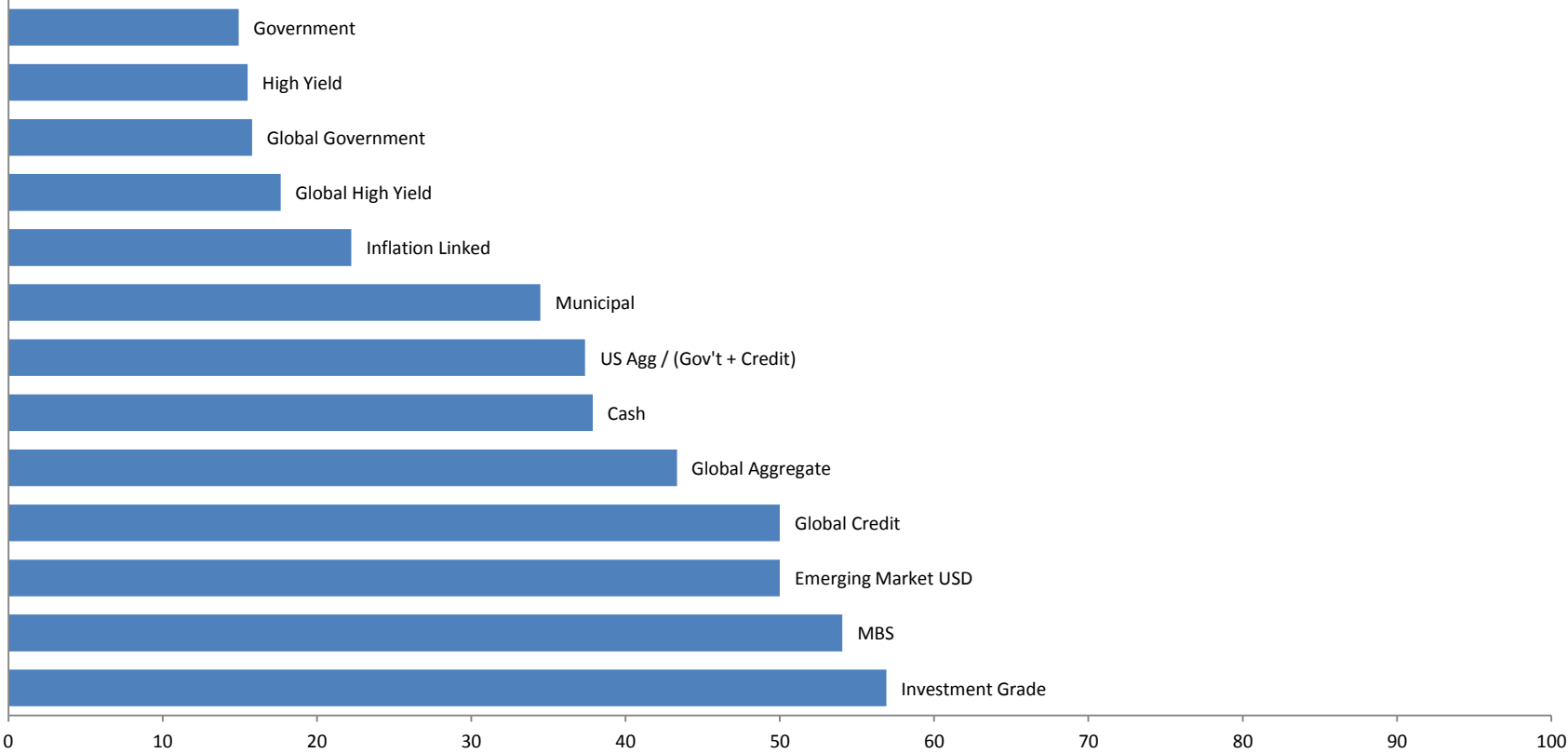
# Most Institutional Equity Managers Underperform



Percentage outperforming over 10 years, gross of fees

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Past performance is no guarantee of future results. Chart is provided for illustrative purposes only.

# Most Institutional Bond Managers Underperform



Percentage outperforming over 10 years, gross of fees

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Past performance is no guarantee of future results. Chart is provided for illustrative purposes only.

# Successful Equity Performance Does Not Persist

## US Equity Funds in Three Consecutive Years

Fund Category	% Repeating in Top Quartile
All Domestic Equity	2.33%
Large Cap	0.93%
Mid Cap	0.00%
Small Cap	3.85%
Persistence if Random	6.25%

Source: S&P Dow Jones Indices LLC, CRSP. Data as of March 31, 2018. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

# Successful Bond Performance Does Not Persist

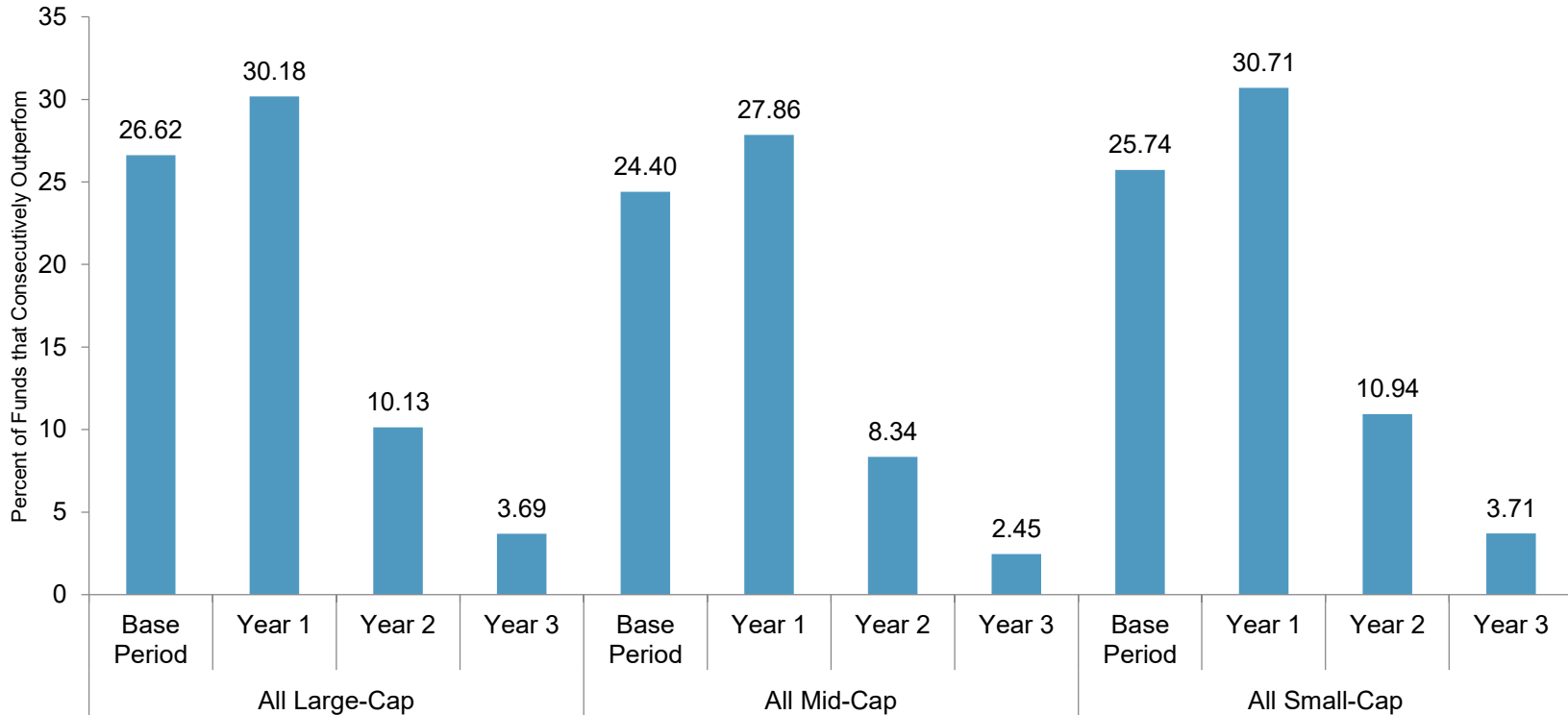
## US Fixed Income Funds in Three Consecutive Years

Fund Category	% Repeating in Top Quartile
Government - Long	7.14%
Investment Grade - Long	4.35%
Investment Grade - Intermediate	2.04%
High Yield	1.96%
Persistence if Random	6.25%

Source: S&P Dow Jones Indices LLC, CRSP. Data as of March 31, 2018. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

# Outperformance is Fleeting

**Average Rolling Quarterly Outperformance Persistence from 2000 to 2017**



“Base Period” represents the percentage of funds that outperformed the benchmark over the past three years (the “winners”). Year 1, Year 2, and Year 3 then show what percentage of the “winners” outperformed in the following years. To calculate what percentage of the original group of funds outperformed across all time periods, multiply the results. For example,  $26.62\% \times 10.13\% = 2.69\%$  of large-cap funds outperformed in the base period AND year 1 AND year 2.

Source: S&P Dow Jones Indices LLC, CRSP. Data as of Sep. 30, 2017. Past performance is no guarantee of future results. Chart is provided for illustrative purposes only.

# Fees Contribute to Underperformance – Equity

## Percentage of Managers Underperforming Over 10 Years

Fund Category	Institutional Accounts (Net of Fees)	Institutional Accounts (Gross of Fees)
All Domestic Equity	76.31%	65.52%
Large Cap	79.58%	69.20%
Mid Cap	92.02%	82.51%
Small Cap	90.61%	78.91%

Source: S&P Dow Jones Indices LLC, CRSP. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

# Fees Contribute to Underperformance – Bonds

Percentage of Managers Underperforming Over 10 Years

Fund Category	Institutional Accounts (Net of Fees)	Institutional Accounts (Gross of Fees)
Investment Grade	48.28%	43.10%
U.S. Aggregate	69.53%	62.62%
High Yield	93.80%	84.50%
Global Aggregate	73.33%	56.67%
Global High Yield	100.00%	82.35%

Source: S&P Dow Jones Indices LLC, CRSP. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.



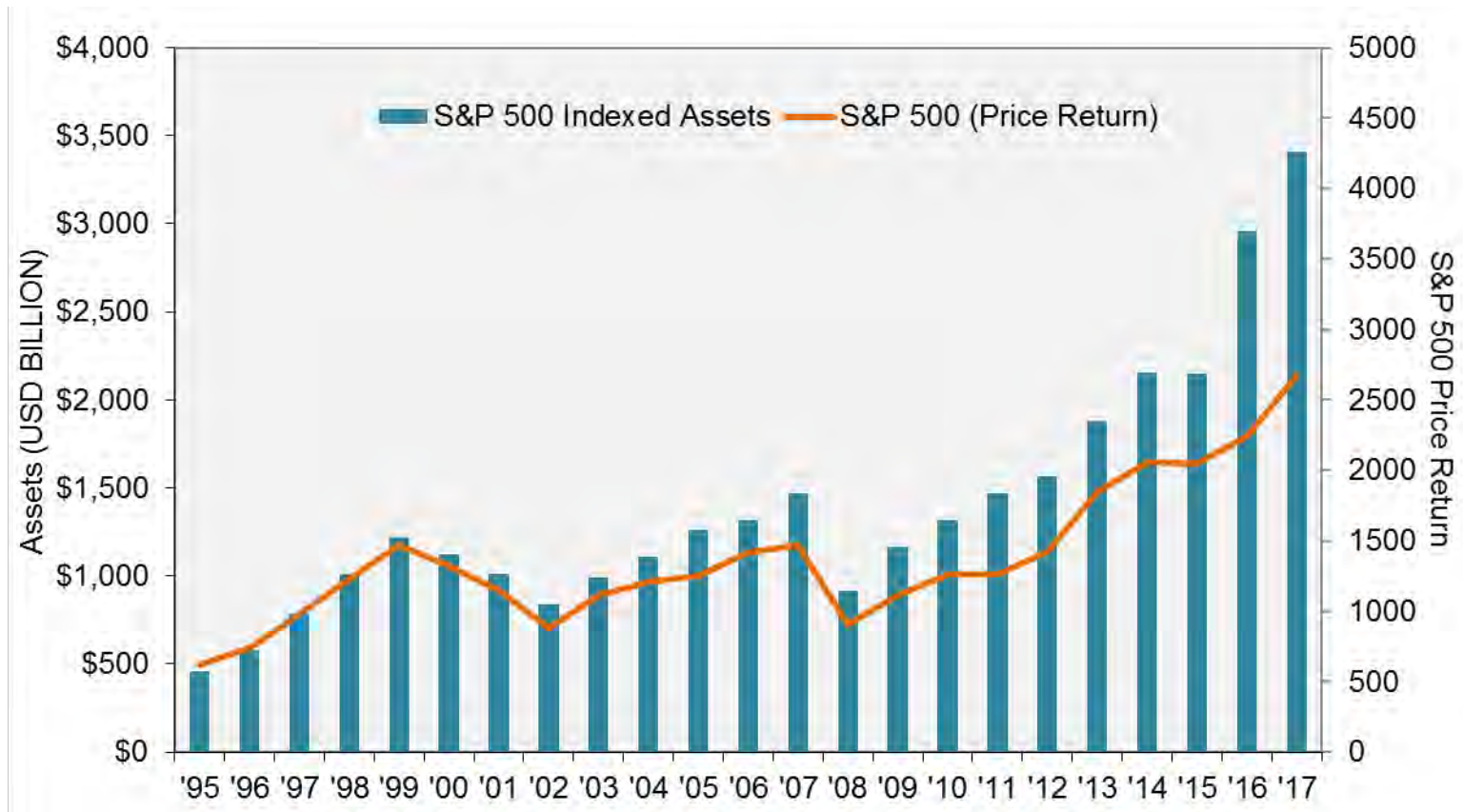
# Explanations

# Why Is Active Management So Difficult?

- Cost
- Professionalization and Market Efficiency
- Return Skewness
- Index Innovation

# Assets Tracking the S&P 500

Approximately USD 3.4 Trillion Track the S&P 500



Source: S&P Dow Jones Indices. Data as of Dec. 31, 2017. Charts are provided for illustrative purposes. Past performance is no guarantee of future results.

**S&P Dow Jones  
Indices**

A Division of S&P Global

# No Natural Source of Alpha

- Investor A can be above average only if Investor B is below average.
- The total outperformance of the winners must equal the total underperformance of the losers (before costs).
- The source of the winners' positive alpha is the losers' negative alpha.
- When funds shift from active to passive, the least skillful active managers lose the most assets.

# Might Active Management Become Even More Difficult?

	A	B
Total Market Cap	\$20.0 T	\$20.0 T
% actively managed	100%	90%
Value Actively Managed	\$20.0 T	\$18.0 T
Value Outperforming	\$10.0 T	\$9.0 T
Value Underperforming	\$10.0 T	\$9.0 T
Average Underperformance (%)	5%	4%
Total Underperformance (\$)	\$500 B	\$360 B

A hypothetical 10% reduction in active AUM led to a hypothetical 28% reduction in outperformance.

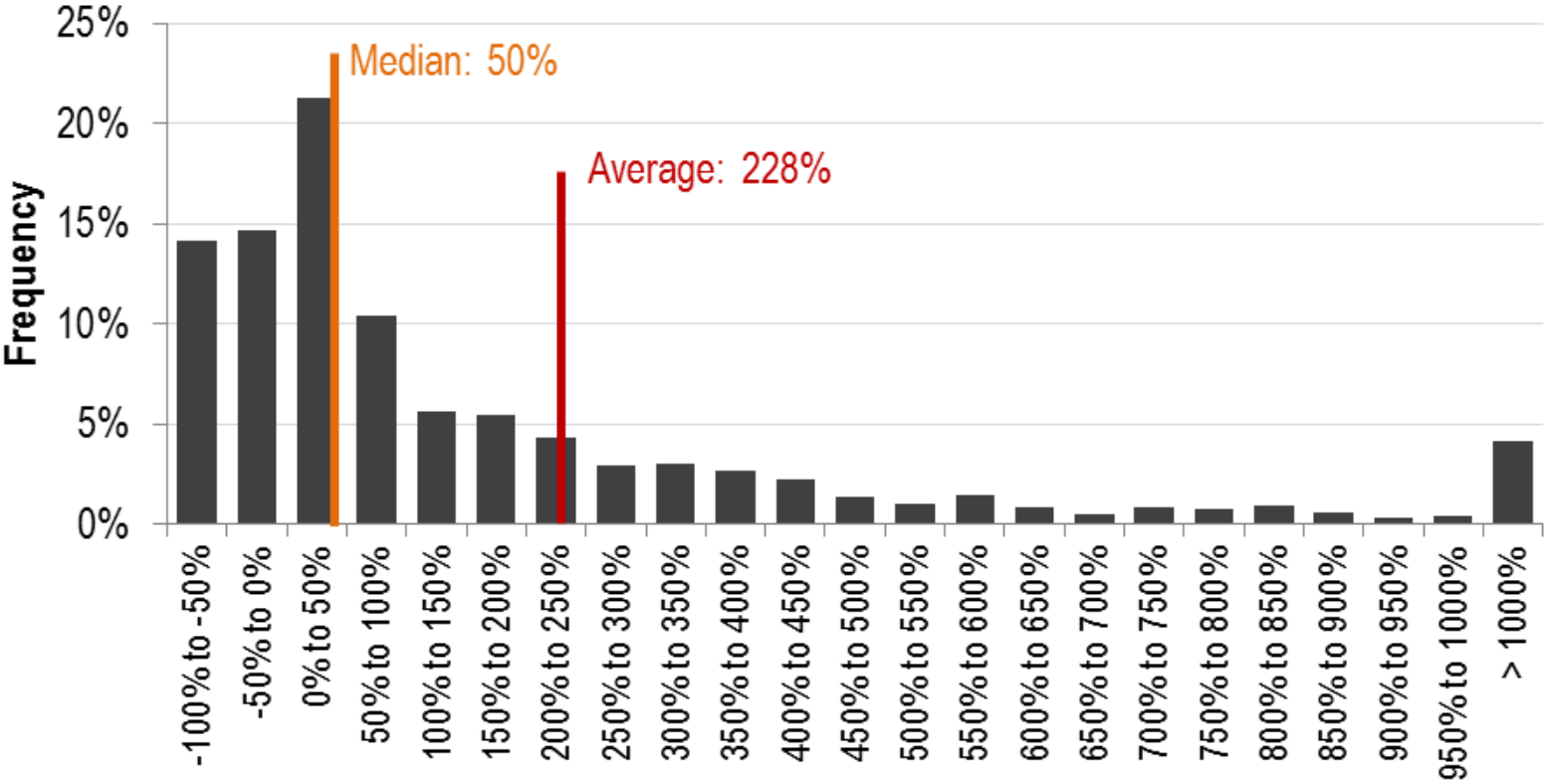
Source: S&P Dow Jones Indices. Chart is for illustrative purposes only and reflects hypothetical performance.

# Skewness

- Stock returns are not normally distributed.
  - A stock can go down only 100%,
  - But can appreciate by much more than that.
- Simple definition of positive skewness: average return > median return
- How often does average return exceed median return?
  - For S&P 500 (1991-2017): 23 of 27 years
  - In U.S. (1926-2016), 4% of stocks “explain the net gain for the entire U.S. stock market...as other stocks collectively matched Treasury bills.”

Source: S&P Dow Jones Indices; Bessembinder, Hendrik, “[Do Stocks Outperform Treasury Bills?](#),” November 2017. Past performance is no guarantee of future results.

# Historical Skewness for S&P 500



Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1997 through Dec. 31, 2017. Past performance is no guarantee of future results. Chart is provided for illustrative purposes.

# Consequences of Skewness

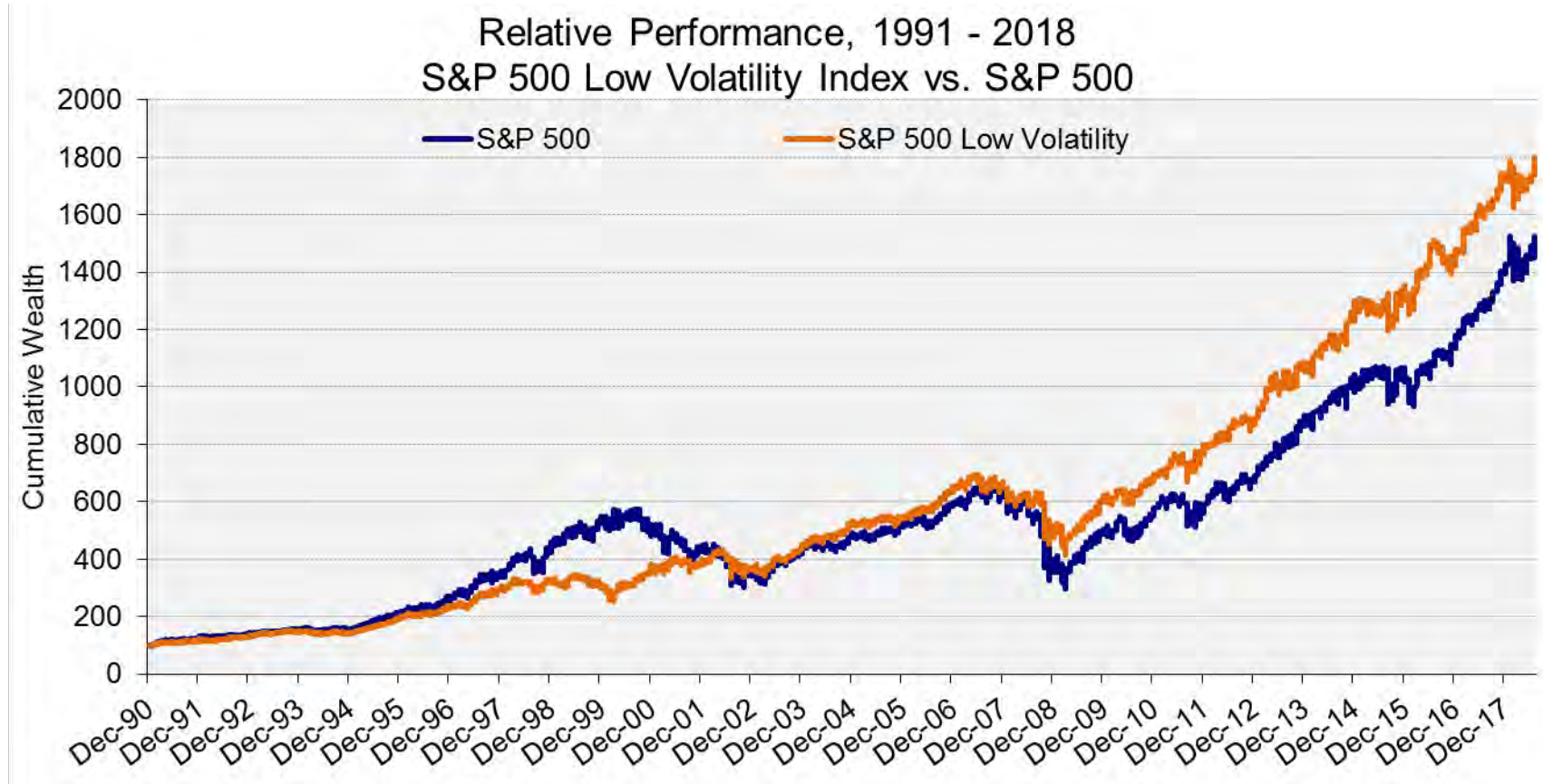
- Handicaps active managers
  - 50% of selections outperform the median return
  - Less than 50% outperform the average return
- Probability of outperformance rises when portfolios hold more stocks
- Suggests possible equilibrium between active and passive
  - If majority of active managers underperform by “a little,” then
  - A minority of active managers can outperform by “a lot”



# Index Evolution

Indices	Examples	Attributes
Broad Market	S&P 500 <sup>®</sup> , S&P Global BMI	<ul style="list-style-type: none"><li>• Capitalization-weighted</li><li>• Aim to represent an asset class</li></ul>
Specialized	S&P MidCap 400 <sup>®</sup> , S&P Select Sectors	<ul style="list-style-type: none"><li>• Focus on a subset of the broader market</li><li>• Typically capitalization-weighted</li></ul>
Factor/ Smart Beta/ Strategic Beta	S&P 500 Low Volatility, S&P 500 Equal Weight	<ul style="list-style-type: none"><li>• Focus on specific <i>patterns</i> or <i>characteristics</i></li><li>• Better “indicize” active strategies</li><li>• Typically <i>not</i> capitalization-weighted</li></ul>

# S&P 500 Low Volatility Index



Source: S&P Dow Jones Indices. Data from Dec. 31, 1990 through July 31, 2018. Charts are provided for illustrative purposes. Past performance is no guarantee of future results. This chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

S&P Dow Jones  
Indices

A Division of S&P Global

# Average Monthly Returns and Spreads

		Average Monthly Return			
	# of Mos	S&P 500 Low Volatility	S&P 500	Low Volatility minus S&P 500	Hit rate
Less than -2.45%	55	-2.81%	-5.61%	2.80%	87%
Between 0 and -2.45%	55	-0.63%	-1.42%	0.79%	76%
Between 0 and 2.47%	111	1.15%	1.26%	-0.11%	47%
Greater than 2.47%	110	3.27%	4.93%	-1.66%	18%

Source: S&P Dow Jones Indices. Data from Dec. 31, 1990 through July 31, 2018. Charts are provided for illustrative purposes. Past performance is no guarantee of future results. This chart may reflect hypothetical historical performance. Please see the Performance Disclosure at the end of this document for more information regarding the inherent limitations associated with back-tested performance.

# Controversy

# Active Managers' Challenges to Indexing

- Common Ownership
- Stewardship
- Bubbles
- Market Efficiency

# Common Ownership

Complaint: Ownership of a substantial fraction of most competitors in an industry leads to diminished competition and higher prices.

## Response

- Confuses correlation with causation.
- Econometric argument not universally accepted.
- Most frequently-cited study deals with airline tickets.
  - Airlines are 0.5% of the S&P 500.
  - Why increase revenue for 0.5% of a portfolio and raise expenses for the other 99.5%?

# Stewardship

Complaint: Index funds have no incentive to engage with corporate management on governance issues.

## Response

- Index funds are permanent capital. This gives them a greater incentive to engage with corporate management, not a lesser incentive.
- Index funds may be locked into their investments, but their clients are not.
- The three largest indexers have all enlarged their corporate engagement staff, and been quite vocal about governance issues.

# Bubbles

Complaint: Flows into index funds cause distortions in the pricing of index constituents; “too much” money going into index funds makes it hard for active managers to compete.

## Response

- Index flows do not cause distortions in relative valuation, since index buy programs depend on pre-existing constituent weights.
- There may be a momentum effect as underperforming managers are fired, but
  - It would still occur in the absence of indexing.
  - Indexing reduces this effect because index funds are more diversified than active portfolios.



# Market Efficiency

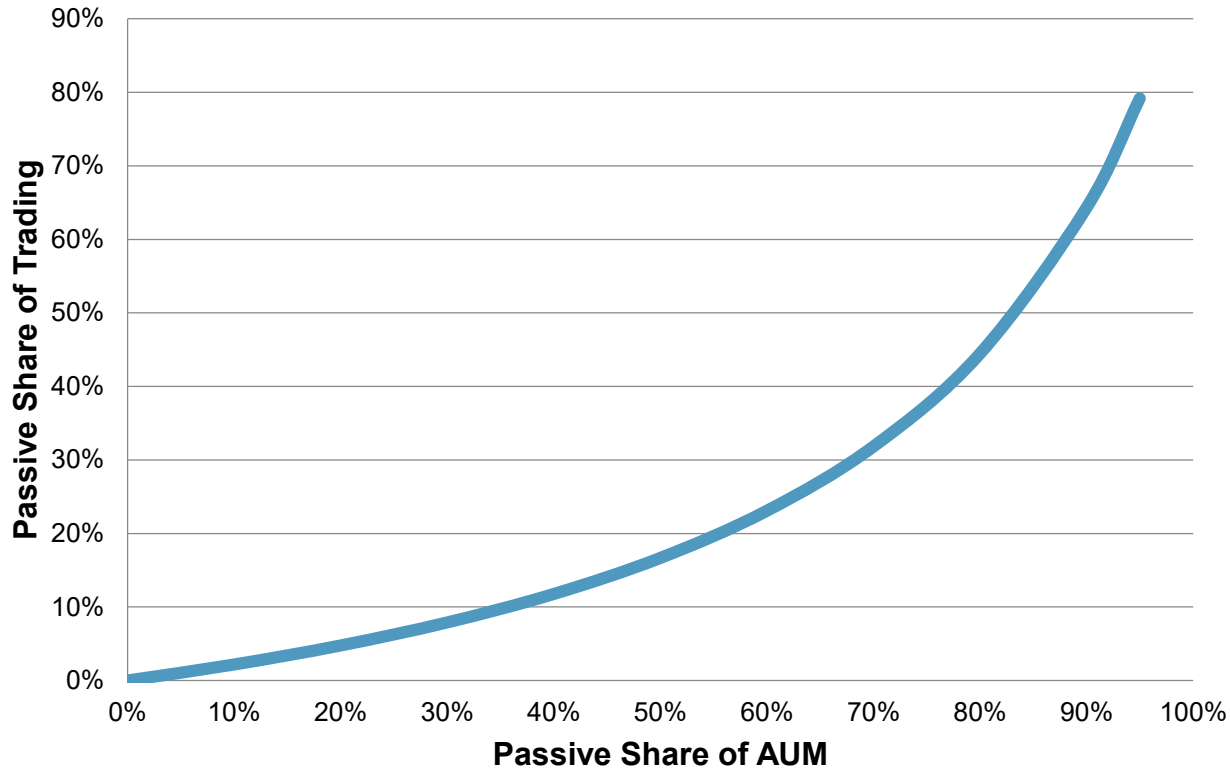
Complaint: Market efficiency depends on the work of active managers; index funds are “price takers,” and “too much” indexing could lead to a loss of capital market efficiency.

## Response

- Factor indices are not price takers.
- Index trading contributes to price discovery at a macro level; the most heavily traded stock in the U.S. is an S&P 500 tracker.
- The growth of passive management raises the quality of the surviving active managers.
- Market efficiency depends on trading, not AUM per se; most individual stock trading is done by active managers.

# Trading Consequences of Index Growth

## Passive Share: Trading vs. AUM



Source: S&P Dow Jones Indices. Assumes active turnover = 50% per year, passive turnover = 10% per year. Chart is provided for illustrative purposes.

# A Hypothetical Market

Stock	Return
A	10%
B	10%
C	10%
D	10%
E	50%
Average	18%
Median	10%

Source: Heaton, J.B., N.G. Polson, and J.H. Witte, "Why Indexing Works," October 2015, [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2673262](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2673262) and S&P Dow Jones Indices. Chart is for illustrative purposes only.

# Possible Portfolio Combinations

Number of Stocks	Number of Portfolios	Median Return	Average Return	Probability of Outperformance
1	5	10%	18%	20%
2	10	10%	18%	40%
3	10	23%	18%	60%
4	5	20%	18%	80%

- *Expected* return is the same regardless of portfolio size, but
- Holding more stocks increases the *likelihood* of outperformance.

Source: S&P Dow Jones Indices. Chart is for illustrative purposes only.

# How Might the Supply of Alpha Shift?

	B	C
Total Market Cap	\$20.0 T	\$20.0 T
% actively managed	90%	90%
Value Actively Managed	\$18.0 T	\$18.0 T
Value Outperforming	\$9.0 T	\$6.0 T
Value Underperforming	\$9.0 T	\$12.0 T
Losers' Underperformance (%)	4%	3%
Winners' Outperformance (%)	4%	6%
Total Underperformance (\$)	\$360 B	\$360 B

Distribution of outperformance and underperformance need not be symmetric.

Source: S&P Dow Jones Indices. Chart is for illustrative purposes only.

# Final Thoughts

- Most active managers fail most of the time.
- The rise of indexing has saved investors billions of dollars in management fees without requiring a sacrifice in investment performance.
- Passive alternatives (including “smart beta”) create a difficult challenge for active management performance.
- Indexing has considerable capacity to grow without damaging market efficiency.

# Performance Disclosure

The S&P 500 Low Volatility Index was launched April 4, 2011. All information presented prior to an index's Launch Date is hypothetical (back-tested), not actual performance. The back-test calculations are based on the same methodology that was in effect on the index Launch Date. However, when creating back-tested history for periods of market anomalies or other periods that do not reflect the general current market environment, index methodology rules may be relaxed to capture a large enough universe of securities to simulate the target market the index is designed to measure or strategy the index is designed to capture. For example, market capitalization and liquidity thresholds may be reduced. Complete index methodology details are available at [www.spdji.com](http://www.spdji.com). Past performance of the Index is not an indication of future results. Prospective application of the methodology used to construct the Index may not result in performance commensurate with the back-test returns shown.

S&P Dow Jones Indices defines various dates to assist our clients in providing transparency. The First Value Date is the first day for which there is a calculated value (either live or back-tested) for a given index. The Base Date is the date at which the Index is set at a fixed value for calculation purposes. The Launch Date designates the date upon which the values of an index are first considered live: index values provided for any date or time period prior to the index's Launch Date are considered back-tested. S&P Dow Jones Indices defines the Launch Date as the date by which the values of an index are known to have been released to the public, for example via the company's public website or its datafeed to external parties. For Dow Jones-branded indices introduced prior to May 31, 2013, the Launch Date (which prior to May 31, 2013, was termed "Date of introduction") is set at a date upon which no further changes were permitted to be made to the index methodology, but that may have been prior to the Index's public release date.

The back-test period does not necessarily correspond to the entire available history of the Index. Please refer to the methodology paper for the Index, available at [www.spdji.com](http://www.spdji.com) for more details about the index, including the manner in which it is rebalanced, the timing of such rebalancing, criteria for additions and deletions, as well as all index calculations.

Another limitation of using back-tested information is that the back-tested calculation is generally prepared with the benefit of hindsight. Back-tested information reflects the application of the index methodology and selection of index constituents in hindsight. No hypothetical record can completely account for the impact of financial risk in actual trading. For example, there are numerous factors related to the equities, fixed income, or commodities markets in general which cannot be, and have not been accounted for in the preparation of the index information set forth, all of which can affect actual performance.

The Index returns shown do not represent the results of actual trading of investable assets/securities. S&P Dow Jones Indices LLC maintains the Index and calculates the Index levels and performance shown or discussed, but does not manage actual assets. Index returns do not reflect payment of any sales charges or fees an investor may pay to purchase the securities underlying the Index or investment funds that are intended to track the performance of the Index. The imposition of these fees and charges would cause actual and back-tested performance of the securities/fund to be lower than the Index performance shown. As a simple example, if an index returned 10% on a US \$100,000 investment for a 12-month period (or US \$10,000) and an actual asset-based fee of 1.5% was imposed at the end of the period on the investment plus accrued interest (or US \$1,650), the net return would be 8.35% (or US \$8,350) for the year. Over a three year period, an annual 1.5% fee taken at year end with an assumed 10% return per year would result in a cumulative gross return of 33.10%, a total fee of US \$5,375, and a cumulative net return of 27.2% (or US \$27,200).

# General Disclaimer

Copyright © 2017 S&P Dow Jones Indices LLC, a division of S&P Global. All rights reserved. STANDARD & POOR'S, S&P, S&P 500, S&P 500 LOW VOLATILITY INDEX, S&P 100, S&P COMPOSITE 1500, S&P MIDCAP 400, S&P SMALLCAP 600, S&P GIVI, GLOBAL TITANS, DIVIDEND ARISTOCRATS, S&P TARGET DATE INDICES, GICS, SPIVA, SPDR and INDEXOLOGY are registered trademarks of Standard & Poor's Financial Services LLC, a division of S&P Global ("S&P"). DOW JONES, DJ, DJIA and DOW JONES INDUSTRIAL AVERAGE are registered trademarks of Dow Jones Trademark Holdings LLC ("Dow Jones"). These trademarks together with others have been licensed to S&P Dow Jones Indices LLC. Redistribution or reproduction in whole or in part are prohibited without written permission of S&P Dow Jones Indices LLC. This document does not constitute an offer of services in jurisdictions where S&P Dow Jones Indices LLC, S&P, Dow Jones or their respective affiliates (collectively "S&P Dow Jones Indices") do not have the necessary licenses. Except for certain custom index calculation services, all information provided by S&P Dow Jones Indices is impersonal and not tailored to the needs of any person, entity or group of persons. S&P Dow Jones Indices receives compensation in connection with licensing its indices to third parties and providing custom calculation services. Past performance of an index is not an indication or guarantee of future results.

It is not possible to invest directly in an index. Exposure to an asset class represented by an index may be available through investable instruments based on that index. S&P Dow Jones Indices does not sponsor, endorse, sell, promote or manage any investment fund or other investment vehicle that is offered by third parties and that seeks to provide an investment return based on the performance of any index. S&P Dow Jones Indices makes no assurance that investment products based on the index will accurately track index performance or provide positive investment returns. S&P Dow Jones Indices LLC is not an investment advisor, and S&P Dow Jones Indices makes no representation regarding the advisability of investing in any such investment fund or other investment vehicle. A decision to invest in any such investment fund or other investment vehicle should not be made in reliance on any of the statements set forth in this document. Prospective investors are advised to make an investment in any such fund or other vehicle only after carefully considering the risks associated with investing in such funds, as detailed in an offering memorandum or similar document that is prepared by or on behalf of the issuer of the investment fund or other investment product or vehicle. S&P Dow Jones Indices LLC is not a tax advisor. A tax advisor should be consulted to evaluate the impact of any tax-exempt securities on portfolios and the tax consequences of making any particular investment decision. Inclusion of a security within an index is not a recommendation by S&P Dow Jones Indices to buy, sell, or hold such security, nor is it considered to be investment advice. Closing prices for S&P Dow Jones Indices' US benchmark indices are calculated by S&P Dow Jones Indices based on the closing price of the individual constituents of the index as set by their primary exchange. Closing prices are received by S&P Dow Jones Indices from one of its third party vendors and verified by comparing them with prices from an alternative vendor. The vendors receive the closing price from the primary exchanges. Real-time intraday prices are calculated similarly without a second verification.

These materials have been prepared solely for informational purposes based upon information generally available to the public and from sources believed to be reliable. No content contained in these materials (including index data, ratings, credit-related analyses and data, research, valuations, model, software or other application or output therefrom) or any part thereof ("Content") may be modified, reverse-engineered, reproduced or distributed in any form or by any means, or stored in a database or retrieval system, without the prior written permission of S&P Dow Jones Indices. The Content shall not be used for any unlawful or unauthorized purposes. S&P Dow Jones Indices and its third-party data providers and licensors (collectively "S&P Dow Jones Indices Parties") do not guarantee the accuracy, completeness, timeliness or availability of the Content. S&P Dow Jones Indices Parties are not responsible for any errors or omissions, regardless of the cause, for the results obtained from the use of the Content. THE CONTENT IS PROVIDED ON AN "AS IS" BASIS. S&P DOW JONES INDICES PARTIES DISCLAIM ANY AND ALL EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE, FREEDOM FROM BUGS, SOFTWARE ERRORS OR DEFECTS, THAT THE CONTENT'S FUNCTIONING WILL BE UNINTERRUPTED OR THAT THE CONTENT WILL OPERATE WITH ANY SOFTWARE OR HARDWARE CONFIGURATION. In no event shall S&P Dow Jones Indices Parties be liable to any party for any direct, indirect, incidental, exemplary, compensatory, punitive, special or consequential damages, costs, expenses, legal fees, or losses (including, without limitation, lost income or lost profits and opportunity costs) in connection with any use of the Content even if advised of the possibility of such damages.

Any credit-related information and other related analyses and statements in the Content are statements of opinion as of the date they are expressed and not statements of fact. Any opinion, analyses and rating acknowledgement decisions are not recommendations to purchase, hold, or sell any securities or to make any investment decisions, and do not address the suitability of any security. S&P Dow Jones Indices does not assume any obligation to update the Content following publication in any form or format. The Content should not be relied on and is not a substitute for the skill, judgment and experience of the user, its management, employees, advisors and/or clients when making investment and other business decisions. S&P Dow Jones Indices LLC does not act as a fiduciary or an investment advisor. While S&P Dow Jones Indices has obtained information from sources they believe to be reliable, S&P Dow Jones Indices does not perform an audit or undertake any duty of due diligence or independent verification of any information it receives.

S&P Global keeps certain activities of its various divisions and business units separate from each other in order to preserve the independence and objectivity of their respective activities. As a result, certain divisions and business units of S&P Global may have information that is not available to other business units. S&P Global has established policies and procedures to maintain the confidentiality of certain non-public information received in connection with each analytical process.

In addition, S&P Dow Jones Indices provides a wide range of services to, or relating to, many organizations, including issuers of securities, investment advisers, broker-dealers, investment banks, other financial institutions and financial intermediaries, and accordingly may receive fees or other economic benefits from those organizations, including organizations whose securities or services they may recommend, rate, include in model portfolios, evaluate or otherwise address.



## Presentation Summary

### S&P Dow Jones Indices

#### Commonwealth of Pennsylvania Public Pension Management & Asset Investment Review Commission

The development of index funds and the rise of passive management must surely rank as one of the most significant developments in modern financial history. Within fewer than 50 years, between a quarter and a third of U.S. assets under management have shifted away from active managers to various forms of index funds. Our presentation discusses three topics:

- What evidence led investors to make this shift?
- What underlying factors produced that evidence?
- Are there disadvantages to the continued growth of indexing?

#### Evidence

The first comparison of active performance versus that of unmanaged indices dates back to 1932, and by the mid-1970s systematic performance measurement had become a standard feature of the investment landscape. S&P Dow Jones Indices produces two major sources of evidence in the active-passive debate:

- **SPIVA** (“Standard and Poor’s Index Versus Active”), a study now in its 18<sup>th</sup> year. This study compares actively-managed mutual funds to an appropriate passive benchmark. The consistent evidence of SPIVA is that most active managers underperform most of the time. For example, in calendar 2017, 63% of large-cap U.S. equity managers underperformed the S&P 500.
- The **Persistence Scorecard** uses the SPIVA database to ask whether managers who were successful (e.g., above average) in one year were also successful in subsequent years. Results vary from period to period, but in general are no better than random – i.e., an investor’s chance of picking a manager who will be above average two years in a row is about the same as his chance of flipping a coin and getting two heads in a row.

The SPIVA database focuses on mutual funds, net of fees, and critics sometimes argue that manager underperformance is entirely due to fee levels. It’s also fair to observe that institutional asset owners have substantial bargaining power, resulting in lower fees and potentially better performance outcomes than mutual fund investors realize. These objections are technically correct, but not decisive. Even ignoring fees, the majority of active managers still underperform. This is as true for institutional managers as it is for mutual funds.

The burden of SPIVA (and related studies) can be summarized easily:

- Most active managers fail most of the time.
- Historical manager success (whether measured against a peer group or a passive benchmark) is not predictive of future success.

## Explanations

These results demand an explanation. After all, active managers are smart people, well-educated and well-trained; they work hard, and they stand to reap tremendous financial rewards if they succeed. Why do so many of them fail? We suggest four reasons:

- **Cost.** Other things equal, index funds charge lower fees than active managers. (The difference in 2016 was approximately 70 basis points annually.) This is an obvious advantage for passive management.

It's interesting to quantify these cost savings. We estimate that approximately \$3.4 trillion is indexed to the S&P 500. A 70 bp fee differential implies total savings of \$23.8 billion annually. Of course, such savings would be chimerical if investors lost in incremental performance what they saved in lower fees. But, as SPIVA and related studies consistently document – they don't.

- **Professionalization** of investment management. There is no natural source of outperformance. Active management is a zero-sum game; one manager's outperformance is only possible because of another manager's underperformance. If a substantial majority of assets are managed by professionals, the likelihood is that at least half of them will underperform.

Professionalization is related to the notion of **market efficiency**. "Market efficiency" for this purpose denotes the notion that market prices are a fair estimate of an asset's true value. To the degree that this is true, active management is fruitless. Indeed, the growth of indexing – by eliminating the least capable active managers – has contributed to market efficiency.

- **Skewed returns.** Stock market returns are not symmetrically distributed – they are skewed to the right, meaning that in most periods the average return is driven by a small number of big winners (e.g. the so-called FANGs last year). Skewed returns mean that most stocks underperform the market average, which is an obvious handicap to managers hoping to add value by stock selection.
- **Innovation.** Indexing has evolved from first generation broad market indices like the S&P 500 to more specialized factor index strategies (often called "smart beta"). Factor indices enable an investor to access a pattern of returns that he formerly would have had to pay active fees to get. "Indicizing" active strategies thus provides an additional benefit to asset owners. Active managers can no longer appear to add value simply because of their factor tilts; rather they must be able to add value by stock selection over and above the benefit of their factor exposures. Factor exposure can now be obtained passively.

## Controversy

As implied above, the economics of indexing are daunting for the active management community. We estimate that the S&P 500 alone saves investors more than \$20 billion annually.

So it's not surprising that active managers have been creatively diligent in criticizing index funds. Their substantive criticisms include:

- Common ownership: Index funds own stakes in many of the competitors in most industries. Does this encourage or facilitate collusive behavior?
- Stewardship: Do index funds exercise proper diligence over the management of the companies in which they invest?
- Bubbles: Do flows into passive vehicles exacerbate, or even cause, market bubbles?
- Market efficiency: Passive investors are "price takers" who buy a stock because it's in an index, not because they think the stock is cheap. Does price taking impede market efficiency?

### Common Ownership

- The study most frequently cited by active managers alleges that the prices of U.S. airline tickets are higher than they would otherwise be because of common ownership. There is in no sense an academic consensus that this view is correct; it confuses causation and correlation. The critics' data on airline ticket prices span 2001-2014. Ticket prices may have risen, and the importance of index funds has certainly increased, but without a clearly identified causal mechanism, it's advisable to be cautious in attributing the first effect to the second.
- One company's revenue is another company's expense. Airlines accounted for 0.5% of the market capitalization of the S&P 500 as of year-end 2017. Even if index funds could cause airline executives to raise prices, why would they do so? Why increase the profits of 0.5% of your portfolio and raise the expenses of the other 99.5%?

### Stewardship

- Each of the big three indexers (BlackRock, Vanguard, State Street) has increased governance staffing and been publicly vocal about their stewardship efforts.
- Index funds will hold every stock in an index, regardless of their view of its fundamental merits. They don't have an option to sell a holding with whose management they're uncomfortable. Because they're essentially permanent capital, index investors have a greater incentive to engage with corporate managements, not a lesser incentive.

### Bubbles

- When new assets flow into an index fund, each index constituent is bought in proportion to its *pre-existing* index weight. Index buying (or selling) does not distort relative valuations.
- Critics sometimes argue that funds flowing into index funds exaggerate the importance of high-momentum stocks. This effect would occur if there were no index funds, since generally underperforming (low-momentum) active managers are replaced by outperforming (high-momentum) active managers. But if the effect exists, indexing reduces its magnitude, since index funds are more diversified than active portfolios.

### Market Efficiency

- Passive managers are indeed price-takers, but so are most economic actors most of the time (unless they live in a barter economy). N.B. This is not true of factor indices,

which buy and sell securities in response to the same variables that influence active managers.

- When index funds are offered in a market for the first time, where do the passive assets come from? If some active managers are more skillful than others, and their skill is manifested in outperformance, presumably the least skillful active managers lose the most assets. Indexing thus has the effect of culling the worst active managers. The ability level of the average active manager goes up. If the quality of active managers rises, market efficiency is enhanced.
- Active management's share of trading is far higher than its share of assets; it is trading that sets prices and drives market efficiency.
- The most frequently-traded security in the U.S. is an ETF tracking the S&P 500, and S&P 500 futures are among the world's most actively-traded derivative contracts. The active trading of these passive vehicles is itself an expression of investor sentiment and thus contributes directly to price discovery. Thanks to arbitrageurs, that discovery is then reflected in the index's component securities. Index vehicles therefore help to set prices at a macroeconomic level.

### Summary

The flow of assets from active to passive management shows no sign of slowing, for some of the reasons we've cited. We speculate that, at some future date, a rough "equilibrium" between passive and active might come about. We suspect that the shape of this equilibrium will require that the majority of surviving active managers underperform by a relatively small amount, thus enabling a minority of active managers to outperform by a relatively large amount.

In the meantime, our conclusions remain:

- Most active managers fail most of the time.
- The rise of indexing has saved asset owners billions of dollars in management fees, without requiring that they accept a concomitant reduction in investment performance.
- Passive alternatives, both first-generation and factor-based, have created a difficult and challenging environment for active managers.
- Indexing has the ability to grow considerably beyond its current size without damaging capital market efficiency.

## CONTRIBUTORS

**Aye M. Soe, CFA**  
Managing Director  
Global Research & Design  
[aye.soe@spglobal.com](mailto:aye.soe@spglobal.com)

**Berlinda Liu, CFA**  
Director  
Global Research & Design  
[berlinda.liu@spglobal.com](mailto:berlinda.liu@spglobal.com)

# Does Past Performance Matter? The Persistence Scorecard

## SUMMARY OF RESULTS

- When it comes to the active versus passive debate, one of the key measurements of successful active management lies in the ability of a manager or a strategy to deliver above-average returns consistently over multiple periods. Demonstrating the ability to outperform peers repeatedly is the one way to differentiate a manager's luck from skill.
- According to the S&P Persistence Scorecard, relatively few funds can consistently stay at the top. Out of 557 domestic equity funds that were in the top quartile as of March 2016, only 2.33% managed to stay in the top quartile at the end of March 2018. Furthermore, 0.93% of the large-cap funds, no mid-cap funds, and 3.85% of the small-cap funds remained in the top quartile.
- For the three-year period that ended in March 2018, persistence figures for funds in the top half were also unfavorable. Over three consecutive 12-month periods, 21.96% of large-cap funds, 7.59% of mid-cap funds, and 13.46% of small-cap funds maintained a top-half ranking.
- An inverse relationship generally exists between the measurement time horizon and the ability of top-performing funds to maintain their status. It is worth noting that only 0.45% of large-cap and no mid-cap or small-cap funds managed to remain in the top quartile at the end of the five-year measurement period. Furthermore, no mid-cap or small-cap funds were able to retain their status as of the end of the fourth 12-month period. This figure paints a negative picture regarding long-term persistence in mutual fund returns.
- Similarly, only 11.41% of large-cap funds, 1.2% of mid-cap funds, and 3.57% of small-cap funds maintained top-half performance over five consecutive 12-month periods. Random expectations would suggest a repeat rate of 6.25%.

- The transition matrices are designed to track the performance of top- and bottom-quintile performers over subsequent time periods. The data show a stronger likelihood for the best-performing funds to become the worst-performing funds than vice versa. Of 364 funds that were in the bottom quartile, 17.03% moved to the top quartile over the five-year horizon, while 25.82% of the 364 funds that were in the top quartile moved to the bottom quartile during the same period.
- Our research also suggests that there is consistency in the death rate of bottom-quartile funds. Across all market cap categories and all periods studied, fourth-quartile funds had a much higher rate of being merged or liquidated. The five-year transition matrix shows that 33.83% of large-cap funds, 33.96% of mid-cap funds, and 29.07% of small-cap funds in the fourth quartile disappeared.
- Compared with domestic equity funds, there was a higher level of performance persistence among the top-quartile fixed income funds over the three-year period ending March 2018. Government Intermediate, Global Income, and Emerging Markets funds were the only categories in which the results showed no performance persistence.
- Over the five-year measurement horizon, the results show a lack of persistence among nearly all the top-quartile fixed income categories, with a few exceptions. Funds investing in long-term government and investment-grade bonds, short-term investment-grade bonds, mortgage-backed securities, general municipal debt, and California municipal debt were the only groups in which a noticeable level of persistence was observed.

## **ABOUT THE PERSISTENCE SCORECARD**

The phrase “past performance is not an indicator of future outcomes” (or some variation thereof) can be found in the fine print of most mutual fund literature. Yet, due to either force of habit or conviction, investors and advisors consider past performance and related metrics to be important factors in fund selection. So does past performance really matter?

To answer this question on a continuous basis, the S&P Persistence Scorecard, released twice per year, tracks the consistency of top performers over yearly consecutive periods and measures performance persistence through transition matrices. As in our widely followed SPIVA<sup>®</sup> Scorecards, the University of Chicago’s Center for Research in Security Prices (CRSP) Survivorship Bias Free Mutual Fund Database serves as our underlying data source.

S&P Dow Jones Indices is one of the world’s leading index providers, maintaining a wide variety of investable and benchmark indices to meet an array of investor needs. Our Global Research & Design team is dedicated to conducting unbiased, in-depth analysis on a broad range of topics and issues facing investors in today’s marketplace. This scorecard highlights performance persistence over three- and five-year consecutive 12-month periods and two non-overlapping three- and five-year periods.

Key features of the S&P Persistence Scorecard include the following.

- **Historical rankings without survivorship bias:** For anyone making an investment decision, all funds available at the time of that decision are part of the initial opportunity set. Nevertheless, in their persistence calculations, analysts often limit their sample to funds that continue to exist over the complete time period examined, ranking only the survivors. If that happens, funds that liquidate or merge during a period of study are disregarded, biasing measurements of persistence. Using the University of Chicago's CRSP Survivorship Bias Free Mutual Fund Database, the S&P Persistence Scorecard ranks all funds available at each point in time and tracks the top-quartile and top-half performers throughout the time period. This approach accounts for all initially available funds.
- **Clean universe:** The mutual fund universe used in these reports comprises actively managed domestic U.S. equity funds. Index funds, sector funds, and index-based dynamic (bull or bear) funds are excluded from the sample. To avoid double counting multiple share classes, only the share class with the highest previous period return of each fund is used.
- **Transition matrices:** Transition matrices show the movements between quartiles and halves over two non-overlapping, three- and five-year periods. They also track the percentage of funds that have merged or liquidated. In addition, we monitor movements between capitalization levels. This helps us capture, for example, the conversion of some large-cap funds to mid- and small-cap funds.
- **Tracking reports of top performers:** The tracking reports show the percentages of funds that remain in the top-quartile or top-half rankings over consecutive three- and five-year periods.

**EXHIBITS**

<b>Exhibit 1: Performance Persistence of Domestic Equity Funds Over Three Consecutive 12-Month Periods</b>				
<b>MUTUAL FUND CATEGORY</b>	<b>FUND COUNT AT START (MARCH 2016)</b>	<b>PERCENTAGE REMAINING IN TOP QUARTILE</b>		
		<b>MARCH 2017</b>		<b>MARCH 2018</b>
<b>TOP QUARTILE</b>				
All Domestic Funds	557	8.08		2.33
All Large-Cap Funds	214	5.61		0.93
All Mid-Cap Funds	79	16.46		0
All Small-Cap Funds	130	16.92		3.85
All Multi-Cap Funds	134	17.16		2.24
<b>MUTUAL FUND CATEGORY</b>	<b>FUND COUNT AT START (MARCH 2016)</b>	<b>PERCENTAGE REMAINING IN TOP HALF</b>		
		<b>MARCH 2017</b>		<b>MARCH 2018</b>
<b>TOP HALF</b>				
All Domestic Funds	1114	34.56		16.25
All Large-Cap Funds	428	38.32		21.96
All Mid-Cap Funds	158	42.41		7.59
All Small-Cap Funds	260	49.62		13.46
All Multi-Cap Funds	268	42.54		20.9

Source: S&P Dow Jones Indices LLC, CRSP. Data as of March 31, 2018. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

<b>Exhibit 2: Performance Persistence of Domestic Equity Funds Over Five Consecutive 12-Month Periods</b>					
<b>MUTUAL FUND CATEGORY</b>	<b>FUND COUNT AT START (MARCH 2014)</b>	<b>PERCENTAGE REMAINING IN TOP QUARTILE</b>			
		<b>MARCH 2015</b>	<b>MARCH 2016</b>	<b>MARCH 2017</b>	<b>MARCH 2018</b>
<b>TOP QUARTILE</b>					
All Domestic Funds	571	30.47	7.88	0.18	0.18
All Large-Cap Funds	223	41.7	8.07	0.45	0.45
All Mid-Cap Funds	83	22.89	3.61	0	0
All Small-Cap Funds	126	29.37	0	0	0
All Multi-Cap Funds	139	28.78	3.6	0.72	0.72
<b>MUTUAL FUND CATEGORY</b>	<b>FUND COUNT AT START (MARCH 2014)</b>	<b>PERCENTAGE REMAINING IN TOP HALF</b>			
		<b>MARCH 2015</b>	<b>MARCH 2016</b>	<b>MARCH 2017</b>	<b>MARCH 2018</b>
<b>TOP HALF</b>					
All Domestic Funds	1144	54.28	28.32	9.62	7.52
All Large-Cap Funds	447	56.38	31.32	14.09	11.41
All Mid-Cap Funds	167	49.1	23.95	5.99	1.2
All Small-Cap Funds	252	52.38	18.65	9.52	3.57
All Multi-Cap Funds	278	52.16	23.74	12.59	8.63

Source: S&P Dow Jones Indices LLC, CRSP. Data as of March 31, 2018. Table is provided for illustrative purposes. Past performance is no guarantee of future results.



<b>Exhibit 3: Three-Year Transition Matrix – Performance Over Two Non-Overlapping Three-Year Periods (Based on Quartile)</b>							
<b>ALL DOMESTIC FUNDS</b>	<b>FUND COUNT AT START (MARCH 2015)</b>	<b>THREE-YEAR PERCENTAGES AT END</b>					
		<b>1ST QUARTILE (%)</b>	<b>2ND QUARTILE (%)</b>	<b>3TH QUARTILE (%)</b>	<b>4TH QUARTILE (%)</b>	<b>MERGED/LIQUIDATED (%)</b>	<b>STYLE CHANGED (%)</b>
1st Quartile	526	30.23	18.25	22.43	23.57	5.51	0
2nd Quartile	525	21.52	28.19	20.95	17.9	11.24	0.19
3rd Quartile	526	19.77	20.91	23	17.3	17.68	1.33
4th Quartile	525	13.52	17.71	18.67	26.29	21.14	2.67
<b>ALL LARGE-CAP FUNDS</b>							
1st Quartile	201	33.83	20.9	20.4	6.47	6.47	11.94
2nd Quartile	201	18.41	24.38	17.41	19.9	11.44	8.46
3rd Quartile	200	17	17	21	22	18	5
4th Quartile	201	7.96	14.43	18.41	28.36	20.9	9.95
<b>ALL MID-CAP FUNDS</b>							
1st Quartile	78	21.79	12.82	21.79	21.79	3.85	17.95
2nd Quartile	77	22.08	18.18	20.78	19.48	7.79	11.69
3rd Quartile	78	11.54	21.79	16.67	12.82	16.67	20.51
4th Quartile	77	12.99	16.88	9.09	14.29	23.38	23.38
<b>ALL SMALL-CAP FUNDS</b>							
1st Quartile	123	23.58	23.58	22.76	22.76	5.69	1.63
2nd Quartile	123	19.51	27.64	23.58	12.2	15.45	1.63
3rd Quartile	122	20.49	18.85	22.95	19.67	13.93	4.1
4th Quartile	123	20.33	13.82	14.63	29.27	18.7	3.25
<b>ALL MULTI-CAP FUNDS</b>							
1st Quartile	125	20.8	18.4	16	21.6	5.6	17.6
2nd Quartile	124	21.77	20.97	15.32	14.52	9.68	17.74
3rd Quartile	125	13.6	16	18.4	9.6	16.8	25.6
4th Quartile	124	8.06	9.68	14.52	18.55	25.81	23.39

Source: S&P Dow Jones Indices LLC, CRSP. Data as of March 31, 2018. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

<b>Exhibit 4: Three-Year Transition Matrix – Performance Over Two Non-Overlapping Three-Year Periods (Based on Halves)</b>					
<b>ALL DOMESTIC FUNDS</b>	<b>FUND COUNT AT START (MARCH 2015)</b>	<b>THREE-YEAR PERCENTAGES AT END</b>			
		<b>TOP HALF (%)</b>	<b>BOTTOM HALF (%)</b>	<b>MERGED/LIQUIDATED (%)</b>	<b>STYLE CHANGED (%)</b>
Top Half	1051	49.1	42.44	8.37	0.1
Bottom Half	1051	35.97	42.63	19.41	2
<b>ALL LARGE-CAP FUNDS</b>					
Top Half	402	48.76	32.09	8.96	10.2
Bottom Half	401	28.18	44.89	19.45	7.48
<b>ALL MID-CAP FUNDS</b>					
Top Half	155	37.42	41.94	5.81	14.84
Bottom Half	155	31.61	26.45	20	21.94
<b>ALL SMALL-CAP FUNDS</b>					
Top Half	246	47.15	40.65	10.57	1.63
Bottom Half	245	36.73	43.27	16.33	3.67
<b>ALL MULTI-CAP FUNDS</b>					
Top Half	249	40.96	33.73	7.63	17.67
Bottom Half	249	23.69	30.52	21.29	24.5

Source: S&P Dow Jones Indices LLC, CRSP. Data as of March 31, 2018. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

<b>Exhibit 5: Five-Year Transition Matrix – Performance Over Two Non-Overlapping Five-Year Periods (Based on Quartile)</b>								
<b>ALL DOMESTIC FUNDS</b>	<b>FUND COUNT AT START (MARCH 2013)</b>	<b>FIVE-YEAR PERCENTAGES AT END</b>						
		<b>1ST QUARTILE (%)</b>	<b>2ND QUARTILE (%)</b>	<b>3TH QUARTILE (%)</b>	<b>4TH QUARTILE (%)</b>	<b>MERGED/LIQUIDATED (%)</b>	<b>STYLE CHANGED (%)</b>	
1st Quartile	364	18.96	22.25	23.35	25.82	9.07	0.55	
2nd Quartile	364	24.18	19.51	22.53	19.23	14.29	0.27	
3rd Quartile	363	17.91	21.76	16.25	18.18	22.59	3.31	
4th Quartile	364	17.03	14.56	15.66	14.84	29.67	8.24	
<b>ALL LARGE-CAP FUNDS</b>								
1st Quartile	133	28.57	20.3	18.8	17.29	6.02	9.02	
2nd Quartile	133	15.04	18.8	16.54	18.8	18.05	12.78	
3rd Quartile	132	12.12	15.15	11.36	15.15	24.24	21.97	
4th Quartile	133	9.02	10.53	18.05	13.53	33.83	15.04	
<b>ALL MID-CAP FUNDS</b>								
1st Quartile	53	11.32	16.98	18.87	20.75	7.55	24.53	
2nd Quartile	53	18.87	13.21	20.75	15.09	15.09	16.98	
3rd Quartile	52	15.38	15.38	13.46	9.62	23.08	23.08	
4th Quartile	53	13.21	13.21	5.66	13.21	33.96	20.75	
<b>ALL SMALL-CAP FUNDS</b>								
1st Quartile	87	22.99	20.69	21.84	22.99	8.05	3.45	
2nd Quartile	86	23.26	23.26	15.12	22.09	15.12	1.16	
3rd Quartile	87	13.79	24.14	24.14	18.39	16.09	3.45	
4th Quartile	86	19.77	12.79	18.6	16.28	29.07	3.49	
<b>ALL MULTI-CAP FUNDS</b>								
1st Quartile	92	19.57	11.96	18.48	14.13	7.61	28.26	
2nd Quartile	92	15.22	19.57	16.3	11.96	14.13	22.83	
3rd Quartile	91	9.89	8.79	10.99	14.29	23.08	32.97	
4th Quartile	92	7.61	11.96	6.52	11.96	26.09	35.87	

Source: S&P Dow Jones Indices LLC, CRSP. Data as of March 31, 2018. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

<b>Exhibit 6: Five-Year Transition Matrix – Performance Over Two Non-Overlapping Five-Year Periods (Based on Halves)</b>					
<b>ALL DOMESTIC FUNDS</b>	<b>FUND COUNT AT START (MARCH 2013)</b>	<b>FIVE-YEAR PERCENTAGES AT END</b>			
		<b>TOP HALF (%)</b>	<b>BOTTOM HALF (%)</b>	<b>MERGED/LIQUIDATED (%)</b>	<b>STYLE CHANGED (%)</b>
Top Half	728	42.45	45.47	11.68	0.41
Bottom Half	727	35.63	32.46	26.13	5.78
<b>ALL LARGE-CAP FUNDS</b>					
Top Half	266	41.35	35.71	12.03	10.9
Bottom Half	265	23.4	29.06	29.06	18.49
<b>ALL MID-CAP FUNDS</b>					
Top Half	106	30.19	37.74	11.32	20.75
Bottom Half	105	28.57	20.95	28.57	21.9
<b>ALL SMALL-CAP FUNDS</b>					
Top Half	173	45.09	41.04	11.56	2.31
Bottom Half	173	35.26	38.73	22.54	3.47
<b>ALL MULTI-CAP FUNDS</b>					
Top Half	184	33.15	30.43	10.87	25.54
Bottom Half	183	19.13	21.86	24.59	34.43

Source: S&P Dow Jones Indices LLC, CRSP. Data as of March 31, 2018. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

<b>Exhibit 7: Performance Persistence of Domestic Fixed Income Funds Over Three Consecutive 12-Month Periods</b>			
<b>MUTUAL FUND CATEGORY</b>	<b>FUND COUNT AT START (MARCH 2016)</b>	<b>PERCENTAGE REMAINING IN TOP QUARTILE</b>	
		<b>MARCH 2017</b>	<b>MARCH 2018</b>
<b>TOP QUARTILE</b>			
Government Long Funds	14	21.43	7.14
Government Intermediate Funds	5	20	0
Government Short Funds	6	16.67	16.67
Investment-Grade Long Funds	23	8.7	4.35
Investment-Grade Intermediate Funds	49	2.04	2.04
Investment-Grade Short Funds	21	23.81	19.05
High Yield Funds	51	1.96	1.96
Mortgage-Backed Securities Funds	13	7.69	7.69
Global Income Funds	26	7.69	0
Emerging Markets Debt Funds	15	40	0
General Municipal Debt Funds	20	40	25
California Municipal Debt Funds	9	22.22	11.11
New York Municipal Debt Funds	7	28.57	14.29
<b>MUTUAL FUND CATEGORY</b>	<b>FUND COUNT AT START (MARCH 2016)</b>	<b>PERCENTAGE REMAINING IN TOP HALF</b>	
		<b>MARCH 2017</b>	<b>MARCH 2018</b>
<b>TOP HALF</b>			
Government Long Funds	29	44.83	31.03
Government Intermediate Funds	10	40	30
Government Short Funds	12	58.33	25
Investment-Grade Long Funds	45	35.56	22.22
Investment-Grade Intermediate Funds	97	27.84	20.62
Investment-Grade Short Funds	42	50	42.86
High Yield Funds	102	28.43	20.59
Mortgage-Backed Securities Funds	26	50	26.92
Global Income Funds	53	24.53	9.43
Emerging Markets Debt Funds	29	55.17	31.03
General Municipal Debt Funds	40	55	42.5
California Municipal Debt Funds	18	61.11	55.56
New York Municipal Debt Funds	14	28.57	21.43

Source: S&P Dow Jones Indices LLC, CRSP. Data as of March 31, 2018. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

<b>Exhibit 8: Performance Persistence of Domestic Fixed Income Funds Over Five Consecutive 12-Month Periods</b>						
<b>MUTUAL FUND CATEGORY</b>	<b>FUND COUNT AT START (MARCH 2014)</b>	<b>PERCENTAGE REMAINING IN TOP QUARTILE</b>				
		<b>MARCH 2015</b>	<b>MARCH 2016</b>	<b>MARCH 2017</b>	<b>MARCH 2018</b>	
<b>TOP QUARTILE</b>						
Government Long Funds	15	6.67	6.67	6.67	6.67	
Government Intermediate Funds	6	0	0	0	0	
Government Short Funds	7	28.57	14.29	14.29	0	
Investment-Grade Long Funds	23	34.78	4.35	4.35	4.35	
Investment-Grade Intermediate Funds	52	26.92	1.92	0	0	
Investment-Grade Short Funds	15	53.33	20	6.67	6.67	
High Yield Funds	47	17.02	4.26	0	0	
Mortgage-Backed Securities Funds	14	35.71	7.14	7.14	7.14	
Global Income Funds	26	26.92	3.85	0	0	
Emerging Markets Debt Funds	9	44.44	11.11	0	0	
General Municipal Debt Funds	19	15.79	5.26	5.26	5.26	
California Municipal Debt Funds	9	33.33	22.22	11.11	11.11	
New York Municipal Debt Funds	7	0	0	0	0	
<b>MUTUAL FUND CATEGORY</b>	<b>FUND COUNT AT START (MARCH 2014)</b>	<b>PERCENTAGE REMAINING IN TOP HALF</b>				
		<b>MARCH 2015</b>	<b>MARCH 2016</b>	<b>MARCH 2017</b>	<b>MARCH 2018</b>	
<b>TOP HALF</b>						
Government Long Funds	29	44.83	24.14	13.79	10.34	
Government Intermediate Funds	11	36.36	27.27	18.18	9.09	
Government Short Funds	15	46.67	33.33	26.67	6.67	
Investment-Grade Long Funds	46	52.17	15.22	8.7	8.7	
Investment-Grade Intermediate Funds	103	39.81	16.5	10.68	9.71	
Investment-Grade Short Funds	31	61.29	41.94	29.03	25.81	
High Yield Funds	95	40	22.11	14.74	11.58	
Mortgage-Backed Securities Funds	28	60.71	35.71	32.14	25	
Global Income Funds	51	43.14	7.84	3.92	0	
Emerging Markets Debt Funds	19	63.16	47.37	15.79	0	
General Municipal Debt Funds	38	47.37	28.95	18.42	18.42	
California Municipal Debt Funds	18	50	38.89	27.78	27.78	
New York Municipal Debt Funds	14	42.86	35.71	28.57	28.57	

Source: S&P Dow Jones Indices LLC, CRSP. Data as of March 31, 2018. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

<b>Exhibit 9: Three-Year Transition Matrix – Performance Over Two Non-Overlapping Three-Year Periods (Based on Quartile)</b>							
<b>GOVERNMENT LONG FUNDS</b>	<b>FUND COUNT AT START (MARCH 2015)</b>	<b>THREE-YEAR PERCENTAGES AT END</b>					
		<b>1ST QUARTILE (%)</b>	<b>2ND QUARTILE (%)</b>	<b>3TH QUARTILE (%)</b>	<b>4TH QUARTILE (%)</b>	<b>MERGED/LIQUIDATED (%)</b>	<b>STYLE CHANGED (%)</b>
1st Quartile	14	28.57	7.14	35.71	21.43	7.14	0
2nd Quartile	14	14.29	42.86	28.57	14.29	0	0
3rd Quartile	13	23.08	30.77	15.38	30.77	0	0
4th Quartile	14	21.43	14.29	7.14	21.43	35.71	0
<b>GOVERNMENT INTERMEDIATE FUNDS</b>							
1st Quartile	6	50	0	16.67	0	33.33	0
2nd Quartile	6	16.67	50	0	0	33.33	0
3rd Quartile	5	0	20	20	40	20	0
4th Quartile	6	0	16.67	33.33	33.33	16.67	0
<b>GOVERNMENT SHORT FUNDS</b>							
1st Quartile	6	33.33	66.67	0	0	0	0
2nd Quartile	7	42.86	28.57	28.57	0	0	0
3rd Quartile	6	0	0	50	16.67	33.33	0
4th Quartile	6	0	0	0	66.67	16.67	16.67
<b>INVESTMENT-GRADE LONG FUNDS</b>							
1st Quartile	22	36.36	22.73	18.18	4.55	4.55	13.64
2nd Quartile	21	23.81	33.33	19.05	9.52	4.76	9.52
3rd Quartile	22	18.18	22.73	31.82	18.18	4.55	4.55
4th Quartile	21	4.76	4.76	9.52	52.38	19.05	9.52
<b>INVESTMENT-GRADE INTERMEDIATE FUNDS</b>							
1st Quartile	43	41.86	23.26	13.95	9.3	9.3	2.33
2nd Quartile	43	25.58	27.91	18.6	20.93	6.98	0
3rd Quartile	42	11.9	23.81	28.57	21.43	11.9	2.38
4th Quartile	43	9.3	11.63	27.91	34.88	13.95	2.33
<b>INVESTMENT-GRADE SHORT FUNDS</b>							
1st Quartile	18	38.89	38.89	11.11	5.56	5.56	0
2nd Quartile	18	27.78	16.67	27.78	11.11	16.67	0
3rd Quartile	17	5.88	29.41	35.29	17.65	11.76	0
4th Quartile	18	11.11	5.56	11.11	50	22.22	0
<b>HIGH YIELD FUNDS</b>							
1st Quartile	43	37.21	27.91	20.93	4.65	6.98	2.33
2nd Quartile	43	18.6	34.88	20.93	23.26	2.33	0
3rd Quartile	42	19.05	16.67	23.81	23.81	16.67	0
4th Quartile	43	11.63	9.3	20.93	34.88	23.26	0

Source: S&P Dow Jones Indices LLC, CRSP. Data as of March 31, 2018. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

<b>Exhibit 9: Three-Year Transition Matrix – Performance Over Two Non-Overlapping Three-Year Periods (Based on Quartile) (cont.)</b>							
<b>MORTGAGE- BACKED SECURITIES FUNDS</b>	<b>FUND COUNT AT START (MARCH 2015)</b>	<b>THREE-YEAR PERCENTAGES AT END</b>					
		<b>1ST QUARTILE (%)</b>	<b>2ND QUARTILE (%)</b>	<b>3TH QUARTILE (%)</b>	<b>4TH QUARTILE (%)</b>	<b>MERGED/ LIQUIDATED (%)</b>	<b>STYLE CHANGED (%)</b>
1st Quartile	12	66.67	16.67	16.67	0	0	0
2nd Quartile	13	15.38	38.46	30.77	15.38	0	0
3rd Quartile	12	8.33	25	25	25	0	16.67
4th Quartile	12	0	16.67	16.67	50	8.33	8.33
<b>GLOBAL INCOME FUNDS</b>							
1st Quartile	21	4.76	23.81	28.57	28.57	9.52	4.76
2nd Quartile	20	25	25	15	30	5	0
3rd Quartile	21	28.57	19.05	19.05	23.81	9.52	0
4th Quartile	20	30	20	25	5	15	5
<b>EMERGING MARKETS DEBT FUNDS</b>							
1st Quartile	7	14.29	42.86	28.57	14.29	0	0
2nd Quartile	6	16.67	33.33	33.33	16.67	0	0
3rd Quartile	7	14.29	0	14.29	14.29	57.14	0
4th Quartile	6	50	0	16.67	33.33	0	0
<b>GENERAL MUNICIPAL DEBT FUNDS</b>							
1st Quartile	18	55.56	33.33	5.56	5.56	0	0
2nd Quartile	18	22.22	27.78	27.78	5.56	11.11	5.56
3rd Quartile	17	11.76	17.65	41.18	23.53	5.88	0
4th Quartile	18	0	11.11	16.67	55.56	5.56	11.11
<b>CALIFORNIA MUNICIPAL DEBT FUNDS</b>							
1st Quartile	9	55.56	22.22	0	11.11	11.11	0
2nd Quartile	8	12.5	50	25	12.5	0	0
3rd Quartile	9	22.22	22.22	22.22	22.22	11.11	0
4th Quartile	8	0	0	37.5	50	0	12.5
<b>NEW YORK MUNICIPAL DEBT FUNDS</b>							
1st Quartile	7	42.86	28.57	14.29	0	0	14.29
2nd Quartile	6	16.67	33.33	33.33	16.67	0	0
3rd Quartile	7	28.57	14.29	28.57	14.29	14.29	0
4th Quartile	6	0	16.67	16.67	66.67	0	0

Source: S&P Dow Jones Indices LLC, CRSP. Data as of March 31, 2018. Table is provided for illustrative purposes. Past performance is no guarantee of future results.



<b>Exhibit 10: Three-Year Transition Matrix – Performance Over Two Non-Overlapping Three-Year Periods (Based on Halves)</b>					
<b>GOVERNMENT LONG FUNDS</b>	<b>FUND COUNT AT START (MARCH 2015)</b>	<b>THREE-YEAR PERCENTAGES AT END</b>			
		<b>TOP HALF (%)</b>	<b>BOTTOM HALF (%)</b>	<b>MERGED/LIQUIDATED (%)</b>	<b>STYLE CHANGED (%)</b>
Top Half	28	46.43	50	3.57	0
Bottom Half	27	44.44	37.04	18.52	0
<b>GOVERNMENT INTERMEDIATE FUNDS</b>					
Top Half	12	58.33	8.33	33.33	0
Bottom Half	11	18.18	63.64	18.18	0
<b>GOVERNMENT SHORT FUNDS</b>					
Top Half	13	84.62	15.38	0	0
Bottom Half	12	0	66.67	25	8.33
<b>INVESTMENT-GRADE LONG FUNDS</b>					
Top Half	43	58.14	25.58	4.65	11.63
Bottom Half	43	25.58	55.81	11.63	6.98
<b>Investment-Grade Intermediate Funds</b>					
Top Half	86	59.3	31.4	8.14	1.16
Bottom Half	85	28.24	56.47	12.94	2.35
<b>INVESTMENT-GRADE SHORT FUNDS</b>					
Top Half	36	61.11	27.78	11.11	0
Bottom Half	35	25.71	57.14	17.14	0
<b>HIGH YIELD FUNDS</b>					
Top Half	86	59.3	34.88	4.65	1.16
Bottom Half	85	28.24	51.76	20	0
<b>MORTGAGE-BACKED SECURITIES FUNDS</b>					
Top Half	25	68	32	0	0
Bottom Half	24	25	58.33	4.17	12.5
<b>GLOBAL INCOME FUNDS</b>					
Top Half	41	39.02	51.22	7.32	2.44
Bottom Half	41	48.78	36.59	12.2	2.44
<b>EMERGING MARKETS DEBT FUNDS</b>					
Top Half	13	53.85	46.15	0	0
Bottom Half	13	30.77	38.46	30.77	0
<b>GENERAL MUNICIPAL DEBT FUNDS</b>					
Top Half	36	69.44	22.22	5.56	2.78
Bottom Half	35	20	68.57	5.71	5.71
<b>CALIFORNIA MUNICIPAL DEBT FUNDS</b>					
Top Half	17	70.59	23.53	5.88	0
Bottom Half	17	23.53	64.71	5.88	5.88
<b>NEW YORK MUNICIPAL DEBT FUNDS</b>					
Top Half	13	61.54	30.77	0	7.69
Bottom Half	13	30.77	61.54	7.69	0

Source: S&P Dow Jones Indices LLC, CRSP. Data as of March 31, 2018. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

<b>Exhibit 11: Five-Year Transition Matrix – Performance Over Two Non-Overlapping Five-Year Periods (Based on Quartile)</b>							
<b>GOVERNMENT LONG FUNDS</b>	<b>FUND COUNT AT START (MARCH 2013)</b>	<b>FIVE-YEAR PERCENTAGES AT END</b>					
		<b>1ST QUARTILE (%)</b>	<b>2ND QUARTILE (%)</b>	<b>3TH QUARTILE (%)</b>	<b>4TH QUARTILE (%)</b>	<b>MERGED/LIQUIDATED (%)</b>	<b>STYLE CHANGED (%)</b>
1st Quartile	9	55.56	11.11	11.11	11.11	11.11	0
2nd Quartile	9	11.11	22.22	11.11	11.11	33.33	11.11
3rd Quartile	8	0	50	25	25	0	0
4th Quartile	9	11.11	0	22.22	33.33	33.33	0
<b>GOVERNMENT INTERMEDIATE FUNDS</b>							
1st Quartile	6	33.33	16.67	0	0	33.33	16.67
2nd Quartile	6	16.67	33.33	16.67	16.67	16.67	0
3rd Quartile	5	20	20	0	20	40	0
4th Quartile	6	0	0	50	33.33	16.67	0
<b>GOVERNMENT SHORT FUNDS</b>							
1st Quartile	7	28.57	28.57	14.29	0	28.57	0
2nd Quartile	7	14.29	28.57	42.86	0	14.29	0
3rd Quartile	6	33.33	0	16.67	0	33.33	16.67
4th Quartile	7	0	0	0	57.14	28.57	14.29
<b>INVESTMENT-GRADE LONG FUNDS</b>							
1st Quartile	16	37.5	25	6.25	0	6.25	25
2nd Quartile	15	20	13.33	26.67	13.33	13.33	13.33
3rd Quartile	16	0	12.5	25	37.5	0	25
4th Quartile	15	13.33	13.33	13.33	13.33	20	26.67
<b>INVESTMENT-GRADE INTERMEDIATE FUNDS</b>							
1st Quartile	38	18.42	15.79	10.53	5.26	15.79	34.21
2nd Quartile	37	18.92	24.32	18.92	0	13.51	24.32
3rd Quartile	38	18.42	15.79	21.05	10.53	21.05	13.16
4th Quartile	37	5.41	2.7	10.81	43.24	24.32	13.51
<b>INVESTMENT-GRADE SHORT FUNDS</b>							
1st Quartile	13	30.77	38.46	7.69	7.69	15.38	0
2nd Quartile	14	21.43	35.71	35.71	7.14	0	0
3rd Quartile	13	7.69	7.69	38.46	30.77	15.38	0
4th Quartile	13	23.08	0	0	38.46	23.08	15.38
<b>HIGH YIELD FUNDS</b>							
1st Quartile	25	40	20	20	8	12	0
2nd Quartile	26	23.08	23.08	7.69	34.62	11.54	0
3rd Quartile	25	16	16	40	4	24	0
4th Quartile	25	4	24	12	36	20	4

Source: S&P Dow Jones Indices LLC, CRSP. Data as of March 31, 2018. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

<b>Exhibit 11: Five-Year Transition Matrix – Performance Over Two Non-Overlapping Five-Year Periods (Based on Quartile) (cont.)</b>								
<b>MORTGAGE-BACKED SECURITIES FUNDS</b>	<b>FUND COUNT AT START (MARCH 2013)</b>	<b>FIVE-YEAR PERCENTAGES AT END</b>						
		<b>1ST QUARTILE (%)</b>	<b>2ND QUARTILE (%)</b>	<b>3TH QUARTILE (%)</b>	<b>4TH QUARTILE (%)</b>	<b>MERGED/LIQUIDATED (%)</b>	<b>STYLE CHANGED (%)</b>	
1st Quartile	10	60	10	30	0	0	0	
2nd Quartile	10	0	40	10	30	20	0	
3rd Quartile	10	20	30	20	20	0	10	
4th Quartile	10	10	0	30	30	20	10	
<b>GLOBAL INCOME FUNDS</b>								
1st Quartile	10	60	10	0	10	20	0	
2nd Quartile	10	10	50	20	0	20	0	
3rd Quartile	9	0	0	33.33	22.22	33.33	11.11	
4th Quartile	10	0	10	10	40	40	0	
<b>EMERGING MARKETS DEBT FUNDS</b>								
1st Quartile	4	50	50	0	0	0	0	
2nd Quartile	4	0	25	50	25	0	0	
3rd Quartile	3	33.33	33.33	0	33.33	0	0	
4th Quartile	4	0	0	25	25	50	0	
<b>GENERAL MUNICIPAL DEBT FUNDS</b>								
1st Quartile	17	47.06	17.65	23.53	11.76	0	0	
2nd Quartile	16	12.5	43.75	12.5	12.5	12.5	6.25	
3rd Quartile	17	17.65	11.76	41.18	17.65	11.76	0	
4th Quartile	16	6.25	12.5	0	43.75	18.75	18.75	
<b>CALIFORNIA MUNICIPAL DEBT FUNDS</b>								
1st Quartile	9	44.44	22.22	11.11	11.11	0	11.11	
2nd Quartile	8	12.5	37.5	37.5	12.5	0	0	
3rd Quartile	9	11.11	33.33	11.11	33.33	11.11	0	
4th Quartile	8	25	0	25	37.5	12.5	0	
<b>NEW YORK MUNICIPAL DEBT FUNDS</b>								
1st Quartile	7	42.86	42.86	14.29	0	0	0	
2nd Quartile	6	33.33	0	33.33	16.67	0	16.67	
3rd Quartile	7	14.29	28.57	14.29	28.57	14.29	0	
4th Quartile	6	0	0	33.33	33.33	33.33	0	

Source: S&P Dow Jones Indices LLC, CRSP. Data as of March 31, 2018. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

<b>Exhibit 12: Five-Year Transition Matrix – Performance Over Two Non-Overlapping Five-Year Periods (Based on Halves)</b>					
<b>GOVERNMENT LONG FUNDS</b>	<b>FUND COUNT AT START (MARCH 2013)</b>	<b>FIVE-YEAR PERCENTAGES AT END</b>			
		<b>TOP HALF (%)</b>	<b>BOTTOM HALF (%)</b>	<b>MERGED/LIQUIDATED (%)</b>	<b>STYLE CHANGED (%)</b>
Top Half	18	50	22.22	22.22	5.56
Bottom Half	17	29.41	52.94	17.65	0
<b>GOVERNMENT INTERMEDIATE FUNDS</b>					
Top Half	12	50	16.67	25	8.33
Bottom Half	11	18.18	54.55	27.27	0
<b>GOVERNMENT SHORT FUNDS</b>					
Top Half	14	50	28.57	21.43	0
Bottom Half	13	15.38	38.46	30.77	15.38
<b>INVESTMENT-GRADE LONG FUNDS</b>					
Top Half	31	48.39	22.58	9.68	19.35
Bottom Half	31	19.35	45.16	9.68	25.81
<b>INVESTMENT-GRADE INTERMEDIATE FUNDS</b>					
Top Half	75	38.67	17.33	14.67	29.33
Bottom Half	75	21.33	42.67	22.67	13.33
<b>INVESTMENT-GRADE SHORT FUNDS</b>					
Top Half	27	62.96	29.63	7.41	0
Bottom Half	26	19.23	53.85	19.23	7.69
<b>HIGH YIELD FUNDS</b>					
Top Half	51	52.94	35.29	11.76	0
Bottom Half	50	30	46	22	2
<b>MORTGAGE-BACKED SECURITIES FUNDS</b>					
Top Half	20	55	35	10	0
Bottom Half	20	30	50	10	10
<b>GLOBAL INCOME FUNDS</b>					
Top Half	20	65	15	20	0
Bottom Half	19	5.26	52.63	36.84	5.26
<b>EMERGING MARKETS DEBT FUNDS</b>					
Top Half	8	62.5	37.5	0	0
Bottom Half	7	28.57	42.86	28.57	0
<b>GENERAL MUNICIPAL DEBT FUNDS</b>					
Top Half	33	60.61	30.3	6.06	3.03
Bottom Half	33	24.24	51.52	15.15	9.09
<b>CALIFORNIA MUNICIPAL DEBT FUNDS</b>					
Top Half	17	58.82	35.29	0	5.88
Bottom Half	17	35.29	52.94	11.76	0
<b>NEW YORK MUNICIPAL DEBT FUNDS</b>					
Top Half	13	61.54	30.77	0	7.69
Bottom Half	13	23.08	53.85	23.08	0

Source: S&P Dow Jones Indices LLC, CRSP. Data as of March 31, 2018. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

## GENERAL DISCLAIMER

Copyright © 2018 S&P Dow Jones Indices LLC. All rights reserved. Standard & Poor's®, S&P 500® and S&P® are registered trademarks of Standard & Poor's Financial Services LLC ("S&P"), a subsidiary of S&P Global. Dow Jones® is a registered trademark of Dow Jones Trademark Holdings LLC ("Dow Jones"). Trademarks have been licensed to S&P Dow Jones Indices LLC. Redistribution, reproduction and/or photocopying in whole or in part are prohibited without written permission. This document does not constitute an offer of services in jurisdictions where S&P Dow Jones Indices LLC, Dow Jones, S&P or their respective affiliates (collectively "S&P Dow Jones Indices") do not have the necessary licenses. All information provided by S&P Dow Jones Indices is impersonal and not tailored to the needs of any person, entity or group of persons. S&P Dow Jones Indices receives compensation in connection with licensing its indices to third parties. Past performance of an index is not a guarantee of future results.

It is not possible to invest directly in an index. Exposure to an asset class represented by an index is available through investable instruments based on that index. S&P Dow Jones Indices does not sponsor, endorse, sell, promote or manage any investment fund or other investment vehicle that is offered by third parties and that seeks to provide an investment return based on the performance of any index. S&P Dow Jones Indices makes no assurance that investment products based on the index will accurately track index performance or provide positive investment returns. S&P Dow Jones Indices LLC is not an investment advisor, and S&P Dow Jones Indices makes no representation regarding the advisability of investing in any such investment fund or other investment vehicle. A decision to invest in any such investment fund or other investment vehicle should not be made in reliance on any of the statements set forth in this document. Prospective investors are advised to make an investment in any such fund or other vehicle only after carefully considering the risks associated with investing in such funds, as detailed in an offering memorandum or similar document that is prepared by or on behalf of the issuer of the investment fund or other vehicle. Inclusion of a security within an index is not a recommendation by S&P Dow Jones Indices to buy, sell, or hold such security, nor is it considered to be investment advice.

These materials have been prepared solely for informational purposes based upon information generally available to the public and from sources believed to be reliable. No content contained in these materials (including index data, ratings, credit-related analyses and data, research, valuations, model, software or other application or output therefrom) or any part thereof (Content) may be modified, reverse-engineered, reproduced or distributed in any form or by any means, or stored in a database or retrieval system, without the prior written permission of S&P Dow Jones Indices. The Content shall not be used for any unlawful or unauthorized purposes. S&P Dow Jones Indices and its third-party data providers and licensors (collectively "S&P Dow Jones Indices Parties") do not guarantee the accuracy, completeness, timeliness or availability of the Content. S&P Dow Jones Indices Parties are not responsible for any errors or omissions, regardless of the cause, for the results obtained from the use of the Content. THE CONTENT IS PROVIDED ON AN "AS IS" BASIS. S&P DOW JONES INDICES PARTIES DISCLAIM ANY AND ALL EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE, FREEDOM FROM BUGS, SOFTWARE ERRORS OR DEFECTS, THAT THE CONTENT'S FUNCTIONING WILL BE UNINTERRUPTED OR THAT THE CONTENT WILL OPERATE WITH ANY SOFTWARE OR HARDWARE CONFIGURATION. In no event shall S&P Dow Jones Indices Parties be liable to any party for any direct, indirect, incidental, exemplary, compensatory, punitive, special or consequential damages, costs, expenses, legal fees, or losses (including, without limitation, lost income or lost profits and opportunity costs) in connection with any use of the Content even if advised of the possibility of such damages.

S&P Dow Jones Indices keeps certain activities of its business units separate from each other in order to preserve the independence and objectivity of their respective activities. As a result, certain business units of S&P Dow Jones Indices may have information that is not available to other business units. S&P Dow Jones Indices has established policies and procedures to maintain the confidentiality of certain non-public information received in connection with each analytical process.

In addition, S&P Dow Jones Indices provides a wide range of services to, or relating to, many organizations, including issuers of securities, investment advisers, broker-dealers, investment banks, other financial institutions and financial intermediaries, and accordingly may receive fees or other economic benefits from those organizations, including organizations whose securities or services they may recommend, rate, include in model portfolios, evaluate or otherwise address.

## CONTRIBUTORS

**Ryan Poirier, FRM**  
Senior Analyst  
Global Research & Design  
[ryan.poirier@spglobal.com](mailto:ryan.poirier@spglobal.com)

**Aye M. Soe, CFA**  
Managing Director  
Global Research & Design  
[aye.soe@spglobal.com](mailto:aye.soe@spglobal.com)

**Hong Xie, CFA**  
Director  
Global Research & Design  
[hong.xie@spglobal.com](mailto:hong.xie@spglobal.com)

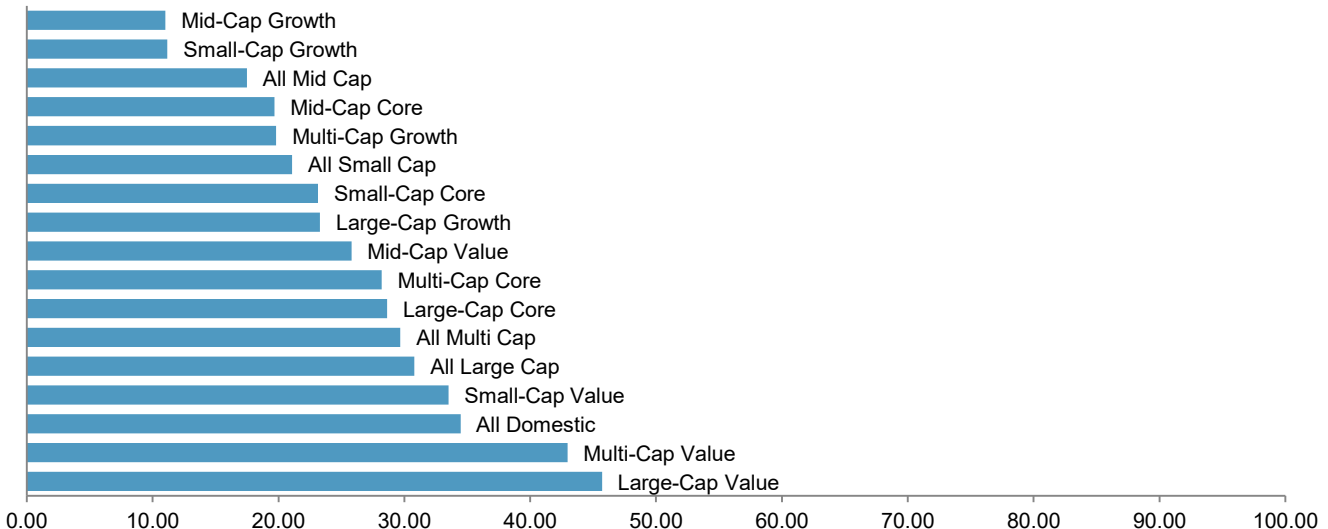
# SPIVA<sup>®</sup> Institutional Scorecard: How Much Do Fees Affect the Active Versus Passive Debate?

## EXECUTIVE SUMMARY

- This report examines the impact of fees on the performance of mutual funds and institutional managed accounts across equity and fixed income categories, using gross- and net-of-fees returns.
- Fees negatively affect managers' performance regardless of the type of investment account, though the magnitude varies depending on the category.
- For mutual fund and institutional managed accounts, the majority of managers in nearly every domestic equity category underperformed their respective benchmarks over the 10-year horizon.
- Large-cap value mutual funds was the only category that outperformed the benchmark on a gross-of-fees basis.
- In general, more mutual fund managers underperformed than their institutional counterparts for most equity categories on a net-of-fees basis, with the exception of small-cap core and small-cap growth.
- In the large-cap equity space, 84.60% of mutual fund managers and 79.58% of institutional accounts underperformed the [S&P 500<sup>®</sup>](#) on a net-of-fees basis. When measured on a gross-of-fees basis, 68.16% of large-cap mutual funds and 69.20% of institutional accounts underperformed.
- Similarly, in the mid-cap space, 96.03% (86.24%) of mutual funds and 92.02% (82.51%) of institutional accounts underperformed the [S&P MidCap 400<sup>®</sup>](#) on a net (gross) basis.
- In the small-cap space, over 80% of managers on both fronts underperformed the [S&P SmallCap 600<sup>®</sup>](#), regardless of fees. The findings in the small-cap space dispel the myth that small-cap equity is an inefficient asset class that is best accessed via active management.
- Managers investing in international, international small-cap, and global equities fared equally to or better than their domestic counterparts with respect to their respective benchmarks on both fee schedules. This finding is consistent for mutual funds and institutional accounts.

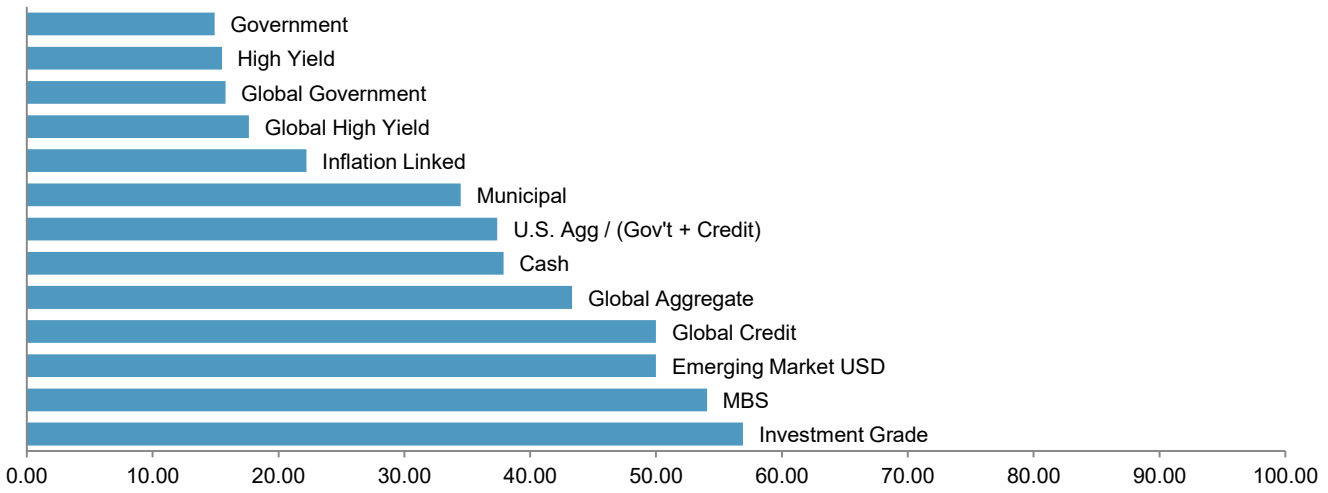
- In fixed income, the results were mixed depending on the market segment. Institutional managers continued to show strength in U.S. products such as mortgage-backed securities (MBSs), investment-grade corporate bonds, and global credit, outperforming their respective benchmarks.
- The municipal bond market saw a significant performance divergence between institutional accounts and mutual funds. Fees overwhelmingly affected the performance of mutual fund muni managers, as approximately 73% of them failed to outperform the benchmark on a net-of-fees basis, while only 47% underperformed on a gross-of-fees basis, constituting a difference of 26%. That difference is reduced to 12% when looking at institutional muni managers.
- The significant difference within the muni mutual fund space was not surprising when we examined average fees charged by muni managers across both investment categories. The median fee for muni mutual funds was 0.75% per year, whereas the median fee for institutional muni accounts was 0.35%.

**Exhibit 1a: Percent of Institutional Equity Managers Outperforming Their Benchmarks**



Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

**Exhibit 1b: Percent of Institutional Fixed Income Managers Outperforming Their Benchmarks**



Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

Fees play a major role in the active versus passive debate. After subtracting fees, returns from active management tend to be less than those from passive management, as the latter costs less.<sup>1</sup> Within active management, it is widely understood and has been documented that fees can vary meaningfully depending on the type of investor.<sup>2</sup> In general, retail investors tend to pay higher advisory and management fees than institutional investors.<sup>3</sup> Institutional investors have the option to negotiate fees directly with asset managers based on the size of the mandate and how many strategies may already exist with one manager. Retail investors, on the other hand, lack such bargaining power.

Since 2002, S&P Dow Jones Indices has been publishing the S&P Indices Versus Active (SPIVA) U.S. Scorecard. The scorecard measures the performance of actively managed equity funds, investing in domestic and international equity, as well as fixed income funds against their respective benchmarks. The University of Chicago's Center for Research in Security Prices (CRSP) Survivor-Bias-Free US Mutual Fund Database serves as the underlying data source for the scorecard. As the CRSP database consists of publicly traded open-ended mutual funds, the fee structure primarily reflects retail products rather than institutional accounts.

This report attempts to answer three questions that are pertinent to the active versus passive debate.

1. When measured on a net- and gross-of-fees basis, do institutional asset managers outperform their respective benchmarks?
2. Similarly, do mutual funds outperform their respective benchmarks when measured on a net- and gross-of-fees basis?
3. For particular asset classes and sub-asset classes, do institutional managers fare better than their retail fund counterparts when measured on a gross-of-fees basis?

To answer these questions, we report the relative performance of U.S. equity and fixed income asset managers for institutional accounts<sup>4</sup> using composite returns from eVestment Alliance,<sup>5</sup> a provider of investment data and analytics for the institutional asset management industry. It should be noted that unlike the publicly traded mutual fund performance data, the data from eVestment relies on self-reporting by managers. Relative performance for retail funds on a gross-of-fees basis is computed by adding back the annual expense ratio to the net-of-fees returns. Appendix A contains detailed mapping of various investment strategies to their groups.

In addition, we compare the relative performance of open-ended mutual funds—using both net-of-fees and gross-of-fees returns—against similar peer groupings composed of institutional accounts. We report the figures for domestic equity, international equity, and fixed income categories.

<sup>1</sup> Sharpe, William F., "The Arithmetic of Active Management" *Financial Analysts Journal*, January/February 1991, Volume 47 Issue 1. "Properly measured, the average actively managed dollar must underperform the average passively managed dollar, net of costs."

<sup>2</sup> For example, research by the Investment Company Institute in "Mutual Funds and Institutional Accounts: A Comparison" (2006) showed that the average mutual fund advisory fee for large-cap domestic equity funds is around 70 bps, whereas the same category for a separate institutional account averages at 53 bps. Similarly, the average mutual fund advisory fee for a domestic fixed income fund ranges around 48 bps, while that for a separate institutional account is 30 bps.

<sup>3</sup> Fee differentials between mutual funds and separate accounts may stem from a number of factors. It is beyond the scope of our paper to cover those factors. For a more detailed write up on the key differences between the two structures, please refer to "Mutual Funds and Institutional Accounts: A Comparison" (2006).

<sup>4</sup> Institutional accounts include institutional separately managed accounts and commingled trusts.

<sup>5</sup> Composite returns can be measured as the equal-weighted or asset-weighted averages of the returns of all individual constituent portfolios, depending on the manager's discretion.



By producing this report, we aim to provide the institutional community with the ability to judge managers' true skills without the possible distortions that fees may create on performance. Including mutual funds—on both a net and gross performance basis—with institutional accounts also allows readers to see if fees make any meaningful difference in a particular asset class for a certain type of market participant.

This report also aims to address the notion that benchmarks are not directly investable and do not incur costs, thereby making any performance comparison of active funds against their benchmarks not “apples-to-apples.” By comparing retail mutual funds and institutional accounts on a gross-of-fees basis against their respective benchmarks, we eliminate any possibility that fees are the sole contributor to a given manager's underperformance.

This report is organized as follows. In Section I, we highlight the relative performance of retail funds and institutional accounts against their respective benchmarks for the equity and fixed income categories. Section II replicates the headline SPIVA U.S. Scorecard using only institutional accounts, detailing related metrics such as survivorship, style consistency, asset-weighted versus equal-weighted performance figures, and quartile breakpoints.

## SECTION I: PERCENTAGE OF RETAIL FUNDS AND INSTITUTIONAL ACCOUNTS UNDERPERFORMING THEIR BENCHMARKS

### Domestic Equity

Across various categories within the domestic equity space, the overwhelming majority of active managers, both retail and institutional, lagged their respective benchmarks. Overall findings suggest that on a gross- or net-of-fees basis, the U.S. equity space poses meaningful challenges for active managers to overcome.

**Exhibit 2: Domestic Equity – Percentage of Managers Underperforming Over 10 Years**

CATEGORY	BENCHMARK	MUTUAL FUND (%) NET OF FEES	MUTUAL FUND (%) GROSS OF FEES	INSTITUTIONAL ACCOUNTS (%) NET OF FEES	INSTITUTIONAL ACCOUNTS (%) GROSS OF FEES
All Domestic Funds	S&P Composite 1500®	82.87	67.11	76.31	65.52
All Large Cap Funds	S&P 500	84.60	68.16	79.58	69.20
All Mid Cap Funds	S&P MidCap 400	96.03	86.24	92.02	82.51
All Small Cap Funds	S&P SmallCap 600	95.64	81.40	90.61	78.91
All Multi Cap Funds	S&P Composite 1500	89.31	77.67	81.31	70.33
Large-Cap Growth Funds	S&P 500 Growth	95.22	77.99	89.96	76.70
Large-Cap Core Funds	S&P 500	89.43	70.73	84.18	71.38
Large-Cap Value Funds	S&P 500 Value	64.49	46.73	62.89	54.30
Mid-Cap Growth Funds	S&P MidCap 400 Growth	97.93	91.71	92.66	88.99
Mid-Cap Core Funds	S&P MidCap 400	98.04	86.27	90.16	80.33
Mid-Cap Value Funds	S&P MidCap 400 Value	89.16	77.11	84.95	74.19
Small-Cap Growth Funds	S&P SmallCap 600 Growth	98.01	92.04	95.53	88.83
Small-Cap Core Funds	S&P SmallCap 600	94.32	80.35	91.74	76.86
Small-Cap Value Funds	S&P SmallCap 600 Value	91.75	68.04	83.80	66.48
Multi-Cap Growth Funds	S&P Composite 1500 Growth	91.28	83.14	87.74	80.19
Multi-Cap Core Funds	S&P Composite 1500	89.40	77.81	82.91	71.79
Multi-Cap Value Funds	S&P Composite 1500 Value	81.05	64.71	66.67	57.02

Source: S&P Dow Jones Indices LLC, eVestment Alliance, CRSP. Data as of Dec. 31, 2016. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

### International Equity

In the non-U.S. equity space, we find that managers investing in international small-cap equities delivered higher returns than their respective benchmarks over the 5- and 10-year periods. Observations from previous SPIVA U.S. Scorecards also show that international small-cap funds is one area of international equity investing in which active management has fared quite well historically. While managers outperformed on a gross-of-fees basis in this space, they failed to provide value after fees were accounted for. This is to be expected, as access to smaller, less liquid foreign securities can be costly.

Managers investing in emerging market equities, which has traditionally been thought to be one area where active management can add value, fell short of the benchmark over the trailing 10-year period.

Nearly two-thirds of these managers failed to deliver excess returns compared with the broad-based benchmark.

**Exhibit 3: International Equity – Percentage of Managers Underperforming Over 10 Years**

CATEGORY	BENCHMARK	MUTUAL FUND (%) NET OF FEES	MUTUAL FUND (%) GROSS OF FEES	INSTITUTIONAL ACCOUNTS (%) NET OF FEES	INSTITUTIONAL ACCOUNTS (%) GROSS OF FEES
Emerging Market Funds	S&P/IFCI Composite	85.71	64.94	78.70	69.44
Global Funds	S&P Global 1200	84.26	58.33	78.63	67.52
International Funds	S&P International 700	83.89	67.45	81.48	69.44
International Small-Cap Funds	S&P Developed Ex-U.S. SmallCap	62.96	48.15	65.38	50.00

Source: S&P Dow Jones Indices LLC, eVestment Alliance, CRSP. Data as of Dec. 31, 2016. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

### Fixed Income

For fixed income, we present the performance of retail funds separate from institutional accounts due to classification nuances. Our source for mutual fund data, the CRSP Survivor-Bias-Free US Mutual Funds Database, adopted style and objective codes from the Lipper objective codes after 1998. Lipper objective codes classify funds by sector, maturity, and credit quality, whereas our source for institutional SMA data, the eVestment Universe, groups fixed income strategies mostly by sector. While it is reasonably straightforward to map sector funds between CRSP and eVestment, a good amount of subjectivity is required in mapping them for composites and composites with various maturity slices. In some sectors, such as government and investment grade, it is challenging to make a direct comparison between the performance of mutual funds and institutional accounts due to maturity slices.

For government bonds, when measured on a gross-of-fees basis, institutional managers performed worse than their mutual fund counterparts in the short- and intermediate-term maturities, and they performed at par in the longer-term maturity range. For investment-grade bonds, institutional accounts outperformed retail funds in all maturity buckets. In other sectors, such as MBSs, high yield, and emerging markets, both institutional and retail funds delivered similar results. In the municipal bond market, mutual fund managers outperformed institutional managers on gross-of-fees basis.

However, when examined on a net-of-fees basis, the narrative changes significantly due to fee structures. In emerging market debt, one-half of the managers in both groups outperformed their benchmarks on a gross-of-fees basis. However, this was negated after fees were accounted for, resulting in nearly three-fourths of the managers underperforming the benchmark.

Fees appeared to give retail MBS and municipal bond managers the biggest performance hurdles. When measured on a gross (net) basis, approximately 40% (84%) of retail municipal bond funds underperformed the benchmark. Similarly, nearly 66% of institutional muni bond managers lagged on a gross-of-fees basis, compared with 78% when measured on a net-of-fees basis.

For MBSs, institutional and retail funds had similar gross-of-fees performance, with the former underperforming the benchmark by 46% and the latter by 50%. However, on a net-of-fees basis, 80% of retail funds underperformed the benchmark while only 54% of institutional accounts underperformed.

**Exhibit 4: Fixed Income – Percentage of Managers Underperforming Over 10 Years**

CATEGORY	BENCHMARK	MUTUAL FUND (%) NET OF FEES	MUTUAL FUND (%) GROSS OF FEES
Government Short Funds	Barclays US Government (1-3 Year)	76.74	51.16
Government Intermediate Funds	Barclays US Government Intermediate	78.18	54.55
Government Long Funds	Barclays US Government Long	95.65	86.96
Investment-Grade Short Funds	Barclays US Government/Credit (1-3 Year)	64.63	51.22
Investment-Grade Intermediate Funds	Barclays US Government/Credit Intermediate	58.60	46.05
Investment-Grade Long Funds	Barclays US Government/Credit Long	96.30	94.44
Mortgage-Backed Securities Funds	Barclays US Aggregate Securitized - MBS	80.36	50.00
High-Yield Funds	Barclays US Corporate High Yield	96.60	76.87
Global Income Funds	Barclays Global Aggregate	61.29	50.00
Emerging Markets Debt Funds	Barclays Emerging Markets	76.19	47.62
General Municipal Debt Funds	S&P National AMT-Free Municipal Bond	72.73	46.59
California Municipal Debt Funds	S&P California AMT-Free Municipal Bond	85.71	38.10
New York Municipal Debt Funds	S&P New York AMT-Free Municipal Bond	94.12	35.29

Source: S&P Dow Jones Indices LLC, CRSP. Data as of Dec. 31, 2016. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

**Exhibit 5: Fixed Income – Percentage of Managers Underperforming Over 10 Years**

CATEGORY	BENCHMARK	INSTITUTIONAL ACCOUNTS (%) NET OF FEES	INSTITUTIONAL ACCOUNTS (%) GROSS OF FEES
Cash Funds	Barclays Short Treasury	66.67	62.12
Government Funds	Barclays US Government	85.07	85.07
Investment-Grade Funds	Barclays US Credit	48.28	43.10
MBS Funds	Barclays US Aggregate Securitized - MBS	54.05	45.95
U.S. Agg. / (Gov't + Credit) Funds	Barclays US Aggregate	69.53	62.62
Inflation-Linked Funds	Barclays US Treasury: US TIPS	88.89	77.78
High-Yield Funds	Barclays US Corporate High Yield	93.80	84.50
Global Aggregate Funds	Barclays Global Aggregate	73.33	56.67
Global Government Funds	Barclays Global Treasuries	89.47	84.21
Global Credit Funds	Barclays Global Aggregate - Corporate	50.00	50.00
Global High-Yield Funds	Barclays Global High Yield	100.00	82.35
Emerging Market USD Funds	Barclays Emerging Markets	75.00	50.00
Municipal Funds	S&P National AMT-Free Municipal Bond	77.93	65.52

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

**SECTION II: INSTITUTIONAL ACCOUNTS – SPIVA U.S. SCORECARD**

<b>Report 1: Percentage of U.S. Equity Funds Outperformed by Benchmarks</b>					
<b>FUND CATEGORY</b>	<b>COMPARISON INDEX</b>	<b>ONE-YEAR</b>	<b>THREE-YEAR</b>	<b>FIVE-YEAR</b>	<b>TEN-YEAR</b>
All Domestic Funds	S&P Composite 1500	63.69	88.33	85.35	76.31
All Large-Cap Funds	S&P 500	72.69	91.53	89.58	79.58
All Mid-Cap Funds	S&P MidCap 400	86.28	87.40	88.49	92.02
All Small-Cap Funds	S&P SmallCap 600	82.42	88.51	90.34	90.61
All Multi-Cap Funds	S&P Composite 1500	70.88	86.76	90.21	81.31
Large-Cap Growth Funds	S&P 500 Growth	80.40	95.00	90.65	89.96
Large-Cap Core Funds	S&P 500	83.00	91.47	91.04	84.18
Large-Cap Value Funds	S&P 500 Value	85.71	83.71	86.36	62.89
Mid-Cap Growth Funds	S&P Midcap 400 Growth	96.74	95.00	92.37	92.66
Mid-Cap Core Funds	S&P MidCap 400	90.57	86.67	89.19	90.16
Mid-Cap Value Funds	S&P MidCap 400 Value	96.30	82.98	87.50	84.95
Small-Cap Growth Funds	S&P SmallCap 600 Growth	94.04	93.53	93.69	95.53
Small-Cap Core Funds	S&P SmallCap 600	92.97	89.13	88.16	91.74
Small-Cap Value Funds	S&P SmallCap 600 Value	87.50	84.04	89.05	83.80
Multi-Cap Growth Funds	S&P Composite 1500 Growth	74.04	94.87	92.25	87.74
Multi-Cap Core Funds	S&P Composite 1500	80.00	85.00	88.51	82.91
Multi-Cap Value Funds	S&P Composite 1500 Value	74.38	78.20	89.47	66.67

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

<b>Report 2: Survivorship and Style Consistency of U.S. Equity Funds</b>			
<b>FUND CATEGORY</b>	<b>NO. OF FUNDS AT START</b>	<b>SURVIVORSHIP (%)</b>	<b>STYLE CONSISTENCY (%)</b>
<b>ONE-YEAR</b>			
All Domestic Funds	3153	92.23	100.00
All Large-Cap Funds	1396	91.98	100.00
All Mid-Cap Funds	393	92.62	100.00
All Small-Cap Funds	774	91.73	100.00
All Multi-Cap Funds	590	93.22	100.00
Large-Cap Growth Funds	433	90.99	100.00
Large-Cap Core Funds	458	92.14	100.00
Large-Cap Value Funds	505	92.67	100.00
Mid-Cap Growth Funds	158	90.51	100.00
Mid-Cap Core Funds	98	92.86	100.00
Mid-Cap Value Funds	137	94.89	100.00
Small-Cap Growth Funds	231	88.74	100.00
Small-Cap Core Funds	243	93.83	100.00
Small-Cap Value Funds	300	92.33	100.00
Multi-Cap Growth Funds	163	93.87	100.00
Multi-Cap Core Funds	217	93.55	100.00
Multi-Cap Value Funds	210	92.38	100.00

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

<b>Report 2: Survivorship and Style Consistency of U.S. Equity Funds (cont.)</b>			
<b>FUND CATEGORY</b>	<b>NO. OF FUNDS AT START</b>	<b>SURVIVORSHIP (%)</b>	<b>STYLE CONSISTENCY (%)</b>
<b>THREE-YEAR</b>			
All Domestic Funds	3354	82.80	100.00
All Large-Cap Funds	1501	82.28	100.00
All Mid-Cap Funds	425	83.29	100.00
All Small-Cap Funds	807	82.53	100.00
All Multi-Cap Funds	621	84.06	100.00
Large-Cap Growth Funds	467	81.58	100.00
Large-Cap Core Funds	502	80.48	100.00
Large-Cap Value Funds	532	84.59	100.00
Mid-Cap Growth Funds	165	83.03	100.00
Mid-Cap Core Funds	109	82.57	100.00
Mid-Cap Value Funds	151	84.11	100.00
Small-Cap Growth Funds	248	76.61	100.00
Small-Cap Core Funds	245	86.12	100.00
Small-Cap Value Funds	314	84.39	100.00
Multi-Cap Growth Funds	180	82.78	100.00
Multi-Cap Core Funds	218	88.07	100.00
Multi-Cap Value Funds	223	81.17	100.00
<b>FIVE-YEAR</b>			
All Domestic Funds	3596	71.44	100.00
All Large-Cap Funds	1600	70.75	100.00
All Mid-Cap Funds	470	71.28	100.00
All Small-Cap Funds	855	72.16	100.00
All Multi-Cap Funds	671	72.28	100.00
Large-Cap Growth Funds	501	70.26	100.00
Large-Cap Core Funds	536	67.91	100.00
Large-Cap Value Funds	563	73.89	100.00
Mid-Cap Growth Funds	181	71.27	100.00
Mid-Cap Core Funds	121	69.42	100.00
Mid-Cap Value Funds	168	72.62	100.00
Small-Cap Growth Funds	280	63.57	100.00
Small-Cap Core Funds	254	75.98	100.00
Small-Cap Value Funds	321	76.64	100.00
Multi-Cap Growth Funds	191	72.25	100.00
Multi-Cap Core Funds	242	74.38	100.00
Multi-Cap Value Funds	238	70.17	100.00

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

**Report 2: Survivorship and Style Consistency of U.S. Equity Funds (cont.)**

FUND CATEGORY	NO. OF FUNDS AT START	SURVIVORSHIP (%)	STYLE CONSISTENCY (%)
<b>TEN-YEAR</b>			
All Domestic Funds	3053	67.28	100.00
All Large-Cap Funds	1397	67.36	100.00
All Mid-Cap Funds	408	65.20	100.00
All Small-Cap Funds	719	66.62	100.00
All Multi-Cap Funds	529	69.57	100.00
Large-Cap Growth Funds	449	66.82	100.00
Large-Cap Core Funds	467	63.81	100.00
Large-Cap Value Funds	481	71.31	100.00
Mid-Cap Growth Funds	165	63.64	100.00
Mid-Cap Core Funds	102	63.73	100.00
Mid-Cap Value Funds	141	68.09	100.00
Small-Cap Growth Funds	241	58.51	100.00
Small-Cap Core Funds	200	70.00	100.00
Small-Cap Value Funds	278	71.22	100.00
Multi-Cap Growth Funds	158	68.35	100.00
Multi-Cap Core Funds	192	70.83	100.00
Multi-Cap Value Funds	179	69.27	100.00

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

**Report 3: Average U.S. Equity Fund Performance (Equal-Weighted)**

CATEGORY	ONE-YEAR (ANNUALIZED %)	THREE-YEAR (ANNUALIZED %)	FIVE-YEAR (ANNUALIZED %)	TEN-YEAR (ANNUALIZED %)
S&P Composite 1500	13.03	8.89	14.78	7.19
All Domestic Funds	12.05	6.12	13.13	6.94
S&P 500	11.96	8.87	14.66	6.95
All Large-Cap Funds	8.86	6.60	13.02	6.44
S&P MidCap 400	20.74	9.04	15.33	9.16
All Mid-Cap Funds	11.04	5.79	12.92	7.36
S&P SmallCap 600	26.56	9.47	16.62	9.03
All Small-Cap Funds	19.05	5.84	13.99	7.58
S&P Composite 1500	13.03	8.89	14.78	7.19
All Multi-Cap Funds	10.18	5.54	12.16	6.71
<b>LARGE-CAP</b>				
S&P 500 Growth	6.89	9.03	14.54	8.29
Large-Cap Growth Funds	3.25	6.10	12.98	6.98
S&P 500	11.96	8.87	14.66	6.95
Large-Cap Core Funds	8.96	6.73	12.74	6.28
S&P 500 Value	17.40	8.51	14.69	5.50
Large-Cap Value Funds	13.56	6.82	13.17	5.87

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

**Report 3: Average U.S. Equity Fund Performance (Equal-Weighted) (cont.)**

CATEGORY	ONE-YEAR (ANNUALIZED %)	THREE-YEAR (ANNUALIZED %)	FIVE-YEAR (ANNUALIZED %)	TEN-YEAR (ANNUALIZED %)
<b>MID-CAP</b>				
S&P MidCap 400 Growth	14.77	7.99	14.42	9.74
Mid-Cap Growth Funds	4.87	3.99	11.69	7.31
S&P MidCap 400	20.74	9.04	15.33	9.16
Mid-Cap Core Funds	12.02	6.34	12.82	7.31
S&P MidCap 400 Value	26.53	9.81	16.07	8.48
Mid-Cap Value Funds	17.25	7.32	14.27	7.27
<b>SMALL-CAP</b>				
S&P SmallCap 600 Growth	22.16	9.26	16.35	9.90
Small-Cap Growth Funds	10.93	3.72	13.17	7.27
S&P SmallCap 600	26.56	9.47	16.62	9.03
Small-Cap Core Funds	19.04	6.38	14.14	7.72
S&P SmallCap 600 Value	31.32	9.64	16.88	8.18
Small-Cap Value Funds	25.97	7.16	14.44	7.55
<b>MULTI-CAP</b>				
S&P Composite 1500 Growth	7.90	8.95	14.60	8.48
Multi-Cap Growth Funds	4.24	3.87	11.76	7.11
S&P Composite 1500	13.03	8.89	14.78	7.19
Multi-Cap Core Funds	10.72	6.25	12.51	6.35
S&P Composite 1500 Value	18.49	8.63	14.87	5.83
Multi-Cap Value Funds	14.82	6.27	12.08	6.48

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

**Report 4: Average U.S. Equity Fund Performance (Asset-Weighted)**

CATEGORY	ONE-YEAR (ANNUALIZED %)	THREE-YEAR (ANNUALIZED %)	FIVE-YEAR (ANNUALIZED %)	TEN-YEAR (ANNUALIZED %)
S&P Composite 1500	13.03	8.89	14.78	7.19
All Domestic Funds	10.11	6.59	13.44	6.60
S&P 500	11.96	8.87	14.66	6.95
All Large-Cap Funds	8.46	6.87	13.57	6.28
S&P MidCap 400	20.74	9.04	15.33	9.16
All Mid-Cap Funds	11.57	6.60	13.54	7.52
S&P SmallCap 600	26.56	9.47	16.62	9.03
All Small-Cap Funds	18.28	5.62	13.51	7.51
S&P Composite 1500	13.03	8.89	14.78	7.19
All Multi-Cap Funds	8.87	6.02	12.34	6.13

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.



<b>Report 4: Average U.S. Equity Fund Performance (Asset-Weighted) (cont.)</b>				
<b>CATEGORY</b>	<b>ONE-YEAR (ANNUALIZED %)</b>	<b>THREE-YEAR (ANNUALIZED %)</b>	<b>FIVE-YEAR (ANNUALIZED %)</b>	<b>TEN-YEAR (ANNUALIZED %)</b>
<b>LARGE-CAP</b>				
S&P 500 Growth	6.89	9.03	14.54	8.29
Large-Cap Growth Funds	1.66	6.33	13.61	7.27
S&P 500	11.96	8.87	14.66	6.95
Large-Cap Core Funds	8.90	6.82	13.08	5.70
S&P 500 Value	17.40	8.51	14.69	5.50
Large-Cap Value Funds	14.04	7.19	13.64	5.62
<b>MID-CAP</b>				
S&P MidCap 400 Growth	14.77	7.99	14.42	9.74
Mid-Cap Growth Funds	6.10	5.36	12.41	7.49
S&P MidCap 400	20.74	9.04	15.33	9.16
Mid-Cap Core Funds	13.72	7.22	14.61	7.81
S&P MidCap 400 Value	26.53	9.81	16.07	8.48
Mid-Cap Value Funds	16.46	7.48	14.38	7.44
<b>SMALL-CAP</b>				
S&P SmallCap 600 Growth	22.16	9.26	16.35	9.90
Small-Cap Growth Funds	9.35	3.38	12.88	7.14
S&P SmallCap 600	26.56	9.47	16.62	9.03
Small-Cap Core Funds	18.93	6.15	13.59	7.65
S&P SmallCap 600 Value	31.32	9.64	16.88	8.18
Small-Cap Value Funds	25.48	7.06	13.81	7.57
<b>MULTI-CAP</b>				
S&P Composite 1500 Growth	7.90	8.95	14.60	8.48
Multi-Cap Growth Funds	5.35	4.47	12.55	6.81
S&P Composite 1500	13.03	8.89	14.78	7.19
Multi-Cap Core Funds	9.10	5.92	12.06	5.54
S&P Composite 1500 Value	18.49	8.63	14.87	5.83
Multi-Cap Value Funds	13.13	8.08	12.57	5.94

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

<b>Report 5: Quartile Breakpoints of U.S. Equity Funds</b>			
<b>FUND CATEGORY</b>	<b>THIRD QUARTILE</b>	<b>SECOND QUARTILE</b>	<b>FIRST QUARTILE</b>
<b>ONE-YEAR</b>			
All Domestic Funds	6.13	11.08	17.30
All Large-Cap Funds	4.80	9.34	13.36
All Mid-Cap Funds	5.95	10.74	17.26
All Small-Cap Funds	13.38	19.66	25.01
All Multi-Cap Funds	4.89	9.26	14.84
Large-Cap Growth Funds	0.58	3.43	6.70
Large-Cap Core Funds	6.29	9.04	11.17
Large-Cap Value Funds	10.18	13.81	16.15
Mid-Cap Growth Funds	2.47	5.59	7.41
Mid-Cap Core Funds	8.68	11.41	16.22
Mid-Cap Value Funds	14.22	17.29	21.06
Small-Cap Growth Funds	6.77	10.93	15.73
Small-Cap Core Funds	17.27	19.39	22.45
Small-Cap Value Funds	21.01	26.21	29.31
Multi-Cap Growth Funds	-1.19	2.88	8.15
Multi-Cap Core Funds	6.24	9.26	12.52
Multi-Cap Value Funds	9.36	14.44	19.37
<b>THREE-YEAR</b>			
All Domestic Funds	4.50	6.69	8.20
All Large-Cap Funds	5.40	6.89	8.12
All Mid-Cap Funds	4.29	6.21	8.16
All Small-Cap Funds	3.73	6.62	8.63
All Multi-Cap Funds	2.83	6.01	8.06
Large-Cap Growth Funds	4.82	6.34	7.58
Large-Cap Core Funds	5.62	7.16	8.22
Large-Cap Value Funds	5.75	7.21	8.29
Mid-Cap Growth Funds	3.05	4.57	6.19
Mid-Cap Core Funds	4.49	6.14	8.16
Mid-Cap Value Funds	6.41	7.95	9.26
Small-Cap Growth Funds	2.05	4.23	6.25
Small-Cap Core Funds	5.38	7.30	8.76
Small-Cap Value Funds	5.23	7.77	9.26
Multi-Cap Growth Funds	1.77	3.52	5.90
Multi-Cap Core Funds	3.94	6.37	8.13
Multi-Cap Value Funds	4.38	7.04	9.43

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

<b>Report 5: Quartile Breakpoints of U.S. Equity Funds (cont.)</b>			
<b>FUND CATEGORY</b>	<b>THIRD QUARTILE</b>	<b>SECOND QUARTILE</b>	<b>FIRST QUARTILE</b>
<b>FIVE-YEAR</b>			
All Domestic Funds	11.77	13.29	14.81
All Large-Cap Funds	11.83	13.21	14.34
All Mid-Cap Funds	11.67	13.54	15.10
All Small-Cap Funds	12.54	14.44	15.94
All Multi-Cap Funds	10.66	12.31	13.92
Large-Cap Growth Funds	11.89	13.02	14.17
Large-Cap Core Funds	11.68	13.15	14.21
Large-Cap Value Funds	11.88	13.38	14.52
Mid-Cap Growth Funds	10.80	12.11	13.49
Mid-Cap Core Funds	11.86	14.09	15.23
Mid-Cap Value Funds	13.41	14.47	15.82
Small-Cap Growth Funds	11.88	13.25	15.52
Small-Cap Core Funds	12.82	14.88	16.17
Small-Cap Value Funds	12.97	14.80	16.10
Multi-Cap Growth Funds	9.47	11.44	13.26
Multi-Cap Core Funds	10.81	12.42	13.94
Multi-Cap Value Funds	11.73	12.74	14.22
<b>TEN-YEAR</b>			
All Domestic Funds	5.92	7.07	8.06
All Large-Cap Funds	5.78	6.72	7.57
All Mid-Cap Funds	6.91	7.78	8.76
All Small-Cap Funds	6.59	7.59	8.45
All Multi-Cap Funds	5.19	6.37	7.67
Large-Cap Growth Funds	6.70	7.47	8.07
Large-Cap Core Funds	6.05	6.58	7.40
Large-Cap Value Funds	5.21	6.02	7.04
Mid-Cap Growth Funds	6.66	7.58	8.59
Mid-Cap Core Funds	7.16	8.14	9.10
Mid-Cap Value Funds	7.01	7.78	8.71
Small-Cap Growth Funds	6.62	7.64	8.69
Small-Cap Core Funds	6.92	7.77	8.59
Small-Cap Value Funds	6.40	7.36	8.26
Multi-Cap Growth Funds	5.28	6.54	8.23
Multi-Cap Core Funds	5.15	6.29	7.39
Multi-Cap Value Funds	5.19	6.37	7.44

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

**Report 6: Percentage of International Equity Funds Outperformed by Benchmarks**

FUND CATEGORY	COMPARISON INDEX	ONE-YEAR	THREE-YEAR	FIVE-YEAR	TEN-YEAR
Emerging Market Funds	S&P/IFCI Composite	67.32	77.73	75.00	78.70
Global Funds	S&P Global 1200	76.53	79.27	77.23	78.63
International Funds	S&P International 700	89.32	75.00	63.91	81.48
International Small-Cap Funds	S&P Developed Ex-U.S. SmallCap	73.58	60.00	38.10	65.38

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

**Report 7: Survivorship and Style Consistency of International Equity Funds**

FUND CATEGORY	NO. OF FUNDS AT START	SURVIVORSHIP (%)	STYLE CONSISTENCY (%)
<b>ONE-YEAR</b>			
Emerging Market Funds	373	92.49	100.00
Global Funds	317	92.43	100.00
International Funds	208	92.79	100.00
International Small-Cap Funds	81	90.12	100.00
<b>THREE-YEAR</b>			
Emerging Market Funds	371	81.67	100.00
Global Funds	309	84.47	100.00
International Funds	218	81.65	100.00
International Small-Cap Funds	74	83.78	100.00
<b>FIVE-YEAR</b>			
Emerging Market Funds	322	71.43	100.00
Global Funds	304	74.01	100.00
International Funds	226	72.57	100.00
International Small-Cap Funds	66	78.79	100.00
<b>TEN-YEAR</b>			
Emerging Market Funds	171	64.91	100.00
Global Funds	181	64.64	100.00
International Funds	187	68.45	100.00
International Small-Cap Funds	48	70.83	100.00

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

**Report 8: Average International Equity Fund Performance (Equal-Weighted)**

CATEGORY	ONE-YEAR (ANNUALIZED %)	THREE-YEAR (ANNUALIZED %)	FIVE-YEAR (ANNUALIZED %)	TEN-YEAR (ANNUALIZED %)
S&P/IFCI Composite	10.79	-1.36	2.56	2.67
Emerging Market Funds	9.35	-2.39	2.34	2.96
S&P Global 1200	8.89	4.40	10.84	4.45
Global Funds	6.16	3.19	10.02	4.53
S&P International 700	4.79	-1.01	6.35	1.66
International Funds	0.76	-1.59	6.51	1.36
S&P Developed Ex-U.S. SmallCap	3.78	2.02	9.67	3.03
International Small-Cap Funds	1.52	2.27	11.32	4.09

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

**Report 9: Average International Equity Fund Performance (Asset-Weighted)**

CATEGORY	ONE-YEAR (ANNUALIZED %)	THREE-YEAR (ANNUALIZED %)	FIVE-YEAR (ANNUALIZED %)	TEN-YEAR (ANNUALIZED %)
S&P/IFCI Composite	10.79	-1.36	2.56	2.67
Emerging Market Funds	9.15	-2.46	1.92	2.56
S&P Global 1200	8.89	4.40	10.84	4.45
Global Funds	6.56	4.00	10.94	3.94
S&P International 700	4.79	-1.01	6.35	1.66
International Funds	0.28	-1.84	6.50	1.20
S&P Developed Ex-U.S. SmallCap	3.78	2.02	9.67	3.03
International Small-Cap Funds	1.17	1.61	10.31	2.76

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

**Report 10: Quartile Breakpoints of International Equity Funds**

FUND CATEGORY	THIRD QUARTILE	SECOND QUARTILE	FIRST QUARTILE
<b>ONE-YEAR</b>			
Emerging Market Funds	4.54	8.37	12.74
Global Funds	2.30	5.48	9.06
International Funds	-1.77	0.15	2.37
International Small-Cap Funds	-1.67	0.41	5.10
<b>THREE-YEAR</b>			
Emerging Market Funds	-3.69	-2.23	-1.11
Global Funds	1.84	2.94	4.60
International Funds	-2.72	-1.50	-0.62
International Small-Cap Funds	0.96	2.01	3.78
<b>FIVE-YEAR</b>			
Emerging Market Funds	1.00	2.38	3.60
Global Funds	9.20	10.21	11.70
International Funds	5.72	6.72	7.77
International Small-Cap Funds	10.01	11.11	13.11
<b>TEN-YEAR</b>			
Emerging Market Funds	1.03	2.21	3.58
Global Funds	3.05	3.95	6.00
International Funds	0.39	1.53	2.27
International Small-Cap Funds	2.60	3.28	3.98

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

**Report 11: Percentage of Fixed Income Funds Outperformed by Benchmarks**

FUND CATEGORY	COMPARISON INDEX	ONE-YEAR	THREE-YEAR	FIVE-YEAR	TEN-YEAR
Cash Funds	Barclays Short Treasury	30.77	48.76	64.14	66.67
Government Funds	Barclays US Government	53.33	83.64	80.56	85.07
Investment-Grade Funds	Barclays US Credit	28.44	35.58	32.67	48.28
MBS Funds	Barclays US Aggregate Securitized - MBS	24.49	50.85	47.62	54.05
High-Yield Funds	Barclays US Corporate High Yield	90.61	79.23	86.77	93.80
U.S. Agg. / (Gov't + Credit) Funds	Barclays US Aggregate	49.52	67.42	60.47	69.53
Inflation-Linked Funds	Barclays US Treasury: US TIPS	68.00	82.76	81.25	88.89
Global Aggregate Funds	Barclays Global Aggregate	59.18	67.27	66.67	73.33
Global Government Funds	Barclays Global Treasuries	60.00	73.33	78.26	89.47
Global Credit Funds	Barclays Global Aggregate - Corporate	38.46	52.00	60.00	50.00
Global High-Yield Funds	Barclays Global High Yield	64.10	52.78	77.42	100.00
Emerging Market USD Funds	Barclays EM USD Aggregate	45.83	86.96	90.48	75.00
Municipal Funds	S&P National AMT-Free Municipal Bond	71.18	76.60	77.96	77.93

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

**Report 12: Survivorship and Style Consistency of Fixed Income Funds**

FUND CATEGORY	NO. OF FUNDS AT START	SURVIVORSHIP (%)	STYLE CONSISTENCY (%)
<b>ONE-YEAR</b>			
Cash Funds	196	92.86	100.00
Government Funds	108	95.37	100.00
Investment-Grade Funds	189	96.83	100.00
MBS Funds	94	96.81	100.00
High-Yield Funds	321	94.08	100.00
U.S. Agg. / (Gov't + Credit) Funds	940	94.68	100.00
Inflation-Linked Funds	52	92.31	100.00
Global Aggregate Funds	106	90.57	100.00
Global Government Funds	29	96.55	100.00
Global Credit Funds	58	93.10	100.00
Global High-Yield Funds	85	96.47	100.00
Emerging Market USD Funds	45	100.00	100.00
Municipal Funds	311	94.53	100.00

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

<b>Report 12: Survivorship and Style Consistency of Fixed Income Funds (cont.)</b>			
<b>FUND CATEGORY</b>	<b>NO. OF FUNDS AT START</b>	<b>SURVIVORSHIP (%)</b>	<b>STYLE CONSISTENCY (%)</b>
<b>THREE-YEAR</b>			
Cash Funds	220	81.36	100.00
Government Funds	119	84.87	100.00
Investment-Grade Funds	185	92.97	100.00
MBS Funds	104	85.58	100.00
High-Yield Funds	324	86.11	100.00
U.S. Agg. / (Gov't + Credit) Funds	998	85.97	100.00
Inflation Linked Funds	58	82.76	100.00
Global Aggregate Funds	109	82.57	100.00
Global Government Funds	32	78.13	100.00
Global Credit Funds	53	90.57	100.00
Global High-Yield Funds	78	88.46	100.00
Emerging Market USD Funds	45	91.11	100.00
Municipal Funds	332	84.34	100.00
<b>FIVE-YEAR</b>			
Cash Funds	242	68.60	100.00
Government Funds	137	72.26	100.00
Investment-Grade Funds	167	86.83	100.00
MBS Funds	108	78.70	100.00
High-Yield Funds	315	77.78	100.00
U.S. Agg. / (Gov't + Credit) Funds	1051	78.40	100.00
Inflation-Linked Funds	62	74.19	100.00
Global Aggregate Funds	105	77.14	100.00
Global Government Funds	37	56.76	100.00
Global Credit Funds	39	82.05	100.00
Global High-Yield Funds	60	83.33	100.00
Emerging Market USD Funds	40	85.00	100.00
Municipal Funds	332	80.12	100.00
<b>TEN-YEAR</b>			
Cash Funds	223	66.37	100.00
Government Funds	125	69.60	100.00
Investment-Grade Funds	95	82.11	100.00
MBS Funds	71	83.10	100.00
High-Yield Funds	231	77.06	100.00
U.S. Agg. / (Gov't + Credit) Funds	923	74.86	100.00
Inflation-Linked Funds	49	67.35	100.00
Global Aggregate Funds	68	79.41	100.00
Global Government Funds	30	46.67	100.00
Global Credit Funds	17	82.35	100.00
Global High-Yield Funds	30	83.33	100.00
Emerging Market USD Funds	15	80.00	100.00
Municipal Funds	253	79.84	100.00

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

<b>Report 13: Average Fixed Income Fund Performance (Equal-Weighted)</b>				
<b>CATEGORY</b>	<b>ONE-YEAR (ANNUALIZED %)</b>	<b>THREE-YEAR (ANNUALIZED %)</b>	<b>FIVE-YEAR (ANNUALIZED %)</b>	<b>TEN-YEAR (ANNUALIZED %)</b>
Barclays Short Treasury	0.53	0.25	0.21	0.99
Cash Funds	1.02	0.75	0.79	1.81
Barclays US Government	1.05	2.26	1.22	3.86
Government Funds	0.84	1.85	1.11	3.26
Barclays US Credit	5.63	4.07	3.85	5.31
Investment-Grade Funds	7.34	5.06	5.09	6.36
Barclays US Aggregate Securitized - MBS	1.67	3.07	2.06	4.28
MBS Funds	2.67	3.35	4.43	5.52
Barclays US Corporate High Yield	17.13	4.66	7.36	7.45
High-Yield Funds	13.02	3.54	6.27	6.34
Barclays US Aggregate	2.65	3.03	2.23	4.34
U.S. Agg. / (Gov't + Credit) Funds	3.42	2.93	2.68	4.48
Barclays US Treasury: U.S. TIPS	4.68	2.26	0.89	4.36
Inflation-Linked Funds	4.67	1.73	0.84	4.13
Barclays Global Aggregate	2.09	-0.19	0.21	3.29
Global Aggregate Funds	2.42	0.60	1.24	3.77
Barclays Global Treasuries	1.65	-0.83	-1.01	2.96
Global Government Funds	4.10	0.50	0.92	3.97
Barclays Global Aggregate - Corporate	4.20	1.54	3.59	4.10
Global Credit Funds	5.54	2.80	4.69	5.37
Barclays Global High-Yield	14.27	3.60	7.37	7.35
Global High-Yield Funds	13.14	3.91	7.05	7.12
Barclays EM USD Aggregate	9.88	5.25	5.69	6.71
Emerging Market USD Funds	9.74	0.58	2.22	5.34
S&P National AMT-Free Municipal Bond	0.36	4.12	3.06	4.02
Municipal Funds	0.09	3.07	2.48	3.85

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.



<b>Report 14: Average Fixed Income Fund Performance (Asset-Weighted)</b>				
<b>CATEGORY</b>	<b>ONE-YEAR (ANNUALIZED %)</b>	<b>THREE-YEAR (ANNUALIZED %)</b>	<b>FIVE-YEAR (ANNUALIZED %)</b>	<b>TEN-YEAR (ANNUALIZED %)</b>
Barclays Short Treasury	0.53	0.25	0.21	0.99
Cash Funds	0.80	0.60	0.62	1.34
Barclays US Government	1.05	2.26	1.22	3.86
Government Funds	1.62	5.69	2.25	5.23
Barclays US Credit	5.63	4.07	3.85	5.31
Investment-Grade Funds	7.51	5.10	4.98	6.35
Barclays US Aggregate Securitized - MBS	1.67	3.07	2.06	4.28
MBS Funds	2.35	3.28	2.81	4.72
Barclays US Corporate High Yield	17.13	4.66	7.36	7.45
High-Yield Funds	13.01	3.96	6.63	6.59
Barclays US Aggregate	2.65	3.03	2.23	4.34
U.S. Agg. / (Gov't + Credit) Funds	4.20	3.52	3.29	5.01
Barclays US Treasury: US TIPS	4.68	2.26	0.89	4.36
Inflation-Linked Funds	4.36	1.94	0.63	3.91
Barclays Global Aggregate	2.09	-0.19	0.21	3.29
Global Aggregate Funds	1.80	1.21	1.19	3.95
Barclays Global Treasuries	1.65	-0.83	-1.01	2.96
Global Government Funds	5.44	0.95	3.70	6.25
Barclays Global Aggregate - Corporate	4.20	1.54	3.59	4.10
Global Credit Funds	6.98	4.38	5.12	5.41
Barclays Global High Yield	14.27	3.60	7.37	7.35
Global High-Yield Funds	13.79	4.31	7.37	7.61
Barclays EM USD Aggregate	9.88	5.25	5.69	6.71
Emerging Market USD Funds	10.30	2.14	3.49	5.77
S&P National AMT-Free Municipal Bond	0.36	4.12	3.06	4.02
Municipal Funds	0.12	3.44	2.83	3.74

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

<b>Report 15: Quartile Breakpoints of Fixed Income Funds</b>			
<b>FUND CATEGORY</b>	<b>THIRD QUARTILE</b>	<b>SECOND QUARTILE</b>	<b>FIRST QUARTILE</b>
<b>ONE-YEAR</b>			
Cash Funds	0.57	1.02	1.37
Government Funds	0.76	1.06	1.46
Investment-Grade Funds	5.79	7.18	9.72
MBS Funds	1.78	2.58	3.84
High-Yield Funds	10.15	13.35	15.29
U.S. Agg. / (Gov't + Credit) Funds	1.98	2.85	4.31
Inflation-Linked Funds	4.00	4.47	4.89
Global Aggregate Funds	0.68	2.25	3.08
Global Government Funds	1.21	1.49	2.97
Global Credit Funds	4.24	5.48	7.39
Global High-Yield Funds	11.87	13.59	15.11
Emerging Market USD Funds	8.91	9.98	11.67
Municipal Funds	-0.35	0.06	0.63
<b>THREE-YEAR</b>			
Cash Funds	0.29	0.61	0.99
Government Funds	0.73	1.22	2.24
Investment-Grade Funds	3.97	4.59	6.86
MBS Funds	2.89	3.36	3.97
High-Yield Funds	3.07	3.92	4.74
U.S. Agg. / (Gov't + Credit) Funds	1.85	2.79	3.52
Inflation-Linked Funds	1.25	1.84	2.25
Global Aggregate Funds	-0.83	-0.20	1.76
Global Government Funds	-1.08	-0.67	0.40
Global Credit Funds	1.31	3.54	4.22
Global High-Yield Funds	3.09	3.93	4.70
Emerging Market USD Funds	-2.48	1.81	4.45
Municipal Funds	1.17	2.56	4.62

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

<b>Report 15: Quartile Breakpoints of Fixed Income Funds (cont.)</b>			
<b>FUND CATEGORY</b>	<b>THIRD QUARTILE</b>	<b>SECOND QUARTILE</b>	<b>FIRST QUARTILE</b>
<b>FIVE-YEAR</b>			
Cash Funds	0.23	0.50	1.03
Government Funds	0.73	1.11	1.71
Investment-Grade Funds	4.32	4.86	5.90
MBS Funds	2.30	3.69	5.97
High-Yield Funds	5.70	6.57	7.13
U.S. Agg. / (Gov't + Credit) Funds	1.85	2.53	3.43
Inflation-Linked Funds	0.54	0.74	1.05
Global Aggregate Funds	-0.31	0.40	3.50
Global Government Funds	-1.00	0.52	0.90
Global Credit Funds	2.96	4.17	4.66
Global High-Yield Funds	6.36	6.82	7.59
Emerging Market USD Funds	-0.13	3.45	5.04
Municipal Funds	1.13	2.00	3.80
<b>TEN-YEAR</b>			
Cash Funds	0.98	1.53	2.05
Government Funds	2.71	3.09	4.04
Investment-Grade Funds	5.28	5.96	6.43
MBS Funds	4.06	4.38	5.18
High-Yield Funds	5.91	6.47	7.08
U.S. Agg. / (Gov't + Credit) Funds	3.55	4.40	4.96
Inflation-Linked Funds	3.82	4.11	4.29
Global Aggregate Funds	3.00	3.30	4.23
Global Government Funds	3.41	3.87	5.30
Global Credit Funds	4.17	5.00	5.97
Global High-Yield Funds	6.09	6.38	6.69
Emerging Market USD Funds	6.39	6.43	7.04
Municipal Funds	2.64	3.71	4.17

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Data as of Dec. 31, 2016. Table is provided for illustrative purposes. Past performance is no guarantee of future results.

## APPENDIX A: MAPPING

### U.S. Equity

While covering the U.S. equity markets, the SPIVA U.S. Scorecard reports on the nine traditional style boxes, as well as multi-cap core, growth, and value funds. It also reports on the U.S. REIT market. Style classifications are based on fundamental characteristics such as the P/E ratio, return on equity (ROE), and earnings growth expectation. Growth and value characteristics are assigned based on a subjective method, with a large weighting on the median of the three statistics as well as the preferred benchmark. Capitalization is subjective, based on the distribution of holdings as well as the preferred benchmark.

<b>Exhibit A1: U.S. Equity Category Mappings</b>	
<b>SPIVA INSTITUTIONAL CATEGORY</b>	<b>eVESTMENT ALLIANCE CLASSIFICATION</b>
Large-Cap Growth Equity	United States Large Cap Growth
Large-Cap Core Equity	United States Large Cap Core
Large-Cap Value Equity	United States Large Cap Value
Mid-Cap Growth Equity	United States Mid Cap Growth
Mid-Cap Core Equity	United States Mid Cap Core
Mid-Cap Value Equity	United States Mid Cap Value
Small-Cap Growth Equity	United States Small Cap Growth
Small-Cap Core Equity	United States Small Cap Core
Small-Cap Value Equity	United States Small Cap Value
Multi-Cap Growth Equity	United States All Cap Growth
Multi-Cap Core Equity	United States All Cap Core
Multi-Cap Value Equity	United States All Cap Value

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Table is provided for illustrative purposes.

## International Equity

For international equity, SPIVA reports on four major categories (global, international, international small-cap, and emerging market funds) of interest to global asset allocators. These categories also include multiple eVestment capitalization and style classifications.

<b>Exhibit A2: International Equity Category Mappings</b>	
<b>SPIVA INSTITUTIONAL CATEGORY</b>	<b>eVESTMENT ALLIANCE CLASSIFICATION</b>
Global Equity	Global Large Cap Value
	Global Large Cap Growth
	Global Large Cap Core
International Equity	EAFE Large Cap Value
	EAFE Large Cap Growth
	EAFE Large Cap Core
International Small-Cap Equity	EAFE Small Cap Value
	EAFE Small Cap Growth
	EAFE Small Cap Core
Emerging Market Equity	Brazil Large Cap Value
	Brazil All Cap Value
	Brazil All Cap Growth
	Brazil All Cap Core
	Mexico All Cap Value
	Mexico All Cap Growth
	Latin America Small Cap Value
	Latin America Mid Cap Value
	Latin America Large Cap Growth
	Latin America Large Cap Core
	Latin America All Cap Value
	Latin America All Cap Growth
	Latin America All Cap Core
	Global Emg Mkts Small Cap Value
	Global Emg Mkts Small Cap Growth
	Global Emg Mkts Small Cap Core
	Global Emg Mkts Mid Cap Value
	Global Emg Mkts Mid Cap Growth
	Global Emg Mkts Mid Cap Core
	Global Emg Mkts Large Cap Value
	Global Emg Mkts Large Cap Growth
Global Emg Mkts Large Cap Core	
Global Emg Mkts All Cap Value	
Global Emg Mkts All Cap Growth	
Global Emg Mkts All Cap Core	

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Table is provided for illustrative purposes.

**Fixed Income**

SPIVA reports include eight domestic and five global fixed income classifications. For maturity buckets, short duration is one to three years, intermediate duration is three to seven years, and long duration is seven years or more. Cash funds are those with a duration similar to cash deposits. For the U.S. market, credit quality is separated into U.S. government, investment-grade corporate ('BBB' rated or higher) and high yield ('BB' rated or lower). eVestment also includes a municipals and U.S. mortgage category.

Global fixed income funds are split into emerging and global markets. Maturity and credit quality is similar to that of the U.S. market.

<b>Exhibit A3: U.S. Fixed Income Category Mappings</b>	
<b>SPIVA INSTITUTIONAL CATEGORY</b>	<b>eVESTMENT ALLIANCE CLASSIFICATION</b>
<b>U.S. FUNDS</b>	
U.S. Agg. / (Gov't + Credit) Funds	United States CoreAggregate
	United States Core Plus
Cash Funds	United States Cash Mgmt
	United States Stable Value
Government Funds	United States GovtAgency Only
Inflation-Linked Funds	United States Inflation Indexed
MBS Funds	United States Mortgage Only
Investment-Grade Funds	United States Corporate Only
High-Yield Funds	United States High Yield
Municipal Funds	United States Municipal Only
<b>GLOBAL/EMERGING FUNDS</b>	
Emerging Market USD Funds	Global Emg Mkts CoreAggregate
Global Aggregate Funds	Global CoreAggregate
Global Government Funds	Global GovtAgency Only
Global Credit Funds	Global Corporate Only
Global High-Yield Funds	Global High Yield

Source: S&P Dow Jones Indices LLC, eVestment Alliance. Table is provided for illustrative purposes.

## **APPENDIX B: GLOSSARY**

### **Percentage of Managers Outperformed by the Index**

To correct for survivorship bias, we use the opportunity set available at the beginning of the period as the denominator. We determine the count of products that have survived and beat the index. We then report the index outperformance percentage.

### **Survivorship (%)**

This measure represents the percentage of products in existence at the beginning of the time period that is still active at the end of the time period.

### **Style Consistency (%)**

This calculation shows the percentage of managers that had the same style classification at the end of the time period as at the beginning of the time period.

### **Equal-Weighted Performance**

Equal-weighted returns for a particular style category are determined by calculating a simple average return of all active managers in that category in a particular month.

### **Asset-Weighted Performance**

Asset-weighted returns for a particular style category are determined by calculating the weighted-average return of all managers in that category in a particular month, with each product's return weighted by its total net assets. Asset-weighted returns are a better indicator of manager category performance because they more accurately reflect the returns of the total money invested in that particular style category.

### **Quartile Breakpoints**

The  $p$ th percentile for a set of data is the value that is greater than or equal to  $p\%$  of the data but is less than or equal to  $(100-p)\%$  of the data. In other words, it is a value that divides the data into two parts: the lower  $p\%$  of the values and the upper  $(100-p)\%$  of the values. The first quartile is the 75th percentile, the value separating the elements of a population into the lower 75% and the upper 25%. The second quartile is the 50th percentile and the third quartile is the 25th percentile.

### **Indices**

A benchmark index provides an investment vehicle against which fund performance can be measured.

#### **U.S. Equity**

##### **S&P 500**

Widely regarded as the best single gauge of the U.S. equities market, this market-capitalization-weighted index includes a representative sample of 500 leading companies in the foremost industries of the U.S. economy and provides over 80% coverage of U.S. equities.

## S&P MIDCAP 400

This index consists of 400 mid-sized companies and covers approximately 7% of the U.S. equities market.

## S&P SMALLCAP 600

This index consists of 600 small-cap stocks and covers approximately 3% of the U.S. equities market.

## S&P COMPOSITE 1500

This is a broad, market-capitalization-weighted index of 1500 stocks. This index is comprised of three size-based indices: the [S&P 500](#), [S&P MidCap 400](#), and [S&P SmallCap 600](#), which measure the performance of large-, mid-, and small-cap stocks, respectively. This index represents 90% of U.S. equities.

## S&P 500 GROWTH AND VALUE INDICES

These indices form an exhaustive, multi-factor style series covering the entire market capitalization of the S&P 500. Constituents, weighted according to market capitalization, are classified as growth, value, or a mix of growth and value.

## S&P MIDCAP 400 GROWTH AND VALUE INDICES

These indices form an exhaustive, multi-factor style series covering the entire market capitalization of the S&P MidCap 400.

## S&P SMALLCAP 600 GROWTH AND VALUE INDICES

These indices form an exhaustive, multi-factor style series covering the entire market capitalization of the S&P SmallCap 600.

## S&P COMPOSITE 1500 GROWTH AND VALUE INDICES

These indices form an exhaustive, multi-factor style series covering the entire market capitalization of the [S&P Composite 1500](#).

## S&P UNITED STATES REIT INDEX

This index measures the investable universe of publicly traded real estate investment trusts.

## International Equity

### S&P GLOBAL 1200

Capturing approximately 70% of the world's capital markets, the [S&P Global 1200](#) is a composite of seven headline indices, many of which are accepted leaders in their regions. It includes the S&P 500 (U.S.), [S&P Europe 350](#) (Europe), [S&P/Topix 150](#) (Japan), [S&P/TSX 60](#) (Canada), [S&P/ASX All Australian 50](#) (Australia), [S&P Asia 50](#) (Asia Ex-Japan), and [S&P Latin America 40](#) (Latin America).



## S&P 700

This index measures the non-U.S. component of the global equity markets, covering all the regions included in the [S&P Global 1200](#), excluding the U.S. ([S&P 500](#)).

## S&P WORLD EX-U.S. SMALL CAP

This index represents the small-cap segment—the bottom 15%—of the world’s universe of institutionally investable securities, excluding the U.S.

## S&P/IFCI COMPOSITE INDEX

This index is widely recognized as a comprehensive and reliable measure of the world’s emerging markets. It measures the returns of stocks that are legally and practically available to foreign investors.

## Fixed Income

### BARCLAYS CAPITAL LONG GOVERNMENT BOND INDEX

This index consists of U.S. Treasury and U.S. Government agency bonds with maturities greater than 10 years.

### BARCLAYS CAPITAL INTERMEDIATE GOVERNMENT BOND INDEX

This index consists of U.S. Treasury and U.S. Government agency bonds with maturities from 1 to 10 years.

### BARCLAYS CAPITAL 1-3 YEAR GOVERNMENT BOND INDEX

This index consists of U.S. Treasury and U.S. Government agency bonds with maturities from one to three years.

### BARCLAYS CAPITAL LONG GOVERNMENT/CREDIT BOND INDEX

This index covers corporate and non-corporate fixed income securities that are rated investment grade and have maturities greater than 10 years.

### BARCLAYS CAPITAL INTERMEDIATE GOVERNMENT/CREDIT BOND INDEX

This index covers corporate and non-corporate fixed income securities that are rated investment grade with maturities from 1 to 10 years.

### BARCLAYS CAPITAL 1-3 YEAR GOVERNMENT/CREDIT BOND INDEX

This index covers corporate and non-corporate fixed income securities that are rated investment grade and have one to three years until their final maturity.

### BARCLAYS CAPITAL HIGH YIELD BOND INDEX

This index includes all fixed income securities with a maximum quality rating of Ba1/BB+ (including defaulted issues), a minimum amount outstanding of USD 100 million, and at least one year to maturity.

**BARCLAYS CAPITAL BROTHERS MORTGAGE-BACKED SECURITIES INDEX**

This index includes 15- and 30-year fixed-rate securities backed by mortgage pools of the Government National Mortgage Association (GNMA), Federal Home Loan Mortgage Corporation (FHLMC), and Federal National Mortgage Association (FNMA).

**BARCLAYS CAPITAL GLOBAL AGGREGATE BOND INDEX**

This index covers the most liquid portion of the global investment-grade, fixed-rate bond market, including government, credit, and collateralized securities.

**BARCLAYS CAPITAL EMERGING MARKETS INDEX**

This index includes fixed- and floating-rate, USD-denominated debt from emerging markets.

**BARCLAYS CAPITAL EMERGING MARKETS LOCAL CURRENCY GOVERNMENT INDEX**

This index includes all emerging markets government debt in the local currency.

**BARCLAYS CAPITAL EMERGING MARKETS USD AGGREGATE - CORPORATE INDEX**

This index covers only the corporate sector of the Barclays Emerging Markets Aggregate Index.

**BARCLAYS CAPITAL GLOBAL AGGREGATE CORPORATE INDEX**

This index covers only the corporate sector of the Barclays Global Aggregate Index.

**BARCLAYS GLOBAL TREASURY INDEX**

This index covers fixed-rate government debt of investment-grade-rated countries.

**BARCLAYS U.S. SHORT TREASURY INDEX**

This index covers fixed-rate, USD-denominated Treasury bills issued by the U.S. Treasury.

**BARCLAYS U.S. AGGREGATE INDEX**

This index covers investment-grade, USD-denominated, fixed-rate taxable bonds.

**BARCLAYS U.S. AGGREGATE CREDIT INDEX**

This index includes all investment-grade, USD-denominated, fixed-rate, taxable corporate, and government-related bonds.

**BARCLAYS U.S. AGGREGATE GOVERNMENT INDEX**

This index covers U.S. Treasury and U.S. Government agency bonds with all maturities.

**BARCLAYS U.S. TIPS INDEX**

This index includes all maturities of U.S. Treasury Inflation Protected Securities.

**S&P/LSTA U.S. LEVERAGED LOAN 100 INDEX**

This index is designed to reflect the performance of the largest facilities in the floating-rate bank loan, or senior loan, market.

**S&P NATIONAL AMT-FREE MUNICIPAL BOND INDEX**

This index is a broad, comprehensive, market-value-weighted index designed to measure the performance of the investment-grade U.S. municipal bonds that are exempt from the Alternative Minimum Tax.

**S&P CALIFORNIA AMT-FREE MUNICIPAL BOND INDEX**

This index is designed to measure the performance of the investment-grade California municipal bonds that are exempt from the Alternative Minimum Tax.

**S&P NEW YORK AMT-FREE MUNICIPAL BOND INDEX**

This index is designed to measure the performance of the investment-grade New York bonds that are exempt from the alternative minimum tax.

<b>S&amp;P DJI RESEARCH CONTRIBUTORS</b>		
Charles Mounts	Global Head	<a href="mailto:charles.mounts@spglobal.com">charles.mounts@spglobal.com</a>
Jake Vukelic	Business Manager	<a href="mailto:jake.vukelic@spglobal.com">jake.vukelic@spglobal.com</a>
<b>GLOBAL RESEARCH &amp; DESIGN</b>		
<b>AMERICAS</b>		
Aye M. Soe, CFA	Americas Head	<a href="mailto:aye.soe@spglobal.com">aye.soe@spglobal.com</a>
Dennis Badlyans	Associate Director	<a href="mailto:dennis.badlyans@spglobal.com">dennis.badlyans@spglobal.com</a>
Phillip Brzenk, CFA	Director	<a href="mailto:phillip.brzenk@spglobal.com">phillip.brzenk@spglobal.com</a>
Smita Chirputkar	Director	<a href="mailto:smita.chirputkar@spglobal.com">smita.chirputkar@spglobal.com</a>
Rachel Du	Senior Analyst	<a href="mailto:rachel.du@spglobal.com">rachel.du@spglobal.com</a>
Bill Hao	Director	<a href="mailto:wenli.hao@spglobal.com">wenli.hao@spglobal.com</a>
Qing Li	Associate Director	<a href="mailto:qing.li@spglobal.com">qing.li@spglobal.com</a>
Berlinda Liu, CFA	Director	<a href="mailto:berlinda.liu@spglobal.com">berlinda.liu@spglobal.com</a>
Ryan Poirier, FRM	Senior Analyst	<a href="mailto:ryan.poirier@spglobal.com">ryan.poirier@spglobal.com</a>
Maria Sanchez	Associate Director	<a href="mailto:maria.sanchez@spglobal.com">maria.sanchez@spglobal.com</a>
Kelly Tang, CFA	Director	<a href="mailto:kelly.tang@spglobal.com">kelly.tang@spglobal.com</a>
Peter Tsui	Director	<a href="mailto:peter.tsui@spglobal.com">peter.tsui@spglobal.com</a>
Hong Xie, CFA	Director	<a href="mailto:hong.xie@spglobal.com">hong.xie@spglobal.com</a>
<b>APAC</b>		
Priscilla Luk	APAC Head	<a href="mailto:priscilla.luk@spglobal.com">priscilla.luk@spglobal.com</a>
Utkarsh Agrawal, CFA	Associate Director	<a href="mailto:utkarsh.agrawal@spglobal.com">utkarsh.agrawal@spglobal.com</a>
Liyu Zeng, CFA	Director	<a href="mailto:liyu.zeng@spglobal.com">liyu.zeng@spglobal.com</a>
Akash Jain	Associate Director	<a href="mailto:akash.jain@spglobal.com">akash.jain@spglobal.com</a>
<b>EMEA</b>		
Sunjiv Mainie, CFA, CQF	EMEA Head	<a href="mailto:sunjiv.mainie@spglobal.com">sunjiv.mainie@spglobal.com</a>
Leonardo Cabrer	Senior Analyst	<a href="mailto:leonardo.cabrer@spglobal.com">leonardo.cabrer@spglobal.com</a>
Andrew Innes	Senior Analyst	<a href="mailto:andrew.innes@spglobal.com">andrew.innes@spglobal.com</a>
<b>INDEX INVESTMENT STRATEGY</b>		
Craig J. Lazzara, CFA	Global Head	<a href="mailto:craig.lazzara@spglobal.com">craig.lazzara@spglobal.com</a>
Fei Mei Chan	Director	<a href="mailto:feimei.chan@spglobal.com">feimei.chan@spglobal.com</a>
Tim Edwards, PhD	Senior Director	<a href="mailto:tim.edwards@spglobal.com">tim.edwards@spglobal.com</a>
Anu R. Ganti, CFA	Director	<a href="mailto:anu.ganti@spglobal.com">anu.ganti@spglobal.com</a>
Hamish Preston	Senior Associate	<a href="mailto:hamish.preston@spglobal.com">hamish.preston@spglobal.com</a>
Howard Silverblatt	Senior Industry Analyst	<a href="mailto:howard.silverblatt@spglobal.com">howard.silverblatt@spglobal.com</a>

## GENERAL DISCLAIMER

Copyright © 2017 by S&P Dow Jones Indices LLC, a part of S&P Global. All rights reserved. Standard & Poor's®, S&P 500® and S&P® are registered trademarks of Standard & Poor's Financial Services LLC ("S&P"), a subsidiary of S&P Global. Dow Jones® is a registered trademark of Dow Jones Trademark Holdings LLC ("Dow Jones"). Trademarks have been licensed to S&P Dow Jones Indices LLC. Redistribution, reproduction and/or photocopying in whole or in part are prohibited without written permission. This document does not constitute an offer of services in jurisdictions where S&P Dow Jones Indices LLC, Dow Jones, S&P or their respective affiliates (collectively "S&P Dow Jones Indices") do not have the necessary licenses. All information provided by S&P Dow Jones Indices is impersonal and not tailored to the needs of any person, entity or group of persons. S&P Dow Jones Indices receives compensation in connection with licensing its indices to third parties. Past performance of an index is not a guarantee of future results.

It is not possible to invest directly in an index. Exposure to an asset class represented by an index is available through investable instruments based on that index. S&P Dow Jones Indices does not sponsor, endorse, sell, promote or manage any investment fund or other investment vehicle that is offered by third parties and that seeks to provide an investment return based on the performance of any index. S&P Dow Jones Indices makes no assurance that investment products based on the index will accurately track index performance or provide positive investment returns. S&P Dow Jones Indices LLC is not an investment advisor, and S&P Dow Jones Indices makes no representation regarding the advisability of investing in any such investment fund or other investment vehicle. A decision to invest in any such investment fund or other investment vehicle should not be made in reliance on any of the statements set forth in this document. Prospective investors are advised to make an investment in any such fund or other vehicle only after carefully considering the risks associated with investing in such funds, as detailed in an offering memorandum or similar document that is prepared by or on behalf of the issuer of the investment fund or other vehicle. Inclusion of a security within an index is not a recommendation by S&P Dow Jones Indices to buy, sell, or hold such security, nor is it considered to be investment advice.

These materials have been prepared solely for informational purposes based upon information generally available to the public and from sources believed to be reliable. No content contained in these materials (including index data, ratings, credit-related analyses and data, research, valuations, model, software or other application or output therefrom) or any part thereof (Content) may be modified, reverse-engineered, reproduced or distributed in any form or by any means, or stored in a database or retrieval system, without the prior written permission of S&P Dow Jones Indices. The Content shall not be used for any unlawful or unauthorized purposes. S&P Dow Jones Indices and its third-party data providers and licensors (collectively "S&P Dow Jones Indices Parties") do not guarantee the accuracy, completeness, timeliness or availability of the Content. S&P Dow Jones Indices Parties are not responsible for any errors or omissions, regardless of the cause, for the results obtained from the use of the Content. THE CONTENT IS PROVIDED ON AN "AS IS" BASIS. S&P DOW JONES INDICES PARTIES DISCLAIM ANY AND ALL EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE, FREEDOM FROM BUGS, SOFTWARE ERRORS OR DEFECTS, THAT THE CONTENT'S FUNCTIONING WILL BE UNINTERRUPTED OR THAT THE CONTENT WILL OPERATE WITH ANY SOFTWARE OR HARDWARE CONFIGURATION. In no event shall S&P Dow Jones Indices Parties be liable to any party for any direct, indirect, incidental, exemplary, compensatory, punitive, special or consequential damages, costs, expenses, legal fees, or losses (including, without limitation, lost income or lost profits and opportunity costs) in connection with any use of the Content even if advised of the possibility of such damages.

S&P Dow Jones Indices keeps certain activities of its business units separate from each other in order to preserve the independence and objectivity of their respective activities. As a result, certain business units of S&P Dow Jones Indices may have information that is not available to other business units. S&P Dow Jones Indices has established policies and procedures to maintain the confidentiality of certain non-public information received in connection with each analytical process.

In addition, S&P Dow Jones Indices provides a wide range of services to, or relating to, many organizations, including issuers of securities, investment advisers, broker-dealers, investment banks, other financial institutions and financial intermediaries, and accordingly may receive fees or other economic benefits from those organizations, including organizations whose securities or services they may recommend, rate, include in model portfolios, evaluate or otherwise address.

## CONTRIBUTORS

**Anu R. Ganti, CFA**  
Director  
Index Investment Strategy  
[anu.ganti@spglobal.com](mailto:anu.ganti@spglobal.com)

**Craig J. Lazzara, CFA**  
Managing Director  
Index Investment Strategy  
[craig.lazzara@spglobal.com](mailto:craig.lazzara@spglobal.com)

# Shooting the Messenger

“Active investing has been subjected to increasing abuse, particularly by those whose opinions are driven by the persistent accumulation of hard data and logical arguments.”<sup>1</sup>

- Charles D. Ellis

## EXECUTIVE SUMMARY

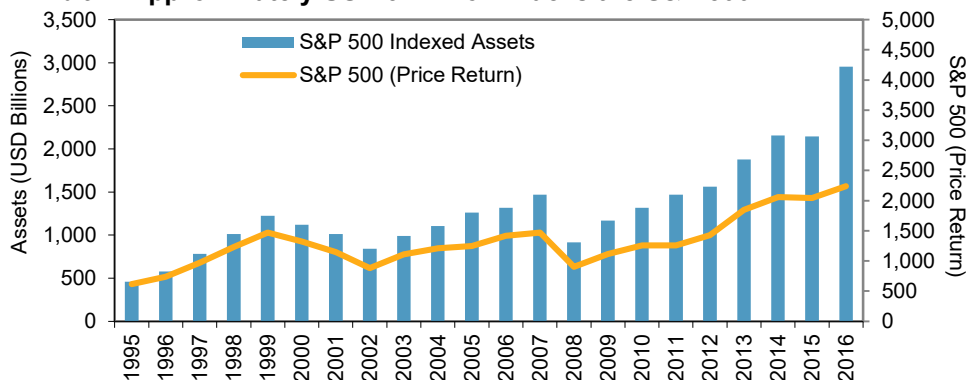
Index funds, which did not exist 50 years ago, now play a prominent role in global financial markets. The growth of indexing was driven by the failure of active managers, in aggregate, to outperform passive benchmarks. This failure is not a new development—it was reported as long ago as the 1930s. **The rise of passive management was the consequence of active performance shortfalls.**

These shortfalls can be attributed to four sources:

- Cost
- The professionalization of investment management
- Market efficiency
- The skewness of stock returns

We estimate that 20% of U.S. equity assets, amounting to approximately USD 5 trillion, was invested in index trackers as of Dec. 30, 2016. This commitment to passive management could save asset owners **more than USD 20 billion annually.**

### Exhibit 1: Approximately USD 3 Trillion Tracks the S&P 500®



Source: S&P Dow Jones Indices LLC. Data as of Dec. 30, 2016. Past performance is no guarantee of future results. Chart is provided for illustrative purposes.

<sup>1</sup> Ellis, Charles D., “[In Defense of Active Investing](#),” *Financial Analysts Journal*, July/August 2015.

## SOME IMPORTANT OBSERVATIONS

Fifty years ago, there were no index funds; all assets were managed actively. The subsequent shift of assets from active to passive management, as illustrated in Exhibit 1, surely must count as one of the most important developments in modern financial history. Our intent in this paper is to suggest why this transformation came about; the answer, in our view, lies both in a *set of observations* and in the subsequent *explanation* of those observations.

The observations to which we refer are designed to identify the extent to which active managers are able to add value to the performance of passive benchmarks. We'll cite evidence from three decades, spanning more than 80 years of history.

The earliest study of active management of which we're aware dates to 1932. Alfred Cowles examined the stock selection records of both financial services and fire insurance companies (what we would today call property and casualty insurers). Both sets of forecasters underperformed the average common stock during the period examined. The same was true of a number of financial publications that made predictions of the overall level of the stock market. For all these cases, "statistical tests...failed to demonstrate that they exhibited skill, and indicated that they more probably were [the] results of chance."<sup>2</sup>

By the 1970s, the financial markets had grown dramatically as professionals, rather than the retail investors of Cowles' day, had come to dominate asset management and trading.

Forty years later, by the 1970s, financial markets had grown dramatically as professionals, rather than the retail investors of Cowles' day, had come to dominate asset management and trading. The growth of professional investment management led to the formation of a number of performance measurement services. Their verdict, by mid-decade, was ominous: "Disagreeable data are streaming out of the computers of Becker securities and Merrill Lynch and all the other performance measurement firms. Over and over and over again, these facts and figures inform us that investment managers are failing to perform. Not only are the nation's leading portfolio managers failing to produce positive absolute rates of return...but they are also failing to produce positive relative rates of return. Contrary to their oft articulated goal of outperforming the market averages, **investment managers are not beating the market: The market is beating them.**"<sup>3</sup>

In reaction to such data, some academics and forward-looking professionals began to argue for the establishment of a new kind of investment vehicle. **Since active managers were generally not able to beat the market, why not buy the market instead?** Such a vehicle—an

<sup>2</sup> Cowles 3rd, Alfred, "[Can Stock Market Forecasters Forecast?](#)" *Econometrica*, July 1933. See also Edwards, Tim, "[Eighty-one years later...](#)," Dec. 19, 2013.

<sup>3</sup> Ellis, Charles D., "[The Loser's Game](#)," *Financial Analysts Journal*, July/August 1975. Emphasis added.

index fund—would buy stocks not because a manager thought they had above-average performance potential, but simply because they were there. “What we need is a no-load, minimum-management-fee mutual fund that simply buys the hundreds of stocks making up the broad stock-market averages and does no trading from security to security in an attempt to catch the winners.”<sup>4</sup>

Nobel laureate Paul Samuelson suggested in 1974 that “some large foundation should set up an in-house portfolio that tracks the S&P 500 Index—if only for the purpose of setting up a naïve model against which their in-house gunslingers can measure their prowess.”<sup>5</sup> Samuelson’s evaluation of active portfolio managers was biting: “a respect for evidence compels me to incline toward the hypothesis that most portfolio decision makers should go out of business—take up plumbing, teach Greek, or help produce the annual GNP by serving as corporate executives.”

Samuelson’s wish for an [S&P 500](#) index fund was granted, more rapidly than he expected,<sup>6</sup> as index funds became available, even to retail investors, in the 1970s. Although many things have changed in the intervening 40 years, the performance data that animated Ellis, Malkiel, and Samuelson have been remarkably robust. Our firm’s SPIVA<sup>®</sup> reports have documented the performance of U.S. managers since 2001 (with shorter histories for other markets), and the results have been almost uniformly discouraging for the advocates of active management. Exhibit 2 illustrates the most recent update.<sup>7</sup>

Note that most active funds underperformed benchmarks appropriate to their investment style. This is not unusual—in fact, over the history of the SPIVA database, underperformance is far more common than not.

**Exhibit 2: The Majority of Active Managers Underperformed Passive Benchmarks**

FUND CATEGORY	COMPARISON INDEX	PERCENTAGE OF UNDERPERFORMING U.S. EQUITY FUNDS		
		1 YEAR	5 YEARS	10 YEARS
Large Cap	S&P 500	57	82	85
Mid Cap	S&P MidCap 400 <sup>®</sup>	61	87	95
Small Cap	S&P SmallCap 600 <sup>®</sup>	60	94	94

Source: S&P Dow Jones Indices LLC, CRSP. Data as of June 30, 2017. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

Note that most active funds underperformed benchmarks appropriate to their investment style. This is not unusual—in fact, over the history of the SPIVA database, underperformance is far more common than not.<sup>8</sup>

Moreover, **extending the time horizon makes active management look worse, not better.** This is consistent with the view that the true odds of

<sup>4</sup> Malkiel, Burton G., *A Random Walk Down Wall Street*, first edition, 1973, p. 226.

<sup>5</sup> Samuelson, Paul A., “[Challenge to judgment](#),” *Journal of Portfolio Management*, Fall 1974. Interestingly, John Bogle credits this article with inspiring him to start the first index mutual fund at Vanguard in 1976.

<sup>6</sup> Bogle, John C., “[The Professor, the Student, and the Index Fund](#),” Sept. 6, 2011.

<sup>7</sup> Soe, Aye M. and Ryan Poirier, “[SPIVA U.S. Scorecard](#),” September 2017.

<sup>8</sup> Soe, Aye M. and Ryan Poirier, “[SPIVA U.S. Scorecard](#),” April 2017, p. 4.



outperformance are less than even. If the likelihood of outperformance were greater than 50%, we would expect to see fluctuations above and below 50% over a period as short as one year, but over time we would expect to see more outperformers than underperformers. In fact, we observe the opposite.

Moreover, it's notable that active managers of mid- and small-cap portfolios seem to have just as much difficulty as their large-cap peers. This is not an intuitive conclusion; in fact it's sometimes argued that investors should index large-cap, well-researched, relatively "efficient" stocks and use active managers in the less well-covered mid- and small-cap arenas. At first blush, this is plausible, and it's certainly true that research coverage is tilted toward larger companies. However, the scarcity of research coverage only implies that the likelihood of *misvaluation* is higher among smaller companies. There's no reason to assume that the likelihood of *undervaluation* is higher, and it's the assumption of undervaluation that's critical to the argument for active management of smaller stocks.

It's notable that active managers of mid- and small-cap portfolios seem to have just as much difficulty as their large-cap peers.

We would argue, in fact, that overvaluation is at least as likely as undervaluation among smaller names. A manager who thinks he sees undervaluation can take advantage of it by buying the undervalued stock. A manager who thinks he sees overvaluation can sell his position down to zero. After that, he's helpless—unless he wants to borrow stock in order to short it. However, smaller names can often be quite difficult (or expensive) to borrow. This implies that overvaluation is likely to be more persistent than undervaluation; it's simply harder to get rid of it.

The SPIVA database focuses on mutual funds, net of fees, and critics sometimes argue that manager underperformance is entirely due to fee levels. It's also fair to observe that institutional asset owners have substantial bargaining power, resulting in lower fees and potentially better performance outcomes than mutual fund investors realize. **These objections are accurate, but not decisive.** Even ignoring fees altogether, Exhibit 3 shows that the majority of active managers still underperform.<sup>9</sup>

<sup>9</sup> Poirier, Ryan, Aye. M. Soe, and Hong Xie, "[SPIVA Institutional Scorecard: How Much Do Fees Affect the Active Versus Passive Debate?](#)" August 2017.

**Exhibit 3: Ignoring Fees Mitigated, but Did Not Eliminate, Active Underperformance**

FUND CATEGORY	COMPARISON INDEX	PERCENTAGE OF UNDERPERFORMING U.S. EQUITY FUNDS			
		MUTUAL FUNDS (NET)	MUTUAL FUNDS (GROSS)	INSTITUTIONAL ACCOUNTS (NET)	INSTITUTIONAL ACCOUNTS (GROSS)
Large Cap	S&P 500	85	68	80	69
Mid Cap	S&P MidCap 400	96	86	92	83
Small Cap	S&P SmallCap 600	96	81	91	79

Source: S&P Dow Jones Indices LLC, CRSP, eVestment Alliance. Data for 10 years ending Dec. 31, 2016. Past performance is no guarantee of future results. Table is provided for illustrative purposes. Gross of fee data adds each fund's expense ratio to its net performance.

If the majority of active managers underperform, it's nonetheless theoretically possible that *some* managers are consistently above average. Samuelson was explicit on this point: "It is not ordained in heaven, or by the second law of thermodynamics, that a small group of intelligent and informed investors cannot systematically achieve higher mean portfolio gains with lower average variabilities. People differ in their heights, pulchritude, and acidity. Why not in their P.Q. or performance quotient?"<sup>10</sup> SPIVA lets us test for this possibility in a number of ways.

Top-quartile managers were more likely to move to the bottom quartile than they were to remain at the top.

Exhibit 4 is representative of the data in our Persistence Scorecard.<sup>11</sup> In this exhibit we take a long-term view of the SPIVA database, looking at 10 years of history. We sorted managers into quartiles based on the first five years' performance and then examined quartile rankings for the second five years.

**Exhibit 4: Top Quartile Performance Did Not Persist**

FUND CATEGORY	% REPEATING IN TOP QUARTILE	% MOVING TO BOTTOM QUARTILE
Large Cap	20.1	20.9
Mid Cap	15.4	19.2
Small Cap	14.0	26.7

Source: S&P Dow Jones Indices LLC. Data for 10 years ending March 31, 2017. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

If performance were completely random, we'd expect 25% of the top-quartile managers from the first five years to be in the same quartile for the second five years. In fact, consistency is less than random—in no capitalization category did as many as 25% of the original top-quartile managers stay there. In fact, top-quartile managers were more likely to move to the bottom quartile than they were to remain at the top.<sup>12</sup>

<sup>10</sup> Samuelson, *op. cit.*, p 19.

<sup>11</sup> Soe, Aye M. and Ryan Poirier, "[Does Past Performance Matter? The Persistence Scorecard](#)," June 2017.

<sup>12</sup> Lazzara, Craig, "[Getting What You Pay For](#)," Oct. 27, 2017. Interestingly, if we ask about the persistence of outperformance versus the benchmark (as opposed to the persistence of ranking versus other managers), the results are equally discouraging. See Poirier, Ryan and Aye M. Soe, "[Fleeting Alpha: Evidence from the SPIVA and Persistence Scorecards](#)," February 2017.

The evidence, over many years, is clear:

- Most active managers underperformed most of the time.
- Outperformance, when it occurred, tended not to persist.

The next section of our paper asks why active managers—well educated, hardworking, and motivated to a fault—nonetheless have such a difficult time delivering outperformance.

## THE EXPLANATION: WHY INDEXING “WORKS”

Four (not mutually exclusive) arguments have been advanced to explain why active managers fail much of the time.

Lower cost is the simplest explanation for the success of passive management.

### Cost

Lower cost is the simplest explanation for the success of passive management. Imagine a market in which all assets are actively managed, and into which a passive alternative is, *deus ex machina*, inserted. This passive alternative buys a pro-rata slice of every company in the market. Since the passive managers buy a pro-rata share of every stock's capitalization, their portfolio, in aggregate, will be identical to the *aggregate* portfolio of the active managers. Before costs, therefore, the passive and active portfolios will have the same return.

However, active managers' costs—for research, trading, management fees, etc.—are inherently higher than those of passive managers. Thus, “properly measured, the average actively managed dollar must underperform the average passively managed dollar, net of costs. Empirical analyses that appear to refute this principle are guilty of improper measurement.”<sup>13</sup>

To illustrate the importance of costs, consider that the average expense ratio for active U.S. equity mutual fund managers in 2016 was 0.82%, compared to only 0.09% for their passive competitors.<sup>14</sup> This difference of approximately 70 bps offers investors an automatic advantage for choosing a passive manager versus an active one. The growing popularity of index funds, along with industry consolidation and economies of scale, has the potential to lower the costs of passive vehicles further.

### The Professionalization of Investment Management

**Investment management is a zero-sum game.** There is no *natural* source of outperformance; the outperformance of above-average investors is offset by the underperformance of below-average investors. “Investors”

<sup>13</sup> Sharpe, William F., “[The Arithmetic of Active Management](#),” *Financial Analysts Journal*, January/February 1991, p. 7-9.

<sup>14</sup> Collins, Sean, and James Duvall, “[Trends in the Expenses and Fees of Funds, 2016](#),” *ICI Research Perspective*, May 2017.

in this sense encompass not just professional money managers, but any owner of securities. These owners may well be undiversified owners of concentrated positions who are not aware that they're in a zero-sum game. Indeed, they may not be aware that there's a game at all.

For example, imagine a conservative retail investor who owns a few high-quality, dividend-paying electric utility companies because he values their relatively secure income stream. Such an investor is a potential source of alpha for every professional manager who is underweight utilities. Similarly, every corporate manager who owns a concentrated position in his own company's stock is a potential source of alpha for every professional manager who is underweight that industry or company. If professional investors represent a relatively small fraction of a market's assets, such undiversified amateurs can be an important source of the professionals' outperformance. **The outperformance garnered by professionals, in other words, could be provided by the underperformance of amateurs.**<sup>15</sup>

If professional investors represent a relatively small fraction of a market's assets, undiversified amateurs can be an important source of the professionals' outperformance.

However, if professionals become the dominant force in a market and amateur investors are relatively unimportant, the game changes—**the professionals are now competing against each other.** In the U.S., professionals had come to dominate by the mid-1970s, as Ellis' 1975 assessment makes clear: "Gifted, determined, ambitious professionals have come into investment management in such large numbers during the past 30 years that it may no longer be feasible for any of them to profit from the errors of all the others sufficiently often and by sufficient magnitude to beat the market averages."<sup>16</sup> This is one reason why, in our view, the 1970s saw so many calls for the establishment of market-tracking index portfolios.

It's important here to distinguish between *absolute* and *relative* skill. Absolute skill in active investing requires managers to access information and to form, based on some combination of fundamental, technical, and quantitative metrics, an assessment of the difference between a stock's current price and its true value. To criticize active managers' performance is by no means to impugn their absolute level of skill.<sup>17</sup> But managers don't operate in a vacuum. Absolute skill may be *necessary* for success as an active manager, but it is not *sufficient*. It's relative skill that determines outperformance and underperformance. It's not enough to be good at valuing companies; a successful active manager has to be better than his competitors.

<sup>15</sup> Mauboussin, Michael J. and Dan Callahan, "[Alpha and the Paradox of Skill](#)," July 15, 2013, p. 7.

<sup>16</sup> Ellis (1975), *op. cit.*, p.19.

<sup>17</sup> See Pastor, Lubos, Robert F. Stambaugh, and Lucian A. Taylor, "[Scale and Skill in Active Management](#)," February 2014.

If investment management is not unique in this respect, it at least is highly unusual. An average physician may be able to cure most illnesses, and an average lawyer may be a perfectly adequate source of legal representation for most needs. Indeed, below-average physicians and lawyers may still be sources of considerable value to their clients. However, investment management is different: an average investment manager is of no value at all. “Investing is unusual, in that the collective judgement of all the participants (weighted by the amount of money they control) is...available for free....**If a professional investor is to earn excess returns for his client, being good is insufficient—he must be exceptional.**”<sup>18</sup>

### Market Efficiency

“In investing, efficiency means that value and price are one and the same.”<sup>19</sup> To the degree that price and value correspond, active managers will be unable to generate incremental risk-adjusted returns. The trouble with this convenient formulation, of course, is that while we can easily observe prices, the proper value of any security is always a matter of opinion and subject to dispute.

If markets are efficient, active management is fruitless.

Eugene Fama coined the term “efficient market” in 1965, defining it as “a market in which prices always ‘fully reflect’ available information.”<sup>20</sup> He concluded that stock market prices follow a random walk, causing analysts to be unable to outperform consistently via fundamental or technical analysis. The challenge for advocates of the efficient markets hypothesis is that it’s quite easy to find *retrospective* evidence of times when value and price did not correspond—for example, during the technology bubble of the late 1990s or immediately prior to the market’s recovery in early 2009.<sup>21</sup>

What such examples demonstrate is that markets are not infallible. But not even Fama claims infallibility for the efficient markets hypothesis. “It’s a model, so it’s not completely true. No models are completely true. They are approximations to the world. The question is: ‘For what purposes are they good approximations?’ As far as I’m concerned, they’re good approximations for almost every purpose. I don’t know any investors who

<sup>18</sup> Arbit, Hal, “[The Nature of the Game](#),” *Journal of Portfolio Management*, Fall 1981, pp. 5-9. Emphasis added.

<sup>19</sup> Mauboussin, Michael J., “[The Paradox of Skill: Why Greater Skill Leads to More Luck](#),” Nov. 14, 2012, p. 12.

<sup>20</sup> Fama, Eugene F. “[The Behavior of Stock-Market Prices](#),” *Journal of Business*, January 1965, pp. 34-105, and “[Efficient Capital Markets: A Review of Theory and Empirical Work](#),” *Journal of Finance*, May 1970, p.383-417. The *weak form* of the efficient market hypothesis assumes that current stock prices fully reflect all currently available security market information, so that technical analysis cannot be used to achieve excess returns. The *semi-strong form* assumes that current prices quickly adjust to the release of all new public information. Prices reflect available market and non-market public information, eliminating the possibility of achieving excess returns using fundamental analysis. The *strong form* of the efficient market hypothesis assumes that current stock prices fully incorporate *all* public and private information, so that realizing consistent excess returns is impossible.

<sup>21</sup> Mauboussin (2012), *op. cit.*

shouldn't act as if markets are efficient."<sup>22</sup> And if markets are efficient, active management is fruitless.

## Skewness

The skewness of stock returns is an underappreciated element in the performance difficulties of active managers. Exhibit 5 is a simple example of skewed returns; we posit a market with five stocks, one of which dramatically outperforms the others.<sup>23</sup> We assume that at the beginning of the year, the stocks' capitalizations are identical, so that the market's return is 18%, driven by the outstanding performance of stock E.

**Exhibit 5: Hypothetical Returns in a Five-Stock Market**

STOCK	A	B	C	D	E
RETURN (%)	10	10	10	10	50

Source: S&P Dow Jones Indices LLC. Table is provided for illustrative purposes.

The skewness of stock returns is an underappreciated element in the performance difficulties of active managers.

We can form portfolios of various sizes from these five stocks, as shown in Exhibit 6. There are, for example, five possible one-stock portfolios, four of which underperform the market as a whole. Alternatively, there are also five possible four-stock portfolios, four of which outperform the market as a whole. Since the market, in this example, is up 18%, the *average* return of the portfolios is always 18%—if the market gives us 18%, it doesn't matter how we slice it up. What changes is the *distribution of returns* across portfolios. **Holding more stocks increases the likelihood of outperformance.**<sup>24</sup>

**Exhibit 6: More Concentrated Portfolios Are More Likely to Underperform**

NUMBER OF STOCKS	NUMBER OF PORTFOLIOS	MEDIAN RETURN (%)	AVERAGE RETURN (%)	PROBABILITY OF OUTPERFORMANCE (%)
1	5	10	18	20
2	10	10	18	40
3	10	23	18	60
4	5	20	18	80

Source: S&P Dow Jones Indices LLC. Table is provided for illustrative purposes.

The intuition here is simple: a manager's picks are more likely to underperform than to outperform simply because there are more underperformers than outperformers from which to choose.<sup>25</sup> If returns are positively skewed, more concentrated portfolios are therefore relatively

<sup>22</sup> Chicago Booth Review, "[Are Markets Efficient?](#)" June 30, 2016.

<sup>23</sup> This example is drawn from Heaton, J.B., Nick Polson, and Jan Hendrik Witte, "[Why Indexing Works](#)," October 2015.

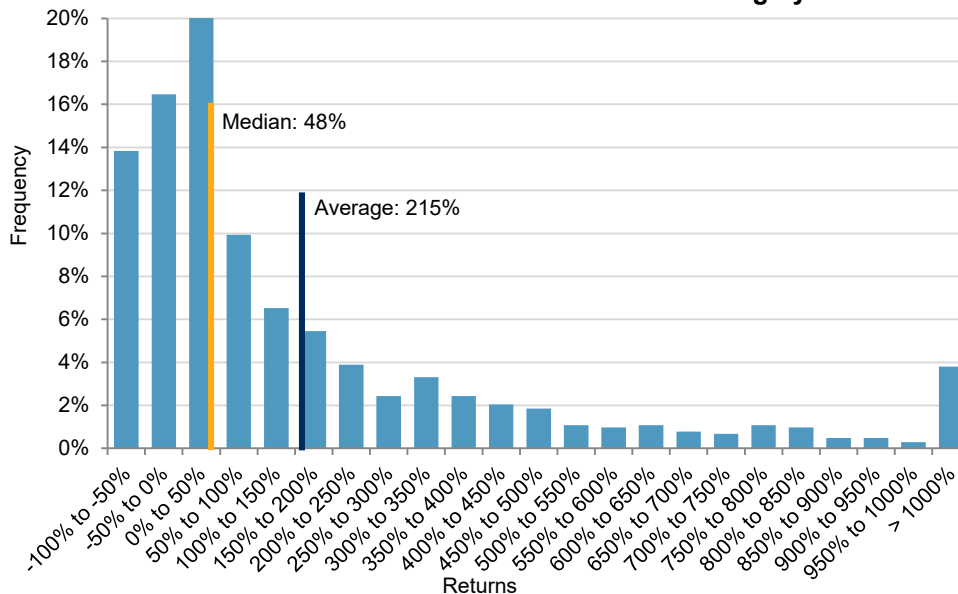
<sup>24</sup> Edwards, Tim and Craig J. Lazzara, "[Fooled by Conviction](#)," July 2016. See also Livnat, Joshua, Gavin Smith, and Martin B. Tarlie, "[Modified IR As a Predictor of Fund Performance](#)," October 2015, for evidence that among comparably-skillful active managers, greater diversification is an indicator of better future performance.

<sup>25</sup> The challenge for stock pickers is exacerbated when the outperformers include the largest stocks in the index. See Chan, Fei Mei and Craig J. Lazzara, "[Degrees of Difficulty: Indications of Active Success](#)," December 2017, pp. 8-9.

likely to underperform, while more diversified portfolios are relatively likely to outperform. Since most active managers run fairly concentrated portfolios (at least relative to the universe from which they draw their stock picks), **if returns in the real world are skewed, that helps us explain active underperformance.**

Real-world returns are skewed. We might suspect that there is a natural tendency toward skewed equity returns—after all, a stock can only go down by 100%, while it can appreciate by much more than that. This intuition is confirmed by Exhibit 7, which plots the distribution of cumulative returns for the constituent stocks of the S&P 500 for the last 20 years. The median return was 48%, far less than the average of 215%. Importantly, the positive skew in equity returns demonstrated by Exhibit 7 is not simply a long-term phenomenon: in the 26 years between 1991 and 2016, the average S&P 500 stock outperformed the median 22 times.<sup>26</sup>

**Exhibit 7: Constituent Returns for S&P 500 Members Are Highly Skewed**



Since data on exchange-traded funds are relatively easy to come by, other pools of assets are sometimes ignored.

Source: S&P Dow Jones Indices LLC, Factset. Data from Oct. 31, 1997, to Oct. 31, 2017. Past performance is no guarantee of future results. Chart is provided for illustrative purposes.

## WHERE ARE WE NOW?

We conclude by estimating the extent to which asset owners in the U.S. market have adopted passive management. Understanding the market share of passive assets requires us to get both the numerator (passive AUM) and denominator (total market capitalization) correct, and much press commentary is mistaken about one or both. Moreover, since data on exchange-traded funds are relatively easy to come by, other pools of assets

<sup>26</sup> We find similar results in other markets. The average stock outperformed the median in 15 of the last 19 years for the [S&P/TSX Composite](#), 13 of 18 years for the [S&P Europe 350](#), 20 of 21 years for the [S&P/TOPIX 150](#), 9 of 16 years for the [S&P/ASX 200](#), and 20 of 20 years for the [S&P Pan Asia ex-Japan & Taiwan BMI](#). For a longer term perspective, see Bessembinder, Hendrik, [“Do Stocks Outperform Treasury Bills?”](#) November 2017.



are sometimes ignored. For example, a common misconception is that the Bank of Japan (BoJ) owns more than two-thirds of the Japanese stock market. In fact, the BoJ owns 70% of *listed ETFs*, and only 2.5% of the capitalization of the market.<sup>27</sup>

**We estimate that 20% of total float-adjusted U.S. market capitalization is held by passive index trackers.** As detailed by Exhibit 8, this estimate includes assets tracking our own indices, as well as those of some prominent competitors. For S&P DJI indices, estimates are drawn from our annual survey of indexed assets.<sup>28</sup> Information on other index providers came from sell-side sources<sup>29</sup> as well as from their own websites. The denominator includes the total float-weighted market capitalization of the large- and small-cap universe. Importantly, this estimate *excludes* the factor indices that underlie “smart beta” ETFs. This exclusion makes sense because factor indices represent a hybrid of passive and active approaches. They are based on fundamental metrics like value or momentum, seeking much the same end, although by different means, as active managers. Hence it is appropriate to exclude them from an estimate of purely passive assets.

Passive management, for the S&P 500 alone, saves investors USD 22.5 billion annually.

**Exhibit 8: Index Trackers Account for 20% of the Value of the U.S. Equity Market**

INDEX	ESTIMATES OF ASSETS TRACKING (IN USD BILLIONS)	FLOAT-ADJUSTED MARKET CAP (IN USD BILLIONS)
S&P 500	2,955	21,150
S&P MidCap 400	133	1,644
S&P SmallCap 600	62	724
Russell 1000	847	23,539
Russell 2000	185	1,904
CRSP – Vanguard Funds (Large, Mid, Small Cap)	822	
Total Assets Tracking	5,004	
Total Float-Adjusted Market Cap (Large and Small Cap)	25,443	
<b>Passive Market Share Estimate</b>	<b>20%</b>	

Source: S&P Dow Jones Indices LLC, Factset, Barclays, CRSP. S&P DJI assets tracking data as of December 2016, Factset data as of July 2017, CRSP data as of June 2017, and Barclays data as of September 2017. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

Exhibit 8 tells us that approximately USD 5 trillion tracks various U.S. cap-weighted indices, with USD 3 trillion tracking the S&P 500 alone. These numbers enable us to estimate one benefit of passive management to investors. We previously noted the roughly 70 bps fee differential that

<sup>27</sup> Takeo, Yuko, Lee, Min Jeong, and Toshiro Hasegawa, “[Japan’s Central Bank Is Distorting the Market, Bourse Chief Says](#),” July 19, 2017. See also Ganti, Anu, “[Don’t Shoot the Messenger](#),” Sept. 27, 2017.

<sup>28</sup> S&P Dow Jones Indices, “[Annual Survey of Assets](#),” June 29, 2017.

<sup>29</sup> U.S. Index Corporate Action Calendar: Week of Sept. 4-Sept. 7, 2017, *Barclays Desk Analysts and Trading*, September 2017.



separates active and passive U.S. mutual fund managers.<sup>30</sup> Multiplying this fee differential by USD 3 trillion tells us that **passive management, for the S&P 500 alone, saves investors USD 22.5 billion annually.**

It would, of course, be penny wise and pound foolish for investors to save a few basis points on management fees if those savings caused them to miss an even larger increment of active performance, but as we've already seen, it isn't because they don't. These savings accrue entirely to the benefit of index fund investors.

## FINAL THOUGHTS

Fifty years ago, there were no index funds. Edward Johnson of Fidelity spoke for most active managers of that time when he said (criticizing the nascent Vanguard), "I can't believe that the great mass of investors are going to be satisfied with receiving just average returns."<sup>31</sup> Ironically, of course, **above-average returns are exactly what index investors have received—and what most active investors have missed.**

If active managers had delivered above-average performance, the passive investment industry would not have developed and would not exist today. Evidence of active underperformance is nearly a century old, and we've suggested some of the reasons—cost, professionalization, market efficiency, and skewness—that help explain it.

Index-tracking assets, conservatively reckoned, amount to perhaps 20% of the value of the U.S. stock market today, and their growth shows no sign of abating. Even at today's share of assets, there has been an enormous transfer of wealth from active managers to asset owners—a transfer amounting to over USD 20 billion annually.

If active managers had delivered above-average performance, the passive investment industry would not have developed and would not exist today.

<sup>30</sup> Collins and Duvall, *op. cit.*, p. 1.

<sup>31</sup> Swedroe, Larry, "[Passive Investing Won't Break Market](#)," Sept. 6, 2016.

<b>S&amp;P DJI RESEARCH CONTRIBUTORS</b>		
Charles Mounts	Global Head	<a href="mailto:charles.mounts@spglobal.com">charles.mounts@spglobal.com</a>
Jake Vukelic	Business Manager	<a href="mailto:jake.vukelic@spglobal.com">jake.vukelic@spglobal.com</a>
<b>GLOBAL RESEARCH &amp; DESIGN</b>		
<b>AMERICAS</b>		
Aye M. Soe, CFA	Americas Head	<a href="mailto:aye.soe@spglobal.com">aye.soe@spglobal.com</a>
Dennis Badlyans	Associate Director	<a href="mailto:dennis.badlyans@spglobal.com">dennis.badlyans@spglobal.com</a>
Phillip Brzenk, CFA	Director	<a href="mailto:phillip.brzenk@spglobal.com">phillip.brzenk@spglobal.com</a>
Smita Chirputkar	Director	<a href="mailto:smita.chirputkar@spglobal.com">smita.chirputkar@spglobal.com</a>
Rachel Du	Senior Analyst	<a href="mailto:rachel.du@spglobal.com">rachel.du@spglobal.com</a>
Bill Hao	Director	<a href="mailto:wenli.hao@spglobal.com">wenli.hao@spglobal.com</a>
Qing Li	Director	<a href="mailto:qing.li@spglobal.com">qing.li@spglobal.com</a>
Berlinda Liu, CFA	Director	<a href="mailto:berlinda.liu@spglobal.com">berlinda.liu@spglobal.com</a>
Ryan Poirier, FRM	Senior Analyst	<a href="mailto:ryan.poirier@spglobal.com">ryan.poirier@spglobal.com</a>
Maria Sanchez	Associate Director	<a href="mailto:maria.sanchez@spglobal.com">maria.sanchez@spglobal.com</a>
Kelly Tang, CFA	Director	<a href="mailto:kelly.tang@spglobal.com">kelly.tang@spglobal.com</a>
Peter Tsui	Director	<a href="mailto:peter.tsui@spglobal.com">peter.tsui@spglobal.com</a>
Hong Xie, CFA	Director	<a href="mailto:hong.xie@spglobal.com">hong.xie@spglobal.com</a>
<b>APAC</b>		
Priscilla Luk	APAC Head	<a href="mailto:priscilla.luk@spglobal.com">priscilla.luk@spglobal.com</a>
Utkarsh Agrawal, CFA	Associate Director	<a href="mailto:utkarsh.agrawal@spglobal.com">utkarsh.agrawal@spglobal.com</a>
Liyu Zeng, CFA	Director	<a href="mailto:liyu.zeng@spglobal.com">liyu.zeng@spglobal.com</a>
Akash Jain	Associate Director	<a href="mailto:akash.jain@spglobal.com">akash.jain@spglobal.com</a>
<b>EMEA</b>		
Sunjiv Mainie, CFA, CQF	EMEA Head	<a href="mailto:sunjiv.mainie@spglobal.com">sunjiv.mainie@spglobal.com</a>
Leonardo Cabrer, PhD	Senior Analyst	<a href="mailto:leonardo.cabrer@spglobal.com">leonardo.cabrer@spglobal.com</a>
Andrew Innes	Associate Director	<a href="mailto:andrew.innes@spglobal.com">andrew.innes@spglobal.com</a>
<b>INDEX INVESTMENT STRATEGY</b>		
Craig J. Lazzara, CFA	Global Head	<a href="mailto:craig.lazzara@spglobal.com">craig.lazzara@spglobal.com</a>
Fei Mei Chan	Director	<a href="mailto:feimei.chan@spglobal.com">feimei.chan@spglobal.com</a>
Tim Edwards, PhD	Senior Director	<a href="mailto:tim.edwards@spglobal.com">tim.edwards@spglobal.com</a>
Anu R. Ganti, CFA	Director	<a href="mailto:anu.ganti@spglobal.com">anu.ganti@spglobal.com</a>
Hamish Preston	Senior Associate	<a href="mailto:hamish.preston@spglobal.com">hamish.preston@spglobal.com</a>
Howard Silverblatt	Senior Index Analyst	<a href="mailto:howard.silverblatt@spglobal.com">howard.silverblatt@spglobal.com</a>

## GENERAL DISCLAIMER

Copyright © 2017 by S&P Dow Jones Indices LLC, a part of S&P Global. All rights reserved. Standard & Poor's®, S&P 500® and S&P® are registered trademarks of Standard & Poor's Financial Services LLC ("S&P"), a subsidiary of S&P Global. Dow Jones® is a registered trademark of Dow Jones Trademark Holdings LLC ("Dow Jones"). Trademarks have been licensed to S&P Dow Jones Indices LLC. Redistribution, reproduction and/or photocopying in whole or in part are prohibited without written permission. This document does not constitute an offer of services in jurisdictions where S&P Dow Jones Indices LLC, Dow Jones, S&P or their respective affiliates (collectively "S&P Dow Jones Indices") do not have the necessary licenses. All information provided by S&P Dow Jones Indices is impersonal and not tailored to the needs of any person, entity or group of persons. S&P Dow Jones Indices receives compensation in connection with licensing its indices to third parties. Past performance of an index is not a guarantee of future results.

It is not possible to invest directly in an index. Exposure to an asset class represented by an index is available through investable instruments based on that index. S&P Dow Jones Indices does not sponsor, endorse, sell, promote or manage any investment fund or other investment vehicle that is offered by third parties and that seeks to provide an investment return based on the performance of any index. S&P Dow Jones Indices makes no assurance that investment products based on the index will accurately track index performance or provide positive investment returns. S&P Dow Jones Indices LLC is not an investment advisor, and S&P Dow Jones Indices makes no representation regarding the advisability of investing in any such investment fund or other investment vehicle. A decision to invest in any such investment fund or other investment vehicle should not be made in reliance on any of the statements set forth in this document. Prospective investors are advised to make an investment in any such fund or other vehicle only after carefully considering the risks associated with investing in such funds, as detailed in an offering memorandum or similar document that is prepared by or on behalf of the issuer of the investment fund or other vehicle. Inclusion of a security within an index is not a recommendation by S&P Dow Jones Indices to buy, sell, or hold such security, nor is it considered to be investment advice.

These materials have been prepared solely for informational purposes based upon information generally available to the public and from sources believed to be reliable. No content contained in these materials (including index data, ratings, credit-related analyses and data, research, valuations, model, software or other application or output therefrom) or any part thereof (Content) may be modified, reverse-engineered, reproduced or distributed in any form or by any means, or stored in a database or retrieval system, without the prior written permission of S&P Dow Jones Indices. The Content shall not be used for any unlawful or unauthorized purposes. S&P Dow Jones Indices and its third-party data providers and licensors (collectively "S&P Dow Jones Indices Parties") do not guarantee the accuracy, completeness, timeliness or availability of the Content. S&P Dow Jones Indices Parties are not responsible for any errors or omissions, regardless of the cause, for the results obtained from the use of the Content. THE CONTENT IS PROVIDED ON AN "AS IS" BASIS. S&P DOW JONES INDICES PARTIES DISCLAIM ANY AND ALL EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE, FREEDOM FROM BUGS, SOFTWARE ERRORS OR DEFECTS, THAT THE CONTENT'S FUNCTIONING WILL BE UNINTERRUPTED OR THAT THE CONTENT WILL OPERATE WITH ANY SOFTWARE OR HARDWARE CONFIGURATION. In no event shall S&P Dow Jones Indices Parties be liable to any party for any direct, indirect, incidental, exemplary, compensatory, punitive, special or consequential damages, costs, expenses, legal fees, or losses (including, without limitation, lost income or lost profits and opportunity costs) in connection with any use of the Content even if advised of the possibility of such damages.

S&P Dow Jones Indices keeps certain activities of its business units separate from each other in order to preserve the independence and objectivity of their respective activities. As a result, certain business units of S&P Dow Jones Indices may have information that is not available to other business units. S&P Dow Jones Indices has established policies and procedures to maintain the confidentiality of certain non-public information received in connection with each analytical process.

In addition, S&P Dow Jones Indices provides a wide range of services to, or relating to, many organizations, including issuers of securities, investment advisers, broker-dealers, investment banks, other financial institutions and financial intermediaries, and accordingly may receive fees or other economic benefits from those organizations, including organizations whose securities or services they may recommend, rate, include in model portfolios, evaluate or otherwise address.

## CONTRIBUTORS

**Aye M. Soe, CFA**  
Managing Director  
Global Research & Design  
[aye.soe@spglobal.com](mailto:aye.soe@spglobal.com)

**Ryan Poirier, FRM**  
Senior Analyst  
Global Research & Design  
[ryan.poirier@spglobal.com](mailto:ryan.poirier@spglobal.com)

# SPIVA<sup>®</sup> U.S. Scorecard

## SUMMARY

- The U.S. equity market ended 2017 on a strong positive note, with the [S&P 500<sup>®</sup>](#) posting 21.83% over the 12-month period as of Dec. 31, 2017. The [S&P MidCap 400<sup>®</sup>](#) and [S&P SmallCap 600<sup>®</sup>](#) followed, reporting gains of 16.24% and 13.23%, respectively.
- During the one-year period, the percentage of managers outperforming their respective benchmarks noticeably increased in categories like Mid-Cap Growth and Small-Cap Growth Funds, compared to results from six months prior. Over the one-year period, 63.08% of large-cap managers, 44.41% of mid-cap managers, and 47.70% of small-cap managers underperformed the S&P 500, the S&P MidCap 400, and the S&P SmallCap 600, respectively.
- While results over the short term were favorable, the majority of active equity funds underperformed over the longer-term investment horizons. Over the five-year period, 84.23% of large-cap managers, 85.06% of mid-cap managers, and 91.17% of small-cap managers lagged their respective benchmarks.
- Similarly, over the 15-year investment horizon, 92.33% of large-cap managers, 94.81% of mid-cap managers, and 95.73% of small-cap managers failed to outperform on a relative basis.
- Over the 12-month period ending Dec. 31, 2017, growth managers across all three market cap ranges fared better than their core and value counterparts. The results highlight the cyclical nature of style box investing, as core managers outperformed 12 months prior with the exception of small caps, while value managers outperformed core and growth 18 months prior.

- Across nine U.S. style categories, large-cap value managers was the best performing category over the 10-year and 15-year horizons, with 29.56% and 14.29% of managers outperforming the benchmark, the [S&P 500 Value](#).
- The headline international equity and emerging market equity indices began a strong rally in November 2016 that continued through 2017. Over the one-year period ending Dec. 31, 2017, the [S&P/IFCI Composite](#) posted 37.89%; the S&P Developed Ex-U.S. Small Cap, [S&P International 700](#), and [S&P Global 1200](#) reported 32.37%, 26.64%, and 23.84%, respectively, over the same period.
- During the one-year period, with the exception of actively managed international small-cap equity funds, the majority of managers investing in global, international, and emerging market funds underperformed their respective benchmarks.
- Over the 3-, 5-, 10-, and 15-year investment horizons, managers across all international equity categories underperformed their benchmarks. Furthermore, the longer the time horizon, in general, the more funds underperformed.
- The U.S. Federal Reserve increased rates three times during 2017. However, the 10-Year U.S. Treasury yield has not moved significantly off of its year-end 2016 levels, resulting in a flatter yield curve. During the one-year period ending Dec. 31, 2017, the majority of active fixed income managers investing in long-term government and corporate credit bonds underperformed their benchmarks, marking a shift from six months prior when they vastly outperformed.
- In contrast, funds investing in short- and intermediate-term government and credit bonds outperformed their benchmarks.
- Across all time periods studied, high-yield managers struggled to outperform their benchmark. During the one-year period, over 80.95% of actively managed high-yield bonds failed to deliver higher returns than the benchmark's 7.50% return.
- The majority of municipal funds outperformed over the 12-month period, despite having mixed results over the three- and five-year investment horizons. However, over the 10- and 15-year periods, most muni funds underperformed their benchmarks. While these funds underperformed over the long term, it should be noted that municipal categories have some of the best survivorship statistics.
- Funds disappear at a meaningful rate. Over the 15-year period, 58% of domestic equity funds, 55% of international equity funds, and an average of 48% of all fixed income funds were merged or liquidated. This finding highlights the importance of addressing survivorship bias in mutual fund analysis.

## A UNIQUE SCORECARD FOR THE ACTIVE VERSUS PASSIVE DEBATE

There is nothing novel about the index versus active debate. It has been a contentious subject for decades, and there are few strong believers on both sides, with the vast majority of market participants falling somewhere in between. Since its first publication 16 years ago, the SPIVA Scorecard has served as the de facto scorekeeper of the active versus passive debate. For more than a decade, we have heard passionate arguments from believers in both camps when headline numbers have deviated from their beliefs.

Beyond the SPIVA Scorecard's widely cited headline numbers is a rich data set that addresses issues related to measurement techniques, universe composition, and fund survivorship that are far less frequently discussed, but are often far more fascinating. These data sets are rooted in the following fundamental principles of the SPIVA Scorecard, with which regular readers will be familiar.

- **Survivorship Bias Correction:** Many funds might be liquidated or merged during a period of study. However, for someone making an investment decision at the beginning of the period, these funds are part of the opportunity set. Unlike other commonly available comparison reports, SPIVA Scorecards account for the entire opportunity set—not just the survivors—thereby eliminating survivorship bias.
- **Apples-to-Apples Comparison:** Fund returns are often compared to popular benchmarks such as the [S&P 500](#), regardless of size or style classification. SPIVA Scorecards avoid this pitfall by measuring a fund's returns against the returns of a benchmark appropriate for that particular investment category.
- **Asset-Weighted Returns:** Average returns for a fund group are often calculated using only equal weighting, which results in the returns of a USD 10 billion fund affecting the average in the same manner as the returns of a USD 10 million fund. An accurate representation of how market participants fared in a particular period can be ascertained by calculating weighted average returns where each fund's return is weighted by net assets. SPIVA Scorecards show both equal- and asset-weighted averages.
- **Style Consistency:** SPIVA Scorecards measure style consistency for each style category across different time horizons. Style consistency is an important metric because style drift (the tendency of funds to diverge from their initial investment categorization) can have an impact on asset allocation decisions.
- **Data Cleaning:** SPIVA Scorecards avoid double counting multiple share classes in all count-based calculations, using only the share class with greater assets. Since this is meant to be a scorecard for active managers, index funds, leveraged and inverse funds, and other index-linked products are excluded.

## Equity Annual League Table

We have often written about the lack of consistency in results when viewing over a shorter horizon. The annual league table is evidence of that, and it shows the yearly match up of the active funds versus indices in the major U.S. equity and fixed income categories (see Exhibits 1 and 2).

Exhibit 1: Equity Annual League Table																		
FUND CATEGORY	BENCHMARK INDEX	(% OF ACTIVE FUNDS OUTPERFORMED BY THEIR BENCHMARK)																
		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
All Domestic Funds	S&P 1500	54.87	58.34	48.01	51.43	42.26	68.02	48.90	64.91	40.68	48.28	84.65	64.91	43.26	86.89	74.03	60.49	63.43
All Large-Cap Funds	S&P 500	65.16	67.73	75.44	68.79	48.81	68.38	44.63	55.95	48.40	65.88	82.24	62.66	54.56	86.73	65.39	66.00	63.08
All Mid-Cap Funds	S&P MidCap 400	67.64	74.43	51.70	64.56	73.63	44.77	45.77	75.73	55.69	73.29	68.59	79.85	37.11	66.05	57.18	89.37	44.41
All Small-Cap Funds	S&P SmallCap 600	53.97	67.54	34.63	83.84	60.95	62.53	45.98	83.30	30.69	53.95	85.81	66.28	67.77	71.96	71.79	85.54	47.70
All Multi-Cap Funds	S&P 1500	54.73	54.02	49.21	49.38	37.14	68.77	45.97	70.14	39.30	60.39	83.88	65.22	46.84	81.62	70.10	74.88	56.46
Large-Cap Growth Funds	S&P 500 Growth	94.80	83.13	48.36	44.08	37.96	93.93	27.14	90.67	36.81	50.98	95.90	45.62	41.08	95.61	47.55	89.79	32.92
Large-Cap Core Funds	S&P 500	77.03	66.55	85.29	82.91	56.16	81.09	43.50	52.26	50.55	76.61	83.21	66.59	57.65	80.38	73.75	74.56	68.98
Large-Cap Value Funds	S&P 500 Value	30.77	34.63	85.98	86.47	54.11	80.28	45.79	24.45	45.71	70.55	54.28	85.05	64.86	77.78	61.52	77.99	46.88
Mid-Cap Growth Funds	S&P MidCap 400 Growth	87.96	86.24	35.75	64.16	79.67	27.96	41.97	90.95	54.01	84.11	76.53	86.81	34.48	55.37	79.68	94.58	18.05
Mid-Cap Core Funds	S&P MidCap 400	80.00	70.42	54.74	57.27	66.34	32.04	60.78	60.18	70.75	86.54	65.66	78.57	42.96	58.65	68.18	90.65	61.67
Mid-Cap Value Funds	S&P MidCap 400 Value	47.42	63.64	68.42	53.09	69.14	36.90	57.83	68.00	47.33	57.14	67.61	73.47	40.85	71.43	34.38	96.77	43.14
Small-Cap Growth Funds	S&P SmallCap 600 Growth	76.64	97.14	26.88	94.71	78.06	50.75	40.80	94.84	31.34	62.25	94.12	62.91	55.25	63.98	87.50	95.96	15.08
Small-Cap Core Funds	S&P SmallCap 600	57.78	67.27	34.88	79.47	58.33	56.34	55.51	82.07	33.22	58.63	86.01	68.68	77.74	66.92	77.46	89.47	58.59
Small-Cap Value Funds	S&P SmallCap 600 Value	39.07	29.93	48.08	71.76	45.24	71.26	39.36	72.07	25.17	41.98	81.82	61.54	78.81	94.07	45.04	88.89	74.07

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

**Fixed Income Annual League Table**

Exhibit 2: Fixed Income Annual League Table																		
FUND CATEGORY	BENCHMARK INDEX	(% OF ACTIVE FUNDS OUTPERFORMED BY THEIR BENCHMARK)																
		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Government Long Funds	Barclays US Government Long	28.95	98.44	85.45	98.25	96.49	20.00	89.36	95.74	8.33	95.29	96.55	71.43	10.94	96.83	20.34	87.93	96.43
Government Intermediate Funds	Barclays US Government Intermediate	91.40	66.67	77.03	62.86	65.08	57.63	92.59	90.00	9.09	73.81	60.53	33.33	76.67	44.44	88.89	74.07	57.89
Government Short Funds	Barclays US Government (1-3 Year)	94.74	72.00	82.98	62.22	65.91	71.43	90.70	86.05	23.81	59.52	60.98	42.50	95.12	60.00	89.74	63.16	47.83
Investment-Grade Long Funds	Barclays US Government/Credit Long	38.27	99.36	68.18	95.95	99.26	9.24	84.26	95.24	7.38	78.01	99.27	62.02	7.32	98.02	12.15	75.00	96.74
Investment-Grade Intermediate Funds	Barclays US Government/Credit Intermediate	87.14	85.58	55.35	36.24	37.73	49.07	93.02	89.87	14.09	31.43	49.65	20.70	63.54	33.07	93.25	19.75	31.37
Investment-Grade Short Funds	Barclays US Government/Credit (1-3 Year)	100.00	87.27	67.21	37.50	53.42	46.91	96.34	98.84	16.67	25.00	56.58	11.11	52.56	50.00	70.87	26.61	22.22
High Yield Funds	Barclays US Corporate High Yield	74.32	41.50	83.21	80.14	54.61	83.92	44.22	39.19	90.69	75.25	80.00	72.86	68.35	74.09	34.75	94.17	80.95
Mortgage-Backed Securities Funds	Barclays US Aggregate Securitized - MBS	84.21	64.29	83.33	95.00	67.24	92.86	87.50	94.34	36.51	25.00	53.13	24.62	71.21	75.81	72.88	60.00	67.92
Global Income Funds	Barclays Global Aggregate	61.54	64.41	35.85	41.18	55.56	69.23	69.35	77.03	30.00	39.64	77.68	18.49	48.92	37.78	61.54	33.08	64.86
Emerging Markets Debt Funds	Barclays Emerging Markets	9.09	60.00	21.74	28.57	50.00	30.00	42.86	65.38	48.28	34.48	91.43	50.85	74.00	77.78	89.33	39.19	22.58
General Municipal Debt Funds	S&P National AMT-Free Municipal Bond	78.99	67.24	47.75	79.63	79.25	73.12	84.09	81.48	25.00	57.32	77.22	20.78	68.67	31.33	59.30	71.91	42.86
California Municipal Debt Funds	S&P California AMT-Free Municipal Bond	75.51	57.78	15.22	85.11	75.56	72.09	95.24	94.87	10.53	77.78	75.00	6.06	91.43	13.89	38.89	61.11	25.71
New York Municipal Debt Funds	S&P New York AMT-Free Municipal Bond	89.13	73.81	79.49	76.92	76.92	76.32	91.18	88.24	27.27	58.06	75.00	17.24	100.00	7.14	53.57	74.07	33.33
Loan Participation Funds	S&P/LSTA U.S. Leveraged Loan 100	-	-	-	-	-	-	-	-	-	55.00	14.81	77.50	36.84	56.86	13.46	81.82	52.08

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Past performance is no guarantee of future results. Table is provided for illustrative purposes.



## REPORTS

### Report 1: Percentage of U.S. Equity Funds Outperformed by Benchmarks

FUND CATEGORY	COMPARISON INDEX	1-YEAR (%)	3-YEAR (%)	5-YEAR (%)	10-YEAR (%)	15-YEAR (%)
All Domestic Funds	S&P Composite 1500	63.43	83.40	86.72	86.65	83.74
All Large-Cap Funds	S&P 500	63.08	80.56	84.23	89.51	92.33
All Mid-Cap Funds	S&P MidCap 400	44.41	86.34	85.06	96.48	94.81
All Small-Cap Funds	S&P SmallCap 600	47.70	88.83	91.17	95.71	95.73
All Multi-Cap Funds	S&P Composite 1500	56.46	83.64	84.91	90.70	87.67
Large-Cap Growth Funds	S&P 500 Growth	32.92	67.58	80.92	93.65	93.49
Large-Cap Core Funds	S&P 500	68.98	88.45	90.99	94.95	94.67
Large-Cap Value Funds	S&P 500 Value	46.88	80.37	85.07	70.44	85.71
Mid-Cap Growth Funds	S&P MidCap 400 Growth	18.05	91.46	81.13	97.69	95.32
Mid-Cap Core Funds	S&P MidCap 400	61.67	88.24	87.90	96.15	96.51
Mid-Cap Value Funds	S&P MidCap 400 Value	43.14	75.41	81.54	88.04	88.89
Small-Cap Growth Funds	S&P SmallCap 600 Growth	15.08	86.53	86.67	95.56	98.73
Small-Cap Core Funds	S&P SmallCap 600	58.59	93.78	95.59	96.23	96.55
Small-Cap Value Funds	S&P SmallCap 600 Value	74.07	82.14	95.45	92.78	89.47
Multi-Cap Growth Funds	S&P Composite 1500 Growth	46.32	83.24	85.11	94.77	86.21
Multi-Cap Core Funds	S&P Composite 1500	68.78	92.78	90.13	90.14	90.82
Multi-Cap Value Funds	S&P Composite 1500 Value	49.57	76.47	76.24	84.21	85.96
Real Estate Funds	S&P United States REIT	36.90	59.76	73.68	84.54	81.13

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Returns shown are annualized. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

<b>Report 2: Survivorship and Style Consistency of U.S. Equity Funds</b>			
<b>FUND CATEGORY</b>	<b>NO. OF FUNDS AT START</b>	<b>SURVIVORSHIP (%)</b>	<b>STYLE CONSISTENCY (%)</b>
<b>1-YEAR</b>			
All Domestic Funds	2243	95.85	95.76
All Large-Cap Funds	845	95.38	91.12
All Mid-Cap Funds	305	95.74	89.51
All Small-Cap Funds	546	96.89	95.97
All Multi-Cap Funds	547	95.61	87.39
Large-Cap Growth Funds	243	94.24	88.48
Large-Cap Core Funds	278	95.68	86.69
Large-Cap Value Funds	324	95.99	91.05
Mid-Cap Growth Funds	134	95.52	87.31
Mid-Cap Core Funds	120	96.67	85.00
Mid-Cap Value Funds	51	94.12	82.35
Small-Cap Growth Funds	180	95.56	93.33
Small-Cap Core Funds	258	98.06	94.96
Small-Cap Value Funds	108	96.30	77.78
Multi-Cap Growth Funds	191	94.24	81.68
Multi-Cap Core Funds	240	96.67	85.42
Multi-Cap Value Funds	116	95.69	79.31
Real Estate Funds	84	96.43	97.62
<b>3-YEAR</b>			
All Domestic Funds	2335	85.78	85.14
All Large-Cap Funds	892	85.76	76.57
All Mid-Cap Funds	346	84.68	68.50
All Small-Cap Funds	549	87.25	85.61
All Multi-Cap Funds	548	85.04	66.61
Large-Cap Growth Funds	256	84.38	73.44
Large-Cap Core Funds	307	86.64	69.38
Large-Cap Value Funds	329	86.02	74.77
Mid-Cap Growth Funds	166	84.34	63.86
Mid-Cap Core Funds	119	82.35	52.10
Mid-Cap Value Funds	61	90.16	54.10
Small-Cap Growth Funds	194	85.57	78.35
Small-Cap Core Funds	243	89.30	79.01
Small-Cap Value Funds	112	85.71	57.14
Multi-Cap Growth Funds	180	86.67	62.78
Multi-Cap Core Funds	265	84.53	57.36
Multi-Cap Value Funds	103	83.50	60.19
Real Estate Funds	82	93.90	92.68

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

<b>Report 2: Survivorship and Style Consistency of U.S. Equity Funds (cont.)</b>			
<b>FUND CATEGORY</b>	<b>NO. OF FUNDS AT START</b>	<b>SURVIVORSHIP (%)</b>	<b>STYLE CONSISTENCY (%)</b>
<b>5-YEAR</b>			
All Domestic Funds	2429	80.16	76.53
All Large-Cap Funds	936	78.95	65.81
All Mid-Cap Funds	350	79.14	62.00
All Small-Cap Funds	535	82.99	80.75
All Multi-Cap Funds	608	80.10	50.66
Large-Cap Growth Funds	284	75.70	62.68
Large-Cap Core Funds	360	79.44	52.50
Large-Cap Value Funds	292	81.51	68.84
Mid-Cap Growth Funds	161	77.02	58.39
Mid-Cap Core Funds	124	78.23	46.77
Mid-Cap Value Funds	65	86.15	47.69
Small-Cap Growth Funds	196	77.55	70.41
Small-Cap Core Funds	229	86.90	72.49
Small-Cap Value Funds	110	84.55	50.00
Multi-Cap Growth Funds	188	79.26	50.00
Multi-Cap Core Funds	318	81.13	39.62
Multi-Cap Value Funds	102	78.43	44.12
Real Estate Funds	76	90.79	92.11
<b>10-YEAR</b>			
All Domestic Funds	2039	55.03	51.84
All Large-Cap Funds	611	55.48	42.39
All Mid-Cap Funds	369	54.47	32.52
All Small-Cap Funds	489	56.03	52.35
All Multi-Cap Funds	570	54.04	28.42
Large-Cap Growth Funds	190	49.47	35.79
Large-Cap Core Funds	218	55.96	32.11
Large-Cap Value Funds	203	60.59	46.31
Mid-Cap Growth Funds	173	45.09	24.86
Mid-Cap Core Funds	104	58.65	26.92
Mid-Cap Value Funds	92	67.39	20.65
Small-Cap Growth Funds	180	50.00	38.89
Small-Cap Core Funds	212	56.13	38.68
Small-Cap Value Funds	97	67.01	26.80
Multi-Cap Growth Funds	153	51.63	22.88
Multi-Cap Core Funds	284	55.99	15.14
Multi-Cap Value Funds	133	52.63	22.56
Real Estate Funds	97	68.04	40.21

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

<b>Report 2: Survivorship and Style Consistency of U.S. Equity Funds (cont.)</b>			
<b>FUND CATEGORY</b>	<b>NO. OF FUNDS AT START</b>	<b>SURVIVORSHIP (%)</b>	<b>STYLE CONSISTENCY (%)</b>
<b>15-YEAR</b>			
All Domestic Funds	1970	41.47	38.93
All Large-Cap Funds	706	35.41	26.63
All Mid-Cap Funds	347	46.69	24.78
All Small-Cap Funds	398	48.74	42.96
All Multi-Cap Funds	519	40.66	19.27
Large-Cap Growth Funds	216	26.85	18.06
Large-Cap Core Funds	300	35.67	19.00
Large-Cap Value Funds	190	44.74	30.00
Mid-Cap Growth Funds	171	33.33	19.30
Mid-Cap Core Funds	86	53.49	15.12
Mid-Cap Value Funds	90	65.56	12.22
Small-Cap Growth Funds	158	39.24	27.85
Small-Cap Core Funds	145	50.34	31.72
Small-Cap Value Funds	95	62.11	20.00
Multi-Cap Growth Funds	145	31.72	13.10
Multi-Cap Core Funds	196	42.35	9.69
Multi-Cap Value Funds	178	46.07	10.67
Real Estate Funds	53	64.15	52.83

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

<b>Report 3: Average U.S. Equity Fund Performance (Equal-Weighted)</b>						
<b>CATEGORY</b>	<b>1-YEAR (%)</b>	<b>3-YEAR (%)</b>	<b>5-YEAR (%)</b>	<b>10-YEAR (%)</b>	<b>15-YEAR (%)</b>	
S&P Composite 1500	21.13	11.41	15.74	8.69	10.18	
All Domestic Funds	19.20	9.04	13.34	7.05	9.14	
S&P 500	21.83	11.41	15.79	8.50	9.92	
All Large-Cap Funds	20.69	9.38	13.66	6.83	8.38	
S&P MidCap 400	16.24	11.14	15.01	9.97	12.00	
All Mid-Cap Funds	18.84	8.35	13.08	7.27	9.99	
S&P SmallCap 600	13.23	12.00	15.99	10.43	12.27	
All Small-Cap Funds	15.28	8.85	12.90	7.61	10.03	
S&P Composite 1500	21.13	11.41	15.74	8.69	10.18	
All Multi-Cap Funds	20.78	8.81	13.12	6.54	8.83	
<b>LARGE-CAP</b>						
S&P 500 Growth	27.44	12.86	17.00	9.99	10.30	
Large-Cap Growth Funds	29.57	11.45	15.27	7.71	8.99	
S&P 500	21.83	11.41	15.79	8.50	9.92	
Large-Cap Core Funds	20.03	9.28	13.71	6.77	8.09	
S&P 500 Value	15.36	9.47	14.24	6.80	9.38	
Large-Cap Value Funds	15.18	7.87	12.35	6.10	8.19	
<b>MID-CAP</b>						
S&P MidCap 400 Growth	19.92	11.98	14.93	10.35	11.97	
Mid-Cap Growth Funds	24.76	8.94	13.30	7.00	9.84	
S&P MidCap 400	16.24	11.14	15.01	9.97	12.00	
Mid-Cap Core Funds	15.12	7.80	12.59	7.35	9.80	
S&P MidCap 400 Value	12.32	9.88	14.83	9.46	11.90	
Mid-Cap Value Funds	12.37	7.97	13.25	7.76	10.46	
<b>SMALL-CAP</b>						
S&P SmallCap 600 Growth	14.79	12.96	16.39	10.82	12.64	
Small-Cap Growth Funds	23.44	9.59	13.79	7.52	9.89	
S&P SmallCap 600	13.23	12.00	15.99	10.43	12.27	
Small-Cap Core Funds	12.23	8.36	12.40	7.49	10.09	
S&P SmallCap 600 Value	11.51	10.97	15.52	9.99	11.85	
Small-Cap Value Funds	9.11	8.51	12.33	7.89	10.17	
<b>MULTI-CAP</b>						
S&P Composite 1500 Growth	26.49	12.82	16.84	10.07	10.65	
Multi-Cap Growth Funds	27.18	10.09	14.38	7.09	9.54	
S&P Composite 1500	21.13	11.41	15.74	8.69	10.18	
Multi-Cap Core Funds	18.60	8.12	12.39	6.27	8.42	
S&P Composite 1500 Value	14.99	9.54	14.32	7.13	9.80	
Multi-Cap Value Funds	14.68	8.06	12.71	6.17	8.44	
<b>REAL ESTATE</b>						
S&P United States REIT	4.33	5.09	9.13	7.28	10.74	
Real Estate Funds	5.41	5.21	8.57	6.15	9.87	

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Returns shown are annualized. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

<b>Report 4: Average U.S. Equity Fund Performance (Asset-Weighted)</b>						
<b>CATEGORY</b>	<b>1-YEAR (%)</b>	<b>3-YEAR (%)</b>	<b>5-YEAR (%)</b>	<b>10-YEAR (%)</b>	<b>15-YEAR (%)</b>	
S&P Composite 1500	21.13	11.41	15.74	8.69	10.18	
All Domestic Funds	21.93	10.35	14.47	7.54	9.56	
S&P 500	21.83	11.41	15.79	8.50	9.92	
All Large-Cap Funds	22.77	10.85	14.89	7.43	8.93	
S&P MidCap 400	16.24	11.14	15.01	9.97	12.00	
All Mid-Cap Funds	20.10	9.39	13.86	7.84	10.78	
S&P SmallCap 600	13.23	12.00	15.99	10.43	12.27	
All Small-Cap Funds	17.12	9.53	13.25	8.17	10.66	
S&P Composite 1500	21.13	11.41	15.74	8.69	10.18	
All Multi-Cap Funds	22.34	9.63	14.05	7.20	9.69	
<b>LARGE-CAP</b>						
S&P 500 Growth	27.44	12.86	17.00	9.99	10.30	
Large-Cap Growth Funds	30.84	13.01	16.39	8.23	9.55	
S&P 500	21.83	11.41	15.79	8.50	9.92	
Large-Cap Core Funds	21.36	10.65	14.89	7.16	8.45	
S&P 500 Value	15.36	9.47	14.24	6.80	9.38	
Large-Cap Value Funds	16.63	8.99	13.45	6.83	8.80	
<b>MID-CAP</b>						
S&P MidCap 400 Growth	19.92	11.98	14.93	10.35	11.97	
Mid-Cap Growth Funds	25.36	10.06	14.19	7.71	10.91	
S&P MidCap 400	16.24	11.14	15.01	9.97	12.00	
Mid-Cap Core Funds	16.60	8.63	13.44	7.97	10.73	
S&P MidCap 400 Value	12.32	9.88	14.83	9.46	11.90	
Mid-Cap Value Funds	13.01	8.86	13.50	7.77	10.69	
<b>SMALL-CAP</b>						
S&P SmallCap 600 Growth	14.79	12.96	16.39	10.82	12.64	
Small-Cap Growth Funds	25.09	10.64	14.67	8.69	11.03	
S&P SmallCap 600	13.23	12.00	15.99	10.43	12.27	
Small-Cap Core Funds	12.99	8.80	12.39	7.80	10.47	
S&P SmallCap 600 Value	11.51	10.97	15.52	9.99	11.85	
Small-Cap Value Funds	9.74	8.75	12.30	8.03	10.38	
<b>MULTI-CAP</b>						
S&P Composite 1500 Growth	26.49	12.82	16.84	10.07	10.65	
Multi-Cap Growth Funds	29.42	11.54	16.12	8.46	10.93	
S&P Composite 1500	21.13	11.41	15.74	8.69	10.18	
Multi-Cap Core Funds	19.36	8.53	12.78	6.84	9.18	
S&P Composite 1500 Value	14.99	9.54	14.32	7.13	9.80	
Multi-Cap Value Funds	14.99	8.00	12.67	5.94	8.35	
<b>REAL ESTATE</b>						
S&P United States REIT	4.33	5.09	9.13	7.28	10.74	
Real Estate Funds	6.40	5.73	9.02	6.42	10.25	

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Returns shown are annualized. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

<b>Report 5: Quartile Breakpoints of U.S. Equity Funds</b>			
<b>FUND CATEGORY</b>	<b>THIRD QUARTILE</b>	<b>SECOND QUARTILE</b>	<b>FIRST QUARTILE</b>
<b>1-YEAR</b>			
All Domestic Funds	13.83	18.77	24.67
All Large-Cap Funds	16.20	20.19	26.11
All Mid-Cap Funds	13.56	18.63	24.74
All Small-Cap Funds	9.77	13.77	20.57
All Multi-Cap Funds	15.81	20.40	25.25
Large-Cap Growth Funds	26.83	29.74	33.37
Large-Cap Core Funds	18.24	20.62	22.22
Large-Cap Value Funds	13.39	15.86	17.78
Mid-Cap Growth Funds	22.13	24.86	27.45
Mid-Cap Core Funds	12.91	15.24	18.54
Mid-Cap Value Funds	10.46	12.63	14.52
Small-Cap Growth Funds	19.18	23.98	27.46
Small-Cap Core Funds	9.67	12.20	14.90
Small-Cap Value Funds	5.80	8.68	11.84
Multi-Cap Growth Funds	23.80	27.44	31.24
Multi-Cap Core Funds	15.62	18.87	22.03
Multi-Cap Value Funds	11.73	15.13	17.56
Real Estate Funds	3.72	5.84	7.30
<b>3-YEAR</b>			
All Domestic Funds	7.70	9.39	11.00
All Large-Cap Funds	8.23	9.79	11.14
All Mid-Cap Funds	7.26	8.63	10.29
All Small-Cap Funds	7.56	9.31	11.02
All Multi-Cap Funds	7.49	9.16	10.80
Large-Cap Growth Funds	10.64	12.06	13.76
Large-Cap Core Funds	8.61	10.06	10.75
Large-Cap Value Funds	7.19	8.69	9.41
Mid-Cap Growth Funds	7.54	9.35	10.92
Mid-Cap Core Funds	6.60	8.15	9.33
Mid-Cap Value Funds	7.92	8.52	9.94
Small-Cap Growth Funds	7.93	10.09	11.88
Small-Cap Core Funds	7.28	8.87	10.28
Small-Cap Value Funds	7.44	9.13	10.39
Multi-Cap Growth Funds	8.99	10.77	12.53
Multi-Cap Core Funds	7.04	8.79	10.14
Multi-Cap Value Funds	7.50	8.16	9.75
Real Estate Funds	4.16	5.04	5.99

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Returns shown are annualized. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

<b>Report 5: Quartile Breakpoints of U.S. Equity Funds (cont.)</b>			
<b>FUND CATEGORY</b>	<b>THIRD QUARTILE</b>	<b>SECOND QUARTILE</b>	<b>FIRST QUARTILE</b>
<b>5-YEAR</b>			
All Domestic Funds	12.23	13.79	15.17
All Large-Cap Funds	12.71	14.25	15.48
All Mid-Cap Funds	12.18	13.47	14.68
All Small-Cap Funds	11.85	13.45	14.75
All Multi-Cap Funds	11.57	13.46	15.19
Large-Cap Growth Funds	14.85	15.80	16.99
Large-Cap Core Funds	12.82	14.36	15.15
Large-Cap Value Funds	12.05	12.87	13.96
Mid-Cap Growth Funds	12.57	13.60	14.92
Mid-Cap Core Funds	11.40	13.07	14.48
Mid-Cap Value Funds	12.16	13.71	14.45
Small-Cap Growth Funds	12.78	14.46	15.68
Small-Cap Core Funds	11.81	13.15	14.29
Small-Cap Value Funds	11.45	12.90	14.08
Multi-Cap Growth Funds	13.02	14.60	16.51
Multi-Cap Core Funds	10.83	12.82	14.68
Multi-Cap Value Funds	12.02	13.39	14.51
Real Estate Funds	8.08	8.58	9.39
<b>10-YEAR</b>			
All Domestic Funds	6.26	7.51	8.64
All Large-Cap Funds	6.29	7.34	8.18
All Mid-Cap Funds	6.71	7.66	8.86
All Small-Cap Funds	7.17	8.25	9.32
All Multi-Cap Funds	5.54	6.88	8.18
Large-Cap Growth Funds	7.12	8.32	9.10
Large-Cap Core Funds	6.29	7.19	7.91
Large-Cap Value Funds	5.87	6.79	7.78
Mid-Cap Growth Funds	6.61	7.56	8.60
Mid-Cap Core Funds	7.01	7.73	8.84
Mid-Cap Value Funds	6.38	7.71	9.02
Small-Cap Growth Funds	7.21	8.31	9.35
Small-Cap Core Funds	7.17	8.26	9.37
Small-Cap Value Funds	7.12	8.21	9.20
Multi-Cap Growth Funds	5.94	7.68	8.86
Multi-Cap Core Funds	5.38	6.79	8.03
Multi-Cap Value Funds	5.37	6.43	7.40
Real Estate Funds	3.67	5.75	7.10

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Returns shown are annualized. Past performance is no guarantee of future results. Table is provided for illustrative purposes.



<b>Report 5: Quartile Breakpoints of U.S. Equity Funds (cont.)</b>			
<b>FUND CATEGORY</b>	<b>THIRD QUARTILE</b>	<b>SECOND QUARTILE</b>	<b>FIRST QUARTILE</b>
<b>15-YEAR</b>			
All Domestic Funds	8.71	9.76	10.85
All Large-Cap Funds	8.26	9.16	9.75
All Mid-Cap Funds	9.32	10.40	11.33
All Small-Cap Funds	10.03	10.83	11.52
All Multi-Cap Funds	8.23	9.37	10.39
Large-Cap Growth Funds	8.82	9.59	10.29
Large-Cap Core Funds	8.20	9.16	9.63
Large-Cap Value Funds	8.10	8.94	9.60
Mid-Cap Growth Funds	9.49	10.69	11.39
Mid-Cap Core Funds	9.38	10.24	10.81
Mid-Cap Value Funds	9.15	10.38	11.34
Small-Cap Growth Funds	10.22	10.96	11.61
Small-Cap Core Funds	10.00	10.70	11.45
Small-Cap Value Funds	9.94	10.88	11.59
Multi-Cap Growth Funds	9.53	10.45	11.78
Multi-Cap Core Funds	8.00	8.90	10.00
Multi-Cap Value Funds	7.93	9.17	10.12
Real Estate Funds	8.97	9.99	10.93

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Returns shown are annualized. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

<b>Report 6: Percentage of International Equity Funds Outperformed by Benchmarks</b>						
<b>FUND CATEGORY</b>	<b>COMPARISON INDEX</b>	<b>1-YEAR (%)</b>	<b>3-YEAR (%)</b>	<b>5-YEAR (%)</b>	<b>10-YEAR (%)</b>	<b>15-YEAR (%)</b>
Global Funds	S&P Global 1200	50.21	77.45	77.71	81.98	82.47
International Funds	S&P International 700	53.95	69.40	70.93	81.68	91.63
International Small-Cap Funds	S&P Developed Ex-U.S. Small Cap	44.05	65.75	65.52	72.55	78.13
Emerging Markets Funds	S&P/IFCI Composite	64.89	78.92	77.78	85.14	94.83

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Returns shown are annualized. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

**Report 7: Survivorship and Style Consistency of International Equity Funds**

FUND CATEGORY	NO. OF FUNDS AT START	SURVIVORSHIP (%)	STYLE CONSISTENCY (%)
<b>1-YEAR</b>			
Global Funds	237	93.67	91.14
International Funds	368	95.38	95.11
International Small Cap Funds	84	97.62	94.05
Emerging Markets Funds	226	91.59	91.15
<b>3-YEAR</b>			
Global Funds	236	83.47	75.85
International Funds	368	88.04	85.33
International Small Cap Funds	73	89.04	86.30
Emerging Markets Funds	224	80.36	79.46
<b>5-YEAR</b>			
Global Funds	175	73.14	58.86
International Funds	258	78.29	75.19
International Small Cap Funds	58	86.21	84.48
Emerging Markets Funds	171	80.12	78.95
<b>10-YEAR</b>			
Global Funds	111	61.26	49.55
International Funds	262	61.45	58.40
International Small Cap Funds	51	76.47	64.71
Emerging Markets Funds	74	66.22	60.81
<b>15-YEAR</b>			
Global Funds	97	43.30	31.96
International Funds	251	45.02	41.83
International Small Cap Funds	32	62.50	56.25
Emerging Markets Funds	58	58.62	55.17

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

**Report 8: Average International Equity Fund Performance (Equal-Weighted)**

CATEGORY	1-YEAR (%)	3-YEAR (%)	5-YEAR (%)	10-YEAR (%)	15-YEAR (%)
S&P Global 1200	23.84	10.16	12.14	5.67	9.52
Global Funds	24.02	8.57	10.34	4.15	8.24
S&P International 700	26.64	8.50	7.93	2.64	9.21
International Funds	26.60	7.58	6.96	1.33	7.19
S&P Developed Ex-U.S. Small Cap	32.37	13.32	12.12	5.22	12.15
International Small-Cap Funds	32.68	11.54	10.39	4.43	11.24
S&P/IFCI Composite	37.89	10.21	5.65	2.50	13.41
Emerging Markets Funds	34.36	7.65	3.74	0.25	10.80

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Returns shown are annualized. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

**Report 9: Average International Equity Fund Performance (Asset-Weighted)**

CATEGORY	1-YEAR (%)	3-YEAR (%)	5-YEAR (%)	10-YEAR (%)	15-YEAR (%)
S&P Global 1200	23.84	10.16	12.14	5.67	9.52
Global Funds	23.46	9.05	11.10	5.11	9.35
S&P International 700	26.64	8.50	7.93	2.64	9.21
International Funds	26.87	7.85	7.77	2.31	8.38
S&P Developed Ex-U.S. Small Cap	32.37	13.32	12.12	5.22	12.15
International Small-Cap Funds	34.27	11.99	10.78	5.23	11.98
S&P/IFCI Composite	37.89	10.21	5.65	2.50	13.41
Emerging Markets Funds	35.65	8.75	5.01	1.61	11.89

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Returns shown are annualized. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

**Report 10: Quartile Breakpoints of International Equity Funds**

FUND CATEGORY	THIRD QUARTILE	SECOND QUARTILE	FIRST QUARTILE
<b>1-YEAR</b>			
Global Funds	20.19	24.12	28.20
International Funds	23.39	26.51	29.65
International Small-Cap Funds	29.96	33.20	36.44
Emerging Markets Funds	28.75	35.04	40.77
<b>3-YEAR</b>			
Global Funds	7.22	8.95	10.57
International Funds	6.54	7.90	9.03
International Small-Cap Funds	10.63	12.33	13.77
Emerging Markets Funds	6.67	8.48	10.38
<b>5-YEAR</b>			
Global Funds	9.06	10.99	12.62
International Funds	6.37	7.49	8.40
International Small-Cap Funds	9.36	11.18	12.85
Emerging Markets Funds	2.87	4.01	5.82
<b>10-YEAR</b>			
Global Funds	3.78	4.91	5.92
International Funds	0.91	1.91	2.93
International Small-Cap Funds	3.76	4.85	6.02
Emerging Markets Funds	0.22	1.12	2.43
<b>15-YEAR</b>			
Global Funds	8.27	8.89	10.22
International Funds	6.79	7.96	8.92
International Small-Cap Funds	10.43	11.05	13.39
Emerging Markets Funds	10.19	11.44	12.49

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Returns shown are annualized. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

**Report 11: Percentage of Fixed Income Funds Outperformed by Benchmarks**

FUND CATEGORY	COMPARISON INDEX	1-YEAR (%)	3-YEAR (%)	5-YEAR (%)	10-YEAR (%)	15-YEAR (%)
Government Long Funds	Barclays US Government Long	96.43	100.00	98.31	95.24	98.00
Government Intermediate Funds	Barclays US Government Intermediate	57.89	90.91	80.00	78.05	90.48
Government Short Funds	Barclays US Government (1-3 Year)	47.83	69.23	79.31	76.47	88.24
Investment-Grade Long Funds	Barclays US Government/Credit Long	96.74	94.68	95.45	95.40	97.73
Investment-Grade Intermediate Funds	Barclays US Government/Credit Intermediate	31.37	35.53	40.94	51.06	73.53
Investment-Grade Short Funds	Barclays US Government/Credit (1-3 Year)	22.22	41.67	43.33	57.81	68.89
High Yield Funds	Barclays US Corporate High Yield	80.95	90.87	93.81	98.37	98.23
Mortgage-Backed Securities Funds	Barclays US Aggregate Securitized - MBS	67.92	73.08	79.31	81.40	93.88
Global Income Funds	Barclays Global Aggregate	64.86	60.55	52.59	58.33	69.44
Emerging Markets Debt Funds	Barclays Emerging Markets	22.58	70.69	85.71	73.68	66.67
General Municipal Debt Funds	S&P National AMT-Free Municipal Bond	42.86	58.75	47.50	63.29	82.88
California Municipal Debt Funds	S&P California AMT-Free Municipal Bond	25.71	30.56	37.14	66.67	84.44
New York Municipal Debt Funds	S&P New York AMT-Free Municipal Bond	33.33	57.14	73.33	85.29	89.47
Loan Participation Funds	S&P/LSTA U.S. Leveraged Loan 100	52.08	56.25	52.78	100.00	-

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Returns shown are annualized. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

**Report 12: Survivorship and Style Consistency of Fixed Income Funds**

FUND CATEGORY	NO. OF FUNDS AT START	SURVIVORSHIP (%)	STYLE CONSISTENCY (%)
<b>1-YEAR</b>			
Government Long Funds	57	94.74	94.74
Government Intermediate Funds	19	94.74	100.00
Government Short Funds	23	95.65	100.00
Investment-Grade Long Funds	95	93.68	94.74
Investment-Grade Intermediate Funds	204	97.55	96.08
Investment-Grade Short Funds	91	98.90	97.80
High Yield Funds	213	97.18	96.24
Mortgage-Backed Securities Funds	53	98.11	96.23
Global Income Funds	111	91.89	90.99
Emerging Markets Debt Funds	62	88.71	88.71
General Municipal Debt Funds	77	98.70	97.40
California Municipal Debt Funds	35	97.14	94.29
New York Municipal Debt Funds	27	96.30	96.30
Loan Participation Funds	48	93.75	93.75

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

<b>Report 12: Survivorship and Style Consistency of Fixed Income Funds (cont.)</b>			
<b>FUND CATEGORY</b>	<b>NO. OF FUNDS AT START</b>	<b>SURVIVORSHIP (%)</b>	<b>STYLE CONSISTENCY (%)</b>
<b>3-YEAR</b>			
Government Long Funds	58	86.21	86.21
Government Intermediate Funds	22	77.27	81.82
Government Short Funds	26	84.62	84.62
Investment-Grade Long Funds	98	91.84	84.69
Investment-Grade Intermediate Funds	197	90.36	84.26
Investment-Grade Short Funds	86	90.70	86.05
High Yield Funds	212	90.09	88.21
Mortgage-Backed Securities Funds	53	98.11	88.68
Global Income Funds	110	81.82	80.00
Emerging Markets Debt Funds	58	81.03	79.31
General Municipal Debt Funds	80	93.75	87.50
California Municipal Debt Funds	36	94.44	91.67
New York Municipal Debt Funds	28	92.86	92.86
Loan Participation Funds	48	93.75	91.67
<b>5-YEAR</b>			
Government Long Funds	60	85.00	80.00
Government Intermediate Funds	25	72.00	72.00
Government Short Funds	29	79.31	72.41
Investment-Grade Long Funds	113	88.50	68.14
Investment-Grade Intermediate Funds	255	83.53	55.69
Investment-Grade Short Funds	61	88.52	78.69
High Yield Funds	197	84.26	81.73
Mortgage-Backed Securities Funds	59	88.14	72.88
Global Income Funds	117	81.20	68.38
Emerging Markets Debt Funds	35	85.71	82.86
General Municipal Debt Funds	80	91.25	82.50
California Municipal Debt Funds	35	94.29	91.43
New York Municipal Debt Funds	30	86.67	86.67
Loan Participation Funds	36	97.22	97.22

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

<b>Report 12: Survivorship and Style Consistency of Fixed Income Funds (cont.)</b>			
<b>FUND CATEGORY</b>	<b>NO. OF FUNDS AT START</b>	<b>SURVIVORSHIP (%)</b>	<b>STYLE CONSISTENCY (%)</b>
<b>10-YEAR</b>			
Government Long Funds	43	60.47	53.49
Government Intermediate Funds	41	56.10	41.46
Government Short Funds	34	55.88	47.06
Investment-Grade Long Funds	87	63.22	41.38
Investment-Grade Intermediate Funds	188	62.23	43.09
Investment-Grade Short Funds	65	63.08	55.38
High Yield Funds	124	69.35	66.13
Mortgage-Backed Securities Funds	43	81.40	72.09
Global Income Funds	49	69.39	53.06
Emerging Markets Debt Funds	19	89.47	68.42
General Municipal Debt Funds	79	70.89	65.82
California Municipal Debt Funds	39	76.92	76.92
New York Municipal Debt Funds	34	67.65	67.65
Loan Participation Funds	17	82.35	76.47
<b>15-YEAR</b>			
Government Long Funds	51	47.06	37.25
Government Intermediate Funds	63	36.51	26.98
Government Short Funds	34	38.24	32.35
Investment-Grade Long Funds	132	41.67	20.45
Investment-Grade Intermediate Funds	170	44.71	32.35
Investment-Grade Short Funds	45	53.33	51.11
High Yield Funds	113	53.98	51.33
Mortgage-Backed Securities Funds	49	57.14	48.98
Global Income Funds	37	62.16	54.05
Emerging Markets Debt Funds	15	73.33	66.67
General Municipal Debt Funds	111	47.75	44.14
California Municipal Debt Funds	45	62.22	60.00
New York Municipal Debt Funds	38	60.53	57.89
Loan Participation Funds	-	-	-

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

<b>Report 13: Average Fixed Income Fund Performance (Equal-Weighted)</b>					
<b>CATEGORY</b>	<b>1-YEAR (%)</b>	<b>3-YEAR (%)</b>	<b>5-YEAR (%)</b>	<b>10-YEAR (%)</b>	<b>15-YEAR (%)</b>
Barclays US Government Long	8.53	2.85	3.49	6.49	6.24
Government Long Funds	2.22	0.97	0.91	2.92	2.95
Barclays US Government Intermediate	1.14	1.12	0.92	2.70	3.03
Government Intermediate Funds	0.91	0.54	0.38	2.04	2.28
Barclays US Government (1-3 Year)	0.45	0.63	0.58	1.53	2.08
Government Short Funds	0.55	0.37	0.15	1.10	1.52
Barclays US Government/Credit Long	10.71	4.52	4.43	7.26	6.77
Investment-Grade Long Funds	5.11	2.95	2.78	4.43	4.32
Barclays US Government/Credit Intermediate	2.14	1.76	1.50	3.32	3.57
Investment-Grade Intermediate Funds	2.94	1.83	1.52	3.18	3.23
Barclays US Government/Credit (1-3 Year)	0.84	0.93	0.84	1.85	2.36
Investment-Grade Short Funds	1.51	1.10	0.85	1.36	1.76
Barclays US Corporate High Yield	7.50	6.35	5.78	8.03	8.98
High Yield Funds	6.11	4.81	4.36	5.66	6.80
Barclays US Aggregate Securitized - MBS	2.47	1.88	2.04	3.84	4.05
Mortgage-Backed Securities Funds	2.08	1.45	1.49	3.21	3.23
Barclays Global Aggregate	7.39	2.02	0.79	3.09	4.22
Global Income Funds	6.64	1.88	0.77	3.19	4.24
Barclays Emerging Markets	8.17	6.38	3.87	7.01	8.98
Emerging Markets Debt Funds	10.00	5.49	2.10	4.80	7.55
S&P National AMT-Free Municipal Bond	5.09	2.89	2.79	4.22	4.26
General Municipal Debt Funds	5.04	2.59	2.60	3.84	3.67
S&P California AMT-Free Municipal Bond	5.15	2.88	3.33	4.64	4.57
California Municipal Debt Funds	5.62	2.97	3.26	4.27	3.99
S&P New York AMT-Free Municipal Bond	4.64	2.84	2.94	4.30	4.34
New York Municipal Debt Funds	4.31	2.54	2.38	3.73	3.62
S&P/LSTA U.S. Leveraged Loan 100	3.31	3.66	3.39	4.65	-
Loan Participation Funds	3.16	3.42	3.16	3.63	-

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Returns shown are annualized. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

<b>Report 14: Average Fixed Income Fund Performance (Asset-Weighted)</b>					
<b>CATEGORY</b>	<b>1-YEAR (%)</b>	<b>3-YEAR (%)</b>	<b>5-YEAR (%)</b>	<b>10-YEAR (%)</b>	<b>15-YEAR (%)</b>
Barclays US Government Long	8.53	2.85	3.49	6.49	6.24
Government Long Funds	2.65	1.34	1.26	3.39	3.49
Barclays US Government Intermediate	1.14	1.12	0.92	2.70	3.03
Government Intermediate Funds	1.17	0.85	0.72	2.64	2.78
Barclays US Government (1-3 Year)	0.45	0.63	0.58	1.53	2.08
Government Short Funds	0.51	0.69	0.55	1.59	2.02
Barclays US Government/Credit Long	10.71	4.52	4.43	7.26	6.77
Investment-Grade Long Funds	6.52	3.45	3.42	4.64	4.76
Barclays US Government/Credit Intermediate	2.14	1.76	1.50	3.32	3.57
Investment-Grade Intermediate Funds	3.66	2.46	2.09	4.06	4.04
Barclays US Government/Credit (1-3 Year)	0.84	0.93	0.84	1.85	2.36
Investment-Grade Short Funds	1.71	1.57	1.36	2.40	2.69
Barclays US Corporate High Yield	7.50	6.35	5.78	8.03	8.98
High Yield Funds	6.99	5.18	4.86	6.17	7.38
Barclays US Aggregate Securitized - MBS	2.47	1.88	2.04	3.84	4.05
Mortgage-Backed Securities Funds	2.18	1.69	1.86	3.84	3.85
Barclays Global Aggregate	7.39	2.02	0.79	3.09	4.22
Global Income Funds	5.06	1.54	1.01	3.83	5.20
Barclays Emerging Markets	8.17	6.38	3.87	7.01	8.98
Emerging Markets Debt Funds	9.70	7.29	3.52	6.23	8.69
S&P National AMT-Free Municipal Bond	5.09	2.89	2.79	4.22	4.26
General Municipal Debt Funds	5.63	3.07	3.15	4.31	4.21
S&P California AMT-Free Municipal Bond	5.15	2.88	3.33	4.64	4.57
California Municipal Debt Funds	6.03	3.35	3.71	4.65	4.45
S&P New York AMT-Free Municipal Bond	4.64	2.84	2.94	4.30	4.34
New York Municipal Debt Funds	4.21	2.89	2.57	3.82	3.98
S&P/LSTA U.S. Leveraged Loan 100	3.31	3.66	3.39	4.65	-
Loan Participation Funds	3.38	3.87	3.39	3.70	-

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Returns shown are annualized. Past performance is no guarantee of future results. Table is provided for illustrative purposes.



<b>Report 15: Quartile Breakpoints of Fixed Income Funds</b>			
<b>FUND CATEGORY</b>	<b>THIRD QUARTILE</b>	<b>SECOND QUARTILE</b>	<b>FIRST QUARTILE</b>
<b>1-YEAR</b>			
Government Long Funds	1.34	1.82	2.36
Government Intermediate Funds	0.80	0.97	1.27
Government Short Funds	0.16	0.55	0.81
Investment-Grade Long Funds	3.81	4.71	6.34
Investment-Grade Intermediate Funds	2.02	3.23	3.92
Investment-Grade Short Funds	0.93	1.33	1.94
High Yield Funds	5.70	6.60	7.26
Mortgage-Backed Securities Funds	1.34	1.90	2.85
Global Income Funds	3.76	6.81	9.20
Emerging Markets Debt Funds	8.67	10.36	12.24
General Municipal Debt Funds	4.65	5.43	6.02
California Municipal Debt Funds	5.28	5.63	6.44
New York Municipal Debt Funds	4.43	4.92	5.24
Loan Participation Funds	2.79	3.32	3.81
<b>3-YEAR</b>			
Government Long Funds	0.84	1.17	1.45
Government Intermediate Funds	0.55	0.68	0.99
Government Short Funds	0.26	0.51	0.75
Investment-Grade Long Funds	2.29	3.03	3.71
Investment-Grade Intermediate Funds	1.70	2.09	2.52
Investment-Grade Short Funds	0.76	1.12	1.58
High Yield Funds	4.41	5.12	5.70
Mortgage-Backed Securities Funds	1.19	1.49	1.99
Global Income Funds	1.17	1.97	3.01
Emerging Markets Debt Funds	4.63	6.00	7.04
General Municipal Debt Funds	2.39	2.83	3.21
California Municipal Debt Funds	2.87	3.04	3.69
New York Municipal Debt Funds	2.66	2.82	3.09
Loan Participation Funds	3.24	3.51	4.23

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Returns shown are annualized. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

<b>Report 15: Quartile Breakpoints of Fixed Income Funds (cont.)</b>			
<b>FUND CATEGORY</b>	<b>THIRD QUARTILE</b>	<b>SECOND QUARTILE</b>	<b>FIRST QUARTILE</b>
<b>5-YEAR</b>			
Government Long Funds	0.83	1.03	1.31
Government Intermediate Funds	0.44	0.56	0.98
Government Short Funds	0.14	0.44	0.59
Investment-Grade Long Funds	1.98	2.59	3.27
Investment-Grade Intermediate Funds	1.32	1.91	2.46
Investment-Grade Short Funds	0.70	0.96	1.33
High Yield Funds	4.12	4.83	5.30
Mortgage-Backed Securities Funds	1.19	1.62	2.01
Global Income Funds	0.16	1.11	2.31
Emerging Markets Debt Funds	1.84	2.97	3.68
General Municipal Debt Funds	2.46	2.93	3.34
California Municipal Debt Funds	3.16	3.50	3.74
New York Municipal Debt Funds	2.50	2.73	2.98
Loan Participation Funds	3.10	3.26	3.83
<b>10-YEAR</b>			
Government Long Funds	2.67	3.19	3.68
Government Intermediate Funds	2.14	2.55	2.91
Government Short Funds	1.12	1.46	1.76
Investment-Grade Long Funds	3.47	4.25	5.27
Investment-Grade Intermediate Funds	3.44	4.02	4.50
Investment-Grade Short Funds	1.61	2.11	2.44
High Yield Funds	5.92	6.39	6.83
Mortgage-Backed Securities Funds	3.09	3.33	3.83
Global Income Funds	2.26	3.22	4.17
Emerging Markets Debt Funds	3.97	6.44	7.15
General Municipal Debt Funds	3.79	4.22	4.61
California Municipal Debt Funds	4.31	4.60	4.83
New York Municipal Debt Funds	3.88	4.12	4.25
Loan Participation Funds	3.28	3.70	3.96

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Returns shown are annualized. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

<b>Report 15: Quartile Breakpoints of Fixed Income Funds (cont.)</b>			
<b>FUND CATEGORY</b>	<b>THIRD QUARTILE</b>	<b>SECOND QUARTILE</b>	<b>FIRST QUARTILE</b>
<b>15-YEAR</b>			
Government Long Funds	2.97	3.19	4.31
Government Intermediate Funds	2.24	2.55	3.04
Government Short Funds	1.64	1.87	2.08
Investment-Grade Long Funds	3.70	4.16	4.89
Investment-Grade Intermediate Funds	3.10	3.82	4.40
Investment-Grade Short Funds	1.94	2.43	2.83
High Yield Funds	6.92	7.38	7.73
Mortgage-Backed Securities Funds	3.19	3.51	3.96
Global Income Funds	3.73	4.33	5.38
Emerging Markets Debt Funds	8.41	8.94	9.30
General Municipal Debt Funds	3.70	4.08	4.37
California Municipal Debt Funds	4.19	4.35	4.53
New York Municipal Debt Funds	3.77	4.01	4.27
Loan Participation Funds	-	-	-

Source: S&P Dow Jones Indices LLC. Data as of Dec. 29, 2017. Returns shown are annualized. Past performance is no guarantee of future results. Table is provided for illustrative purposes.

## APPENDIX A

### SPIVA Styles and Lipper Fund Classifications

The CRSP Survivor-Bias-Free US Mutual Fund Database is the only complete database of both active and liquidated or merged mutual funds. It was created in 1995 and contains fund data from December 1961. Current and historical data from August 1998 has been supplied by Lipper and Thomson Reuters. The fund classifications are based upon the Lipper fund classification system. The SPIVA Scorecard covers domestic equity, global equity, and global fixed income categories.

## U.S. Equity

SPIVA covers major capitalization levels (large-, mid-, small-, and multi-cap funds) and investment styles (growth, core, and value). S&P Dow Jones Indices uses the Lipper fund classifications, which determine a fund portfolio's capitalization and investment style assignments.

Lipper assigns a market capitalization to each fund based on the percentages of a fund's three-year weighted equity assets that fall into each of Lipper's three defined market capitalization slices. The market capitalization breakpoints are calculated using all common stocks, excluding all non-U.S. domiciled stocks and ADRs, trading on the NYSE, AMEX, and NASDAQ. Funds are assigned to the capitalization level in which they have a 75% or higher weighting. Any fund that has less than 75% of its three-year weighted allocation in any of the three market capitalization ranges is classified as a multi-cap fund.

For investment style selection, the Lipper classification system uses three-year fundamental portfolio characteristics (price/earnings, price/book, and three-year sales-per-share growth) and, if necessary, confirming secondary characteristics (price-to-sales and price-to-operating cash flow). Fund statistics are compared to their relevant S&P Dow Jones Indices capitalization-level index to determine the growth, core, or value style.

In some cases, S&P Dow Jones Indices combines closely related Lipper fund classifications in one SPIVA category. Exhibit 2 maps the SPIVA U.S. Equity fund categories to Lipper classifications.

<b>Exhibit 1: U.S. Equity Category Mappings</b>	
<b>SPIVA CATEGORY</b>	<b>LIPPER FUND CLASSIFICATION</b>
Large-Cap Growth Funds	Large-Cap Growth Funds
Large-Cap Core Funds	Large-Cap Core Funds
Large-Cap Value Funds	Large-Cap Value Funds
	Equity Income Funds
Mid-Cap Growth Funds	Mid-Cap Growth Funds
Mid-Cap Core Funds	Mid-Cap Core Funds
Mid-Cap Value Funds	Mid-Cap Value Funds
Small-Cap Growth Funds	Small-Cap Growth Funds
Small-Cap Core Funds	Small-Cap Core Funds
Small-Cap Value Funds	Small-Cap Value Funds
Multi-Cap Growth Funds	Multi-Cap Growth Funds
Multi-Cap Core Funds	Multi-Cap Core Funds
Multi-Cap Value Funds	Multi-Cap Value Funds
Real Estate Funds	Real Estate Funds

Source: S&P Dow Jones Indices LLC, Lipper. Table is provided for illustrative purposes.

## International Equity

For international equity, SPIVA reports on four major categories (Global, International, International Small-Cap, and Emerging Market Funds) of interest to global asset allocators. These categories also include multiple Lipper capitalization and style classifications.

<b>Exhibit 2: Global Equity Category Mappings</b>	
<b>SPIVA CATEGORY</b>	<b>LIPPER FUND CLASSIFICATION</b>
Global Funds	Global Large-Cap Growth Funds
	Global Large-Cap Core Funds
	Global Large-Cap Value Funds
	Global Multi-Cap Growth Funds
	Global Multi-Cap Core Funds
	Global Multi-Cap Value Funds
International Funds	International Large-Cap Growth Funds
	International Large-Cap Core Funds
	International Large-Cap Value Funds
	International Multi-Cap Growth Funds
	International Multi-Cap Core Funds
	International Multi-Cap Value Funds
International Small-Cap Funds	International Small-/Mid-Cap Growth Funds
	International Small-/Mid-Cap Core Funds
	International Small-/Mid-Cap Value Funds
Emerging Market Funds	Emerging Markets Funds

Source: S&P Dow Jones Indices LLC, Lipper. Table is provided for illustrative purposes.

### Fixed Income

SPIVA reports on nine domestic, two global, and three municipal fixed income categories. The Lipper domestic fixed income classifications are based on maturity and credit quality. For maturity, long is 10+ years, intermediate is 5-10 years, short/intermediate is 1-5 years, and short is 1-3.5 years. For credit quality, bonds are assigned to U.S. Treasury, U.S. Government (includes government and agency issues), A- or BBB-rated (according to Lipper fund rating methodology), Loan Participations, and High Yield classifications. Lipper also includes U.S. Mortgages and GNMA classifications.

In global fixed income, Lipper differentiates between global (including the U.S.) and international (excluding the U.S.) objectives. For municipal debt funds, we include the general classification (invests in the top four credit ratings) plus two state funds (California and New York).

<b>Exhibit 3: Fixed Income Category Mappings</b>	
<b>SPIVA CATEGORY</b>	<b>LIPPER FUND CLASSIFICATION</b>
Government Long Funds	General U.S. Government Funds
	General U.S. Treasury Funds
Government Intermediate Funds	Intermediate U.S. Government
	Short-Intermediate U.S. Government
Government Short Funds	Short U.S. Government Funds
	Short U.S. Treasury
Investment-Grade Long Funds	Corporate Debt Funds A-Rated
	Corporate Debt Funds BBB-Rated
Investment-Grade Intermediate Funds	Intermediate Investment-Grade Debt Funds
	Short-Intermediate Investment-Grade Debt Funds
Investment-Grade Short Funds	Short Investment-Grade Debt Funds
High-Yield Funds	High Current Yield Funds
Mortgage-Backed Securities Funds	U.S. Mortgage Funds
	GNMA Funds
Global Income Funds	Global Income Funds
	International Income Funds
Emerging Market Debt Funds	Emerging Market Debt Funds
Loan Participation Funds	Loan Participation Funds
General Municipal Debt Funds	General Municipal Debt Funds
California Municipal Debt Funds	California Municipal Debt Funds
New York Municipal Debt Funds	New York Municipal Debt Funds

Source: S&P Dow Jones Indices LLC, Lipper. Table is provided for illustrative purposes.

## **APPENDIX B: GLOSSARY**

### **Percentage of Funds Outperformed by the Index**

To correct for survivorship bias, we use the opportunity set available at the beginning of the period as the denominator. We determine the count of funds that have survived and beat the index. We then report the index outperformance percentage.

### **Survivorship (%)**

This measure represents the percentage of funds in existence at the beginning of the time period that is still active at the end of the time period.

### **Style Consistency (%)**

This calculation shows the percentage of funds that had the same style classification at the end of the time period as at the beginning of the time period.

### **Equal-Weighted Fund Performance**

Equal-weighted returns for a particular style category are determined by calculating a simple average return of all active funds in that category in a particular month.

## Asset-Weighted Fund Performance

Asset-weighted returns for a particular style category are determined by calculating a weighted average return of all funds in that category in a particular month, with each fund's return weighted by its total net assets. Asset-weighted returns are a better indicator of fund category performance because they more accurately reflect the returns of the total money invested in that particular style category.

## Quartiles Breakpoints

The  $p^{\text{th}}$  percentile for a set of data is the value that is greater than or equal to  $p\%$  of the data, but is less than or equal to  $(100 - p)\%$  of the data. In other words, it is a value that divides the data into two parts: the lower  $p\%$  of the values and the upper  $(100-p)\%$  of the values. The first quartile is the 75<sup>th</sup> percentile, the value separating the elements of a population into the lower 75% and the upper 25%. The second quartile is the 50<sup>th</sup> percentile and the third quartile is the 25<sup>th</sup> percentile. For fund category quartiles in a particular time horizon, the data used is the return of the largest share class of the fund net of fees, excluding loads.

## Survivorship Bias

Many funds might liquidate or merge during a period of study. This usually occurs due to continued poor performance by the fund. Therefore, if index returns were compared to fund returns using only surviving funds, the comparison would be biased in favor of the fund category. These reports remove this bias by (a) using the entire investment opportunity set, made up of all funds in that particular category at the outset of the period, as the denominator for outperformance calculations, (b) explicitly showing the survivorship rate in each category, and (c) constructing peer average return series for each category based on all available funds at the outset of the period.

## Fees

The fund returns used are net of fees, excluding loads.

## Indices<sup>1</sup>

A benchmark index provides an investment vehicle against which fund performance can be measured.

### U.S. Equity

#### S&P 500

Widely regarded as the best single gauge of the U.S. equities market, this market-capitalization-weighted index includes a representative sample of 500 leading companies in the foremost industries of the U.S. economy and provides over 80% coverage of U.S. equities.

#### S&P MIDCAP 400

This index consists of 400 mid-sized companies and covers approximately 7% of the U.S. equities market.

<sup>1</sup> For more information on S&P Dow Jones Indices, please visit [www.spindices.com](http://www.spindices.com).

## S&P SMALLCAP 600

This index consists of 600 small-cap stocks and covers approximately 3% of the U.S. equities market.

## S&P COMPOSITE 1500

This is a broad, market-capitalization-weighted index of 1500 stocks. This index is comprised of three size-based indices: the [S&P 500](#), [S&P MidCap 400](#), and [S&P SmallCap 600](#), which measure the performance of large-, mid-, and small-cap stocks, respectively. This index represents 90% of U.S. equities.

## S&P 500 GROWTH AND VALUE INDICES

These indices form an exhaustive, multi-factor style series covering the entire market capitalization of the S&P 500. Constituents, weighted according to market capitalization, are classified as growth, value, or a mix of growth and value.

## S&P MIDCAP 400 GROWTH AND VALUE INDICES

These indices form an exhaustive, multi-factor style series covering the entire market capitalization of the S&P MidCap 400.

## S&P SMALLCAP 600 GROWTH AND VALUE INDICES

These indices form an exhaustive, multi-factor style series covering the entire market capitalization of the S&P SmallCap 600.

## S&P COMPOSITE 1500 GROWTH AND VALUE INDICES

These indices form an exhaustive, multi-factor style series covering the entire market capitalization of the [S&P Composite 1500](#).

## S&P UNITED STATES REIT INDEX

This index measures the investable universe of publicly traded real estate investment trusts.

## **International Equity**

### S&P GLOBAL 1200

Capturing approximately 70% of the world's capital markets, the S&P Global 1200 is a composite of seven headline indices, many of which are accepted leaders in their regions. It includes the S&P 500 (U.S.), [S&P Europe 350](#) (Europe), [S&P/TOPIX 150](#) (Japan), [S&P/TSX 60](#) (Canada), [S&P/ASX All Australian 50](#) (Australia), [S&P Asia 50](#) (Asia Ex-Japan), and [S&P Latin America 40](#) (Latin America).

### S&P 700

This index measures the non-U.S. component of the global equity markets, covering all the regions included in the [S&P Global 1200](#), excluding the U.S. (S&P 500).



## S&P WORLD EX-U.S. SMALL CAP

This index represents the small-cap segment—the bottom 15%—of the world’s universe of institutionally investable securities, excluding the U.S.

## S&P/IFCI COMPOSITE INDEX

This index is widely recognized as a comprehensive and reliable measure of the world’s emerging markets. It measures the returns of stocks that are legally and practically available to foreign market participants.

## Fixed Income<sup>2</sup>

### BARCLAYS CAPITAL LONG GOVERNMENT BOND INDEX

This index consists of U.S. Treasury and U.S. Government agency bonds with maturities greater than 10 years.

### BARCLAYS CAPITAL INTERMEDIATE GOVERNMENT BOND INDEX

This index consists of U.S. Treasury and U.S. Government agency bonds with maturities from 1 to 10 years.

### BARCLAYS CAPITAL 1-3 YEAR GOVERNMENT BOND INDEX

This index consists of U.S. Treasury and U.S. Government agency bonds with maturities from one to three years.

### BARCLAYS CAPITAL LONG GOVERNMENT/CREDIT BOND INDEX

This index covers corporate and non-corporate fixed income securities that are rated investment grade and have maturities greater than 10 years.

### BARCLAYS CAPITAL INTERMEDIATE GOVERNMENT/CREDIT BOND INDEX

This index covers corporate and non-corporate fixed income securities that are rated investment grade with maturities from 1 to 10 years.

### BARCLAYS CAPITAL 1-3 YEAR GOVERNMENT/CREDIT BOND INDEX

This index covers corporate and non-corporate fixed income securities that are rated investment grade and have one to three years until their final maturity.

### BARCLAYS CAPITAL HIGH YIELD BOND INDEX

This index includes all fixed income securities with a maximum quality rating of Ba1/BB+ (including defaulted issues), a minimum amount outstanding of USD 100 million, and at least one year to maturity.

<sup>2</sup> Barclays Capital Fixed Income Indices were formerly the Lehman Brothers Indices.

**BARCLAYS CAPITAL BROTHERS MORTGAGE-BACKED SECURITIES INDEX**

This index includes 15- and 30-year fixed-rate securities backed by mortgage pools of the Government National Mortgage Association (GNMA), Federal Home Loan Mortgage Corporation (FHLMC), and Federal National Mortgage Association (FNMA).

**BARCLAYS CAPITAL GLOBAL AGGREGATE BOND INDEX**

This index covers the most-liquid portion of the global investment-grade, fixed-rate bond market, including government, credit, and collateralized securities.

**BARCLAYS CAPITAL EMERGING MARKETS INDEX**

This index includes fixed- and floating-rate USD-denominated debt from emerging markets.

**S&P/LSTA U.S. LEVERAGED LOAN 100 INDEX**

This index is designed to reflect the performance of the largest facilities in the floating-rate bank loan, or senior loan, market.

**S&P NATIONAL AMT-FREE MUNICIPAL BOND INDEX**

This index is a broad, comprehensive, market-value-weighted index designed to measure the performance of the investment-grade U.S. municipal bonds that are exempt from the Alternative Minimum Tax.

**S&P CALIFORNIA AMT-FREE MUNICIPAL BOND INDEX**

This index is designed to measure the performance of the investment-grade California municipal bonds that are exempt from the Alternative Minimum Tax.

**S&P NEW YORK AMT-FREE MUNICIPAL BOND INDEX**

This index is designed to measure the performance of the investment-grade New York bonds that are exempt from the alternative minimum tax.

<b>S&amp;P DJI RESEARCH CONTRIBUTORS</b>		
Charles Mounts	Global Head	<a href="mailto:charles.mounts@spglobal.com">charles.mounts@spglobal.com</a>
Jake Vukelic	Business Manager	<a href="mailto:jake.vukelic@spglobal.com">jake.vukelic@spglobal.com</a>
<b>GLOBAL RESEARCH &amp; DESIGN</b>		
<b>AMERICAS</b>		
Aye M. Soe, CFA	Americas Head	<a href="mailto:aye.soe@spglobal.com">aye.soe@spglobal.com</a>
Dennis Badlyans	Associate Director	<a href="mailto:dennis.badlyans@spglobal.com">dennis.badlyans@spglobal.com</a>
Phillip Brzenk, CFA	Director	<a href="mailto:phillip.brzenk@spglobal.com">phillip.brzenk@spglobal.com</a>
Smita Chirputkar	Director	<a href="mailto:smita.chirputkar@spglobal.com">smita.chirputkar@spglobal.com</a>
Rachel Du	Senior Analyst	<a href="mailto:rachel.du@spglobal.com">rachel.du@spglobal.com</a>
Bill Hao	Director	<a href="mailto:wenli.hao@spglobal.com">wenli.hao@spglobal.com</a>
Qing Li	Associate Director	<a href="mailto:qing.li@spglobal.com">qing.li@spglobal.com</a>
Berlinda Liu, CFA	Director	<a href="mailto:berlinda.liu@spglobal.com">berlinda.liu@spglobal.com</a>
Ryan Poirier, FRM	Senior Analyst	<a href="mailto:ryan.poirier@spglobal.com">ryan.poirier@spglobal.com</a>
Maria Sanchez	Associate Director	<a href="mailto:maria.sanchez@spglobal.com">maria.sanchez@spglobal.com</a>
Kelly Tang, CFA	Director	<a href="mailto:kelly.tang@spglobal.com">kelly.tang@spglobal.com</a>
Peter Tsui	Director	<a href="mailto:peter.tsui@spglobal.com">peter.tsui@spglobal.com</a>
Hong Xie, CFA	Director	<a href="mailto:hong.xie@spglobal.com">hong.xie@spglobal.com</a>
<b>APAC</b>		
Priscilla Luk	APAC Head	<a href="mailto:priscilla.luk@spglobal.com">priscilla.luk@spglobal.com</a>
Utkarsh Agrawal, CFA	Associate Director	<a href="mailto:utkarsh.agrawal@spglobal.com">utkarsh.agrawal@spglobal.com</a>
Liyu Zeng, CFA	Director	<a href="mailto:liyu.zeng@spglobal.com">liyu.zeng@spglobal.com</a>
Akash Jain	Associate Director	<a href="mailto:akash.jain@spglobal.com">akash.jain@spglobal.com</a>
<b>EMEA</b>		
Sunjiv Mainie, CFA, CQF	EMEA Head	<a href="mailto:sunjiv.mainie@spglobal.com">sunjiv.mainie@spglobal.com</a>
Leonardo Cabrer	Senior Analyst	<a href="mailto:leonardo.cabrer@spglobal.com">leonardo.cabrer@spglobal.com</a>
Andrew Innes	Senior Analyst	<a href="mailto:andrew.innes@spglobal.com">andrew.innes@spglobal.com</a>
<b>INDEX INVESTMENT STRATEGY</b>		
Craig J. Lazzara, CFA	Global Head	<a href="mailto:craig.lazzara@spglobal.com">craig.lazzara@spglobal.com</a>
Fei Mei Chan	Director	<a href="mailto:feimei.chan@spglobal.com">feimei.chan@spglobal.com</a>
Tim Edwards, PhD	Senior Director	<a href="mailto:tim.edwards@spglobal.com">tim.edwards@spglobal.com</a>
Anu R. Ganti, CFA	Director	<a href="mailto:anu.ganti@spglobal.com">anu.ganti@spglobal.com</a>
Hamish Preston	Senior Associate	<a href="mailto:hamish.preston@spglobal.com">hamish.preston@spglobal.com</a>
Howard Silverblatt	Senior Index Analyst	<a href="mailto:howard.silverblatt@spglobal.com">howard.silverblatt@spglobal.com</a>

## GENERAL DISCLAIMER

Copyright © 2018 by S&P Dow Jones Indices LLC, a part of S&P Global. All rights reserved. Standard & Poor's®, S&P 500® and S&P® are registered trademarks of Standard & Poor's Financial Services LLC ("S&P"), a subsidiary of S&P Global. Dow Jones® is a registered trademark of Dow Jones Trademark Holdings LLC ("Dow Jones"). Trademarks have been licensed to S&P Dow Jones Indices LLC. Redistribution, reproduction and/or photocopying in whole or in part are prohibited without written permission. This document does not constitute an offer of services in jurisdictions where S&P Dow Jones Indices LLC, Dow Jones, S&P or their respective affiliates (collectively "S&P Dow Jones Indices") do not have the necessary licenses. All information provided by S&P Dow Jones Indices is impersonal and not tailored to the needs of any person, entity or group of persons. S&P Dow Jones Indices receives compensation in connection with licensing its indices to third parties. Past performance of an index is not a guarantee of future results.

It is not possible to invest directly in an index. Exposure to an asset class represented by an index is available through investable instruments based on that index. S&P Dow Jones Indices does not sponsor, endorse, sell, promote or manage any investment fund or other investment vehicle that is offered by third parties and that seeks to provide an investment return based on the performance of any index. S&P Dow Jones Indices makes no assurance that investment products based on the index will accurately track index performance or provide positive investment returns. S&P Dow Jones Indices LLC is not an investment advisor, and S&P Dow Jones Indices makes no representation regarding the advisability of investing in any such investment fund or other investment vehicle. A decision to invest in any such investment fund or other investment vehicle should not be made in reliance on any of the statements set forth in this document. Prospective investors are advised to make an investment in any such fund or other vehicle only after carefully considering the risks associated with investing in such funds, as detailed in an offering memorandum or similar document that is prepared by or on behalf of the issuer of the investment fund or other vehicle. Inclusion of a security within an index is not a recommendation by S&P Dow Jones Indices to buy, sell, or hold such security, nor is it considered to be investment advice.

These materials have been prepared solely for informational purposes based upon information generally available to the public and from sources believed to be reliable. No content contained in these materials (including index data, ratings, credit-related analyses and data, research, valuations, model, software or other application or output therefrom) or any part thereof (Content) may be modified, reverse-engineered, reproduced or distributed in any form or by any means, or stored in a database or retrieval system, without the prior written permission of S&P Dow Jones Indices. The Content shall not be used for any unlawful or unauthorized purposes. S&P Dow Jones Indices and its third-party data providers and licensors (collectively "S&P Dow Jones Indices Parties") do not guarantee the accuracy, completeness, timeliness or availability of the Content. S&P Dow Jones Indices Parties are not responsible for any errors or omissions, regardless of the cause, for the results obtained from the use of the Content. THE CONTENT IS PROVIDED ON AN "AS IS" BASIS. S&P DOW JONES INDICES PARTIES DISCLAIM ANY AND ALL EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE, FREEDOM FROM BUGS, SOFTWARE ERRORS OR DEFECTS, THAT THE CONTENT'S FUNCTIONING WILL BE UNINTERRUPTED OR THAT THE CONTENT WILL OPERATE WITH ANY SOFTWARE OR HARDWARE CONFIGURATION. In no event shall S&P Dow Jones Indices Parties be liable to any party for any direct, indirect, incidental, exemplary, compensatory, punitive, special or consequential damages, costs, expenses, legal fees, or losses (including, without limitation, lost income or lost profits and opportunity costs) in connection with any use of the Content even if advised of the possibility of such damages.

S&P Dow Jones Indices keeps certain activities of its business units separate from each other in order to preserve the independence and objectivity of their respective activities. As a result, certain business units of S&P Dow Jones Indices may have information that is not available to other business units. S&P Dow Jones Indices has established policies and procedures to maintain the confidentiality of certain non-public information received in connection with each analytical process.

In addition, S&P Dow Jones Indices provides a wide range of services to, or relating to, many organizations, including issuers of securities, investment advisers, broker-dealers, investment banks, other financial institutions and financial intermediaries, and accordingly may receive fees or other economic benefits from those organizations, including organizations whose securities or services they may recommend, rate, include in model portfolios, evaluate or otherwise address.

## CONTRIBUTORS

**Anu R. Ganti, CFA**  
Director  
Index Investment Strategy  
[anu.ganti@spglobal.com](mailto:anu.ganti@spglobal.com)

**Craig J. Lazzara, CFA**  
Managing Director  
Index Investment Strategy  
[craig.lazzara@spglobal.com](mailto:craig.lazzara@spglobal.com)

# The Slings and Arrows of Passive Fortune

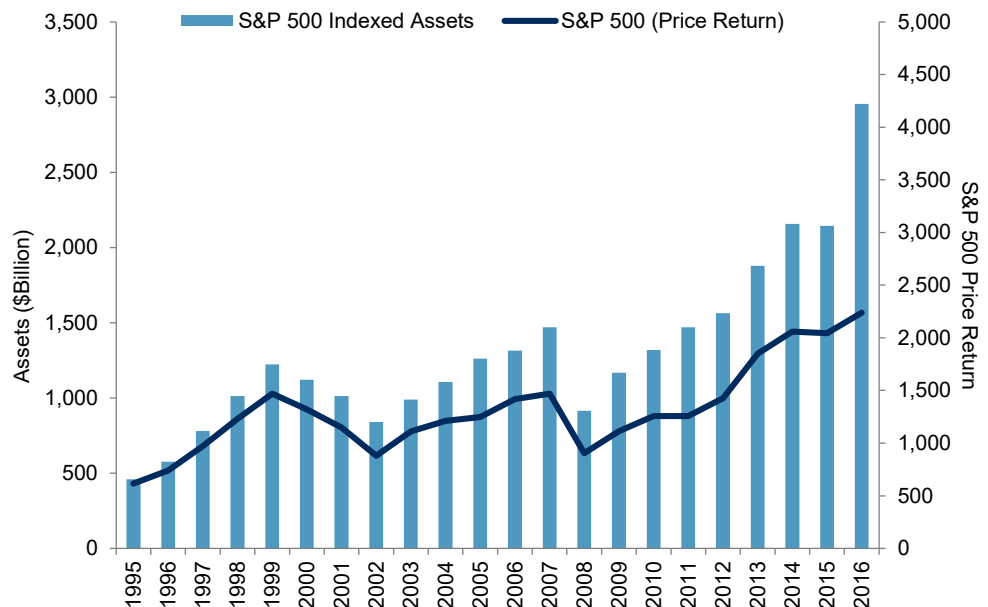
“When sorrows come, they come not single spies, but in battalions.”

*Hamlet, Act 4*

## EXECUTIVE SUMMARY

Passively managed assets have grown dramatically since the inception of indexing in the 1970s. (Exhibit 1 illustrates this for the [S&P 500®](#), arguably the most widely tracked index in the world.) Unsurprisingly, some active managers, as well as other critics, have raised questions about the impact of the growth of indexing. The charges leveled at index funds include suggestions that they encourage collusive behavior, that they are poor stewards of their customers' assets, that they contribute to market bubbles, and that they diminish market efficiency. We offer rebuttals to each of these concerns, and suggest how an eventual equilibrium between active and passive assets under management might arise.

### Exhibit 1: Approximately \$3 Trillion Tracks the S&P 500



Source: S&P Dow Jones Indices LLC. Data as of Dec. 30, 2016. Past performance is no guarantee of future results. Chart is provided for illustrative purposes.

## O TEMPORA! O MORES!

Recent years have witnessed a plethora of criticism directed at passive management by the advocates of a more traditional, active approach. To appreciate the extent of these claims, consider the following simple exercise. We performed a Google News search for “danger of passive investing” and found 171,000 news items. A search for “danger of passive smoking” yielded 29,700 news items.<sup>1</sup> Yet **does any reasonable person believe that index funds are more dangerous than cigarette smoke** (which might, after all, actually kill you)?

The critics of passive management sometimes conflate issues that all market participants face with issues uniquely attributable to index funds.

Passive investing has attracted so much criticism in part because its critics sometimes conflate issues that all market participants face with issues uniquely attributable to index funds. For example, the authors recently heard an active manager describe what he characterized as flaws in executive compensation and stock option plans, which supposedly operate to the detriment of investors.<sup>2</sup> These were described as “the hidden cost of passive investing.” His argument may or may not be correct (we are skeptical), but if it is, it describes a problem for *all* market participants, not just for investors in index funds.

Nonetheless, a number of respectable sources have also directed criticisms at passive management. We’ll address the following assertions:

- Common ownership: Index funds own stakes in many of the competitors in most industries. Does this encourage or facilitate collusive behavior?
- Stewardship: Do index funds exercise proper diligence over the management of the companies in which they invest?
- Bubbles: Do flows into passive vehicles exacerbate, or even cause, market bubbles?<sup>3</sup>
- Market efficiency: Passive investors are “price takers” who buy a stock because it’s in an index, not because they think the stock is cheap. Does price taking impede market efficiency?

We’ll conclude with some thoughts about how an ultimate equilibrium between active and passive investors might evolve.

## COMMON OWNERSHIP

Passively invested assets, at least in the U.S., are dominated by three large entities: BlackRock, Vanguard, and State Street. They (or, in BlackRock’s

<sup>1</sup> These numbers come from a Google news search on Feb. 1, 2018. Results of this exercise vary day by day, but the majority for investing over smoking has been quite stable. “Dangers” (plural) gives a different answer than “danger” (singular). If someone can explain why, we’ll be grateful.

<sup>2</sup> See LaFon, Holly, “[David Winters Takes Aim at Passive Investing](#),” Jan. 16, 2018.

<sup>3</sup> This is distinct from asking whether the *inclusion* of a stock in an index affects the stock’s valuation.

case, its predecessor companies) were among the pioneers of index funds in the 1970s, and today the big three manage approximately \$13 trillion.<sup>4</sup>

Fully passive index funds manage approximately 20% of the total float-adjusted capitalization of the U.S. stock market.

We've estimated previously that fully passive index funds manage approximately 20% of the total float-adjusted capitalization of the U.S. stock market.<sup>5</sup> Assume (incorrectly, but for the sake of argument) that the entire 20% is controlled by the three largest indexers, and assume further (correctly, this time) that they also manage factor-based “smart beta” funds as well as fully active portfolios. Then it's plausible to argue that the big three, on behalf of their clients, own between one-quarter and one-third of nearly every large company in the U.S.

So what? Critics claim that ownership of a substantial fraction of most or all of the competitors in an industry could lead to “softer competition among product rivals” and higher consumer prices.<sup>6</sup> The most often-cited example of this putative problem is the claim that U.S. airline ticket prices are “3-7% higher because of common ownership.”<sup>7</sup> Therefore, it is argued, public policy should require that “investors in firms in well-defined oligopolistic industries...choose either to limit their holdings of an industry to a small stake...or to hold the shares of only a single ‘effective firm’ per industry.”<sup>8</sup>

In response, we offer three observations:

- First, **there is by no means an academic consensus** that common ownership has raised the price of airline tickets.<sup>9</sup> Moreover, the critics' statistics are, like any statistical analysis, indicative of *correlation* rather than *causation*.<sup>10</sup> The critics' data on airline ticket prices span 2001-2014. Ticket prices may have risen, and the importance of index funds has certainly increased, but without a clearly identified causal mechanism, we should be cautious in attributing the first effect to the second.<sup>11</sup>

The critics' statistics are indicative of *correlation* rather than *causation*.

<sup>4</sup> Not all of which is fully passive. See Krouse, Sarah, “[At BlackRock, Vanguard and State Street, ‘Engagement’ Has Different Meanings.](#)” *Wall Street Journal*, Jan. 20, 2018.

<sup>5</sup> Ganti, Anu and Craig J. Lazzara, “[Shooting the Messenger.](#)” December 2017.

<sup>6</sup> Posner, Eric A., Fiona Scott Morton, and E. Glen Weyl, “[A Proposal to Limit the Anti-Competitive Power of Institutional Investors.](#)” Nov. 29, 2016.

<sup>7</sup> Azar, Jose, Martin C. Schmalz, and Isabel Tecu, “[Anti-Competitive Effects of Common Ownership.](#)” Mar. 15, 2017.

<sup>8</sup> Posner et al., *op. cit.*, p. 1.

<sup>9</sup> See Dennis, Patrick J., Kristopher Gerardi, and Carola Schenone, “[Common Ownership Does Not Have Anti-Competitive Effects in the Airline Industry.](#)” Feb. 5, 2017; and Kennedy, Pauline, Daniel P. O'Brien, Minjae Song, and Keith Waehrer, “[The Competitive Effects of Common Ownership: Economic Foundations and Empirical Evidence.](#)” July 2017. A particularly useful summary can be found in Committee on Capital Markets Regulation, “[Common Ownership and Antitrust Concerns.](#)” November 2017.

<sup>10</sup> See CCMR, *op. cit.*, p. 10.

<sup>11</sup> For a cautionary tale about the dangers of the *post hoc* fallacy, see Leinweber, David J., “[Stupid Data Miner Tricks: Overfitting the S&P 500.](#)” *Journal of Investing*, January 2007. The article was initially written in 1995.

Why increase the profits of 0.5% of your portfolio and raise the expenses of the other 99.5%?

- One company's revenue is another company's expense. Airlines accounted for 0.5% of the float-adjusted market capitalization of the S&P 500 as of year-end 2017. Even if index funds could cause airline executives to raise prices, why would they do so? Why increase the profits of 0.5% of your portfolio and raise the expenses of the other 99.5%?
- Price fixing and collusion are proscribed under applicable anti-trust laws. If such behaviors were suspected, appropriate legal remedies are presumably near at hand.

Finally, even if we accept the critics' view that indexers' common ownership of competitors is a problem for the economy, their proposed solution may be a cure worse than the disease. We estimate that **the passive management industry, at its current scale, saves investors more than \$20 billion annually in management fees alone**, a benefit that accrues to institutional and retail investors alike.<sup>12</sup> Handicapping an industry that delivers benefits of this magnitude on weak evidence of an ill-defined problem strikes us as a bridge too far.

## STEWARDSHIP

Some critics of passive management question whether index fund managers are good stewards of their investors' assets. They argue that index funds hold a stock because of its index membership, not because they necessarily believe in its virtues as an investment. Since index fund managers compete vigorously to reduce costs, it's at least plausible that they might treat governance research and company engagement as expensive luxuries not relevant to their price-sensitive clients.<sup>13</sup> As indexing grows, therefore, some critics argue that investor engagement with corporate management will diminish, and the overall quality of corporate governance will suffer as a result.

Many indices are explicitly designed to incorporate ESG criteria into the constituent selection process.

In this discussion, it's important to distinguish between the construction of indices in general and the construction of indices with a tilt toward governance issues. Index funds hold a company's stock to replicate an underlying index. The underlying index includes constituents based on predetermined eligibility rules, which are typically published in a methodology document.<sup>14</sup> If the objective of an index is to measure a particular market segment (as, for example, the S&P 500 is designed to measure the largest-capitalization segment of the U.S. market), the index methodology might not include corporate governance considerations. On the other hand, many indices are explicitly designed to incorporate environmental, social, and governance (ESG) criteria into the constituent

<sup>12</sup> Ganti and Lazzara, *op. cit.*, pp. 11-12.



selection process.<sup>15</sup> Such diverse index offerings facilitate investors' efforts to reflect their views of appropriate corporate behavior in their portfolios.

Even so, it's not correct to suppose that index funds without an explicit ESG mandate are indifferent to corporate governance issues. The most obvious reason for this turns the critics' argument on its head. Index funds will hold every stock in an index, regardless of their view of its fundamental merits. They don't have an option to sell a holding with whose management they're uncomfortable. **Because they're essentially permanent capital, index investors have a greater incentive to engage with corporate managements, not a lesser incentive.**

Index funds are permanent capital. They have a greater incentive than active managers to engage with corporate management.

In fact, objective observers report that "the world's largest index managers have expanded their stewardship or corporate-governance teams and...are increasingly committed to improving the ESG practices of their holdings through proxy voting and engagement."<sup>16</sup> Evidence suggests that passive management is associated with "more independent directors, removal of takeover defenses, and more equal voting rights."<sup>17</sup> Passive investing has also been found to facilitate the ability of activist investors to achieve board representation or otherwise to achieve successful, value-enhancing outcomes.<sup>18</sup>

The largest indexers are not shy about their views of corporate stewardship. BlackRock has been particularly vocal,<sup>19</sup> and has recently demanded that "companies in which it invests should have at least two female directors."<sup>20</sup> Vanguard has publicly declared its interest in monitoring "appropriate compensation, board composition, governance structure and risk oversight."<sup>21</sup> State Street, having previously expressed its discomfort with all-male boards, has recently begun to take a more aggressive view of executive compensation.<sup>22</sup> Whether such initiatives ultimately benefit the indexers' clients' portfolios is an open issue. But they are hardly indicative of a weak approach to corporate stewardship.

<sup>13</sup> Authers, John, "[Stewardship and cross-ownership top the passive worries](#)," *Financial Times*, Dec. 14, 2017.

<sup>14</sup> See, e.g., "[S&P U.S. Indices Methodology](#)," March 2018.

<sup>15</sup> See Nadig, Dave, "[The 'ESG' Umbrella Has Leaks](#)," Mar. 13, 2018.

<sup>16</sup> Bioy, Hortense, Alex Bryan, Jackie Choy, Jose Garcia-Zarate, and Ben Johnson, "[Passive Fund Providers Take an Active Approach to Investment Stewardship](#)," *Morningstar*, December 2017.

<sup>17</sup> Appel, Ian, Todd A. Gormley, and Donald B. Keim, "[Passive Investors, Not Passive Owners](#)," *Journal of Financial Economics*, forthcoming, Feb. 6, 2016.

<sup>18</sup> Appel, Ian, Todd A. Gormley, and Donald B. Keim, "[Standing on the shoulders of giants: The effect of passive investors on activism](#)," Feb. 2, 2018.

<sup>19</sup> Krouse, Sarah, "[BlackRock CEO to Companies: Pay Attention to 'Societal Impact'](#)," *Wall Street Journal*, Jan. 16, 2018.

<sup>20</sup> Krouse, Sarah, "[BlackRock: Companies Should Have at Least Two Female Directors](#)," *Wall Street Journal*, Feb. 2, 2018.

<sup>21</sup> Kozlowski, Rob, "[Vanguard releases proxy-voting report, outlines governance goals in letter to public companies](#)," *Pensions & Investments*, Aug. 31, 2017.

<sup>22</sup> McLannahan, Ben and Robin Wigglesworth, "[State Street ramps up pressure on excessive executive pay](#)," *Financial Times*, Feb. 3, 2018.

## BUBBLES

Some critics of passive management argue that indexing can lead to an inflation or distortion of stock prices as assets flow into passive vehicles. For instance, in April 2017, it was reported that “Unruly trading in the shares of some small gold companies is rekindling investor concern about the pressure that fast-growing passive funds can exert on the stocks they are meant to track.”<sup>23</sup> “Waves of money” flowing into a number of exchange-traded funds tracking gold-mining companies had supposedly caused pricing distortions in the underlying stocks—a classic case of the supposed tail wagging the supposed dog.

We have no opinion on whether there was a bubble in gold stocks in April 2017. The bubble, if there was one, had nothing to do with passive management, and is only tangentially related to the ETF in question.

Consider what would have happened if no ETFs invested in gold stocks, but actively-managed mutual funds did. Then presumably the assets that flowed into the gold ETF would have gone into an actively-managed fund. An active portfolio would almost certainly be less diversified than the ETF, which means that **the same asset flows would have been directed to a smaller number of stocks** where they would presumably have been even more disruptive.<sup>24</sup>

This episode is illustrative of a more general criticism of passive management—the **claim that it’s hard for active managers to outperform because too much money goes into index funds**. The critics argue that since “every new indexed dollar goes to the same places as previous dollars did, this guarantees that the most valuable company stays the most valuable, and gets more valuable and keeps going up.” Without valuation parameters, the market supposedly becomes a “bubble machine” which “inflates already large companies, blind to whether they’re actually selling more widgets or generating bigger profits.”<sup>25</sup> Capitalization-weighted indices like the S&P 500 are therefore “too trusting of the market’s judgment on a handful of very large stocks.”<sup>26</sup>

This, say the critics, leads to a vicious cycle. When managers underperform, they risk termination. The asset owner might then reinvest with an index fund. Underperforming managers own underperforming stocks; the index funds that gain assets own outperforming stocks (as well

Without ETFs, the same asset flows would have been directed into fewer stocks.

<sup>23</sup> Loder, Asjlynn and Chris Dieterich, “[How a \\$1.4 Billion ETF Gold Rush Rattled Mining Stocks Around the World](#),” *Wall Street Journal*, Apr. 23, 2017.

<sup>24</sup> Lazzara, Craig, “[The Wrong Diagnosis](#),” Apr. 24, 2017.

<sup>25</sup> Ledbetter, James, “[Is Passive Investment Actively Hurting The Economy?](#),” *The New Yorker*, Mar. 9, 2016. The author is quoting Timothy O’Neill of Goldman Sachs.

<sup>26</sup> Rennison, Joe and John Authers, “[‘Momentum’ investing bubble worries fanned by focus on market cap](#),” *Financial Times*, Oct. 10, 2017.

Underperforming managers own underperforming stocks; the index funds that gain assets own outperforming stocks as well.

as the underperformers); the shift from one to the other “lead[s] to the amplification of the prevailing price trends. A version of this is happening now as investors shift funds from active managers...into passive ETFs.”<sup>27</sup> This supposedly produces “exploitative momentum investing,” which gives short shrift to the analysis and valuation of company fundamentals.

Notice that this complaint is quite distinct from the so-called “inclusion effect,” which denotes the tendency of a stock’s price to rise when it becomes a member of an index. There is evidence of such an effect, although it may be shrinking over time, and some analysts suggest that it is strictly temporary.<sup>28</sup> The critics’ argument is not about the changes in an index’s composition, but rather about the effect of assets moving into an index with unchanging constituents.

So understood, this argument is a classic example of the critics attributing to passive management conditions that, if they exist at all, are a function of investment management in general. Overvalued and undervalued stocks exist regardless of index funds. So does the practice of momentum investing, although we’re not quite sure what’s “exploitative” about it. It is true that underperforming managers are more likely to be fired than outperformers, and it’s tautological that underperforming managers are disproportionately invested in underperforming stocks. Thus, if assets move from underperformers to index funds, those flows are likely to result in low momentum stocks being sold and high momentum stocks being bought.

To whatever degree assets would have moved into high momentum stocks, the move would still have happened without index funds.

But consider what would happen if there were no index funds. Underperforming active managers would still be fired, and presumably replaced with active managers who had been more successful in the recent past. To whatever degree assets would have moved from low momentum stocks to high momentum stocks, **the move would still have happened even in the absence of passive management.** In fact, the effect would be even greater without index funds, since the active managers who gained assets would typically be less diversified, and therefore arguably have a higher momentum bet, than a comparable index.<sup>29</sup>

We would go further and argue that **flows into index funds produce no distortion in the relative valuations of index constituents.** Suppose an asset owner makes a large contribution to an S&P 500 index fund, requiring the purchase of all 500 issuers. Apple Inc. is the largest component of the index, with a weighting of approximately 4%. For every \$1,000,000 going into the index, \$40,000 goes into Apple. The result of the investment of the

<sup>27</sup> Wooley, Paul and Dimitri Vayanos, “[Why investors should be weaned off tight tracking to market indices](#),” *Financial Times*, Dec. 20, 2017.

<sup>28</sup> See, e.g., Soe, Aye M. and Srikant Dash, “[The Shrinking Index Effect: A Global Perspective](#),” November 2008 and Kasch, Maria and Asani Sarkar, “[Is There an S&P 500 Index Effect?](#),” *Federal Reserve Bank of New York Staff Reports*, November 2012.

<sup>29</sup> See Edwards, Tim, Craig J. Lazzara, and Luca Ramotti “[The Volatility of Active Management](#),” August 2016.

asset owner's contribution is simple: **Apple was 4% of the index before the hypothetical trade, was 4% of the amount purchased, and is 4% of the index after the trade.** The flow of funds into the S&P 500, in other words, **had no impact** on the stock's relative valuation.<sup>30</sup>

This by no means demonstrates that Apple is fairly valued. It may very well be overvalued, as the critics imply. But if it's overvalued, it got to be that way because investors bought Apple, not because they bought the entire S&P 500.

Bubbles have inflated and deflated long before the existence of index funds.

Finally, we note that bubbles have inflated and deflated long before the existence of index funds. "If index funds cause market bubbles, they're not nearly as good at it as human beings are. Why should we be more afraid of index funds causing a bubble today than anybody was of active investors causing one in 1999 or 1972 or 1929? The Panic of 1907, the Panic of 1873, the Panic of 1857, the Panic of 1837, the crash of 1792 and the pan-European bubble of 1720 were all inflamed by human stock-pickers long before the idea of an index fund had ever occurred to anybody."<sup>31</sup>

#### **Why Active Management Has Become More Difficult**

Importantly, to say that index funds don't create bubbles is not to say that index funds don't make life more challenging for active managers. They do, but not because they promote the persistent overvaluation of the index's largest holdings. The difficulty arises because, in any market, there is **no net supply of alpha**. The outperformance of above-average investors is precisely offset (before costs) by the underperformance of below-average investors. **When professionals become the dominant force in a market, the average professional cannot expect to outperform.**<sup>32</sup>

The outperformance of the winners is precisely offset by the underperformance of the losers.

Exhibit 2 provides a simple illustration. We posit two scenarios, both for a market valued at \$20 trillion. In Scenario A, the entire market is assumed to be actively managed. Thus \$10 trillion will have above-average performance, and \$10 trillion will suffer below-average performance. By how much will the winners win? It depends on the answer to another question: by how much do the losers lose?

In Scenario A, we've (arbitrarily) assumed that the average underperformance of the losers is 5%. Then the total alpha available for the above-average managers to harvest is \$500 billion (5% of \$10 trillion).

<sup>30</sup> See Siegel, Laurence B., "[Index Fund Silliness: Indexing Doesn't Distort Anything](#)," AJO, August 2017.

<sup>31</sup> Zweig, Jason, "[And Now For Something on Index Funds](#)," Apr. 13, 2017.

<sup>32</sup> Ganti and Lazzara, *op.cit.*, pp. 6-8. See also Lazzara, Craig J., "[The Shrinking Supply of Alpha](#)," Oct. 10, 2013.

Exhibit 2: A Passive Alternative Shrinks the Supply of Alpha		
	SCENARIO A	SCENARIO B
Total Market Cap (\$ Trillion)	20.0	20.0
Percentage Actively Managed (%)	100%	80%
Value Actively Managed (\$ Trillion)	20.0	16.0
Value Outperforming (\$ Trillion)	10.0	8.0
Value Underperforming (\$ Trillion)	10.0	8.0
Average Underperformance of Underperformers (%)	5%	4%
Total Underperformance (\$ Billion)	500	320

Source: S&P Dow Jones Indices LLC. Table is provided for illustrative purposes.

In Scenario B, we make two changes. First, we assume that 20% of the market is now managed by index funds, leaving \$16 trillion for active managers. Half of this value will underperform, meaning that \$8 trillion of assets will lag the market. **What is the average underperformance of the underperformers now?** We argue that it should be *better* than the 5% lag in Scenario A. When a passive alternative is available, presumably **it is the least capable active managers who lose the most assets. Index investing thus has the effect of culling the worst active managers.** The ability level of the average active manager goes up, which means that the average underperformance of the laggards improves. **If the losers' underperformance improves, however, the winners' outperformance must also diminish.**

By reducing the number of underperforming active managers, indexing reduces the rewards for those who remain.

We've assumed in Scenario B that the losers' underperformance improves from -5% to -4%. Then the aggregate alpha available to the above-average managers is \$320 billion (4% of \$8 trillion). The hypothetical aggregate alpha pool falls by 36% as a consequence of a 20% decline in actively managed assets. **By reducing the number of potentially underperforming active managers, indexing reduces the rewards for those who remain.**

This may seem paradoxical, since the flow of assets from active to index managers raises the quality of the active managers who survive, increasing their average absolute ability. Why do more able active managers not achieve better results? Because **what matters is not absolute, but relative skill.** Passive management makes the active management game harder.<sup>33</sup>

## MARKET EFFICIENCY

Index funds buy the stocks they buy because those stocks are included in the index the funds are trying to track. Unlike active investors, who devote

<sup>33</sup> See Mauboussin, Michael J., Dan Callahan, and Darius Majd, "[Looking for Easy Games: How Passive Investing Shapes Active Management](#)," Jan. 4, 2017.

Market prices may not always be correct, but they're sufficiently correct that it's not worthwhile to try to detect when they're not.

considerable resources to some combination of fundamental, technical, and quantitative analysis, index funds rely on an index provider's rules and methodologies. Market prices may not always be correct, they'll argue, but they're sufficiently correct that it's not worthwhile to try to detect when they're not.<sup>34</sup> Indexers, in that sense, can be called "price takers," at least for individual stocks.

This ungrudging acceptance of market prices leads the critics of passive management to complain that index funds are both parasitic and potentially destructive. "Markets are efficient only because active managers buy underpriced assets and sell overpriced ones...By making markets more efficient, active managers are creating an environment where index fund investing is more appealing."<sup>35</sup> More importantly, observers have asked what will happen if passive management continues to take market share from active. Can there be too much indexing, and if there is, would the efficiency of capital markets be impaired?<sup>36</sup>

Factor indices are not price takers.

Although it's correct to say that most passive investors are price takers, this is *not* true of the factor indices that underlie "smart beta" portfolios. Factor indices are based on metrics like value or momentum; they seek much the same end as active managers, although by different means.<sup>37</sup> A broad-based index like the S&P 500 may hold some richly-valued stocks, but a value-oriented index will avoid them in the same way that a value-driven active manager will avoid them.<sup>38</sup>

That said, investors in non-factor-based index funds do indeed function as price takers. **In this respect, they resemble most of the world's population most of the time**, or at least that fraction of the world's population that doesn't live in a barter economy. When I bought my lunch today, I didn't bargain with the restaurant or otherwise engage in "price discovery"—I simply used the posted prices. The absence of bargaining was a feature, not a defect: "Widespread availability of market prices for everything from industrial commodities to manicures is what allows independent agents to make free economic choices that lead to far more liberty and prosperity than central planners could ever deliver."<sup>39</sup> **Passive investors, in other words, are hardly unique in their willingness to be price takers.**

<sup>34</sup> See Eugene Fama's comments in *Chicago Booth Review*, "[Are Markets Efficient?](#)," June 30, 2016.

<sup>35</sup> Pozen, Robert and Theresa Hamacher, "[Has the death knell of active management been rung too soon?](#)," *Financial Times*, Feb. 1, 2015.

<sup>36</sup> For a recent, and reasonable, summary of these concerns, see Landsman, Stephanie, "[Passive investing is a 'chaotic system' that could be dangerous, warns Robert Shiller](#)," Nov. 14, 2017. A less understated version can be found at Fraser-Jenkins, Inigo, et al., "[The Silent Road to Serfdom: Why Passive Investing is Worse Than Marxism](#)," Aug. 23, 2016.

<sup>37</sup> For an overview of factor investing, see Mainie, Sunjiv, "[The Story of Factor-Based Investing](#)," February 2015 and Doll, Christopher, "[Q&A: What is factor investing?](#)," Feb. 28, 2017. See also Lazzara, Craig, "[The Teleology of Smart Beta](#)," Mar. 29, 2016.

<sup>38</sup> Examples of such value-oriented indices would include the [S&P 500 Pure Value](#) and the [S&P 500 Enhanced Value Index](#).

<sup>39</sup> Asness, Cliff, "[Indexing Is Capitalism at Its Best](#)," *Bloomberg View*, Sept. 2, 2016.



Misvaluation is like street crime; active managers are like police officers on the beat.

A more important issue is whether there is a point beyond which the expansion of indexing causes market efficiency to degrade. At the limit, if 100% of assets were passively managed, misvaluation would be rife. One academic observer compares misvaluation to street crime and active managers to police officers on the beat.<sup>40</sup> **More police, less crime; more active managers, less misvaluation.** This is an important issue for indexers no less than for active investors, since the assumption of market efficiency is one of the underpinnings of the case for passive management.<sup>41</sup> We find the argument that the growth of indexing is damaging market efficiency unconvincing:

The growth of passive investing raises the quality of the surviving active managers. This enhances market efficiency.

- First, we can't resist observing that not all active investing contributes to market efficiency and efficient capital allocation. Those of us old enough to remember names like [Pets.com](#) or [Drkoop.com](#) will recognize that active managers are fallible human beings; they sometimes get it wrong, and when they do, capital can be badly misallocated. One of the ways the economy might adjust to such misallocations is by reducing the assets entrusted to those who made them—for example, by moving from active managers to index funds.
- Second, when index funds are offered in a market that was formerly controlled entirely by active managers, where do the passive assets come from? As we implied in our discussion of market bubbles, anyone who believes that some active managers are more skillful than others, and that their skill is manifested in outperformance, presumably must also believe that **the least skillful active managers lose the most assets.** Therefore **the growth of passive management must raise the quality of the surviving active managers.** If the quality of active managers rises, market efficiency is enhanced.
- Third, active traders trade with other active traders. If an active manager spots what he believes to be an opportunity and wants to allocate capital to a putatively undervalued stock, he will have to buy it from another active manager (or from a dealer who will lay off the position to another active manager).<sup>42</sup> An index fund would have no reason to be the source of liquidity for such an information-driven trade. Whether index funds represent 10% of assets or 90%, **all information-driven trades are between two active managers.**
- Finally, active management's share of trading is far higher than its share of assets; it is trading that sets prices and drives market efficiency. **Passive assets under management (AUM) can rise**

Active traders trade with other active traders, regardless of the fraction of assets active managers manage.

<sup>40</sup> Pastor, Lubos, "[Active Funds Have Time on Their Side: Lubos Pastor](#)," *Bloomberg View*, Mar. 7, 2012.

<sup>41</sup> But not the only one! See Ganti and Lazzara, *op. cit.*, pp. 6-10.

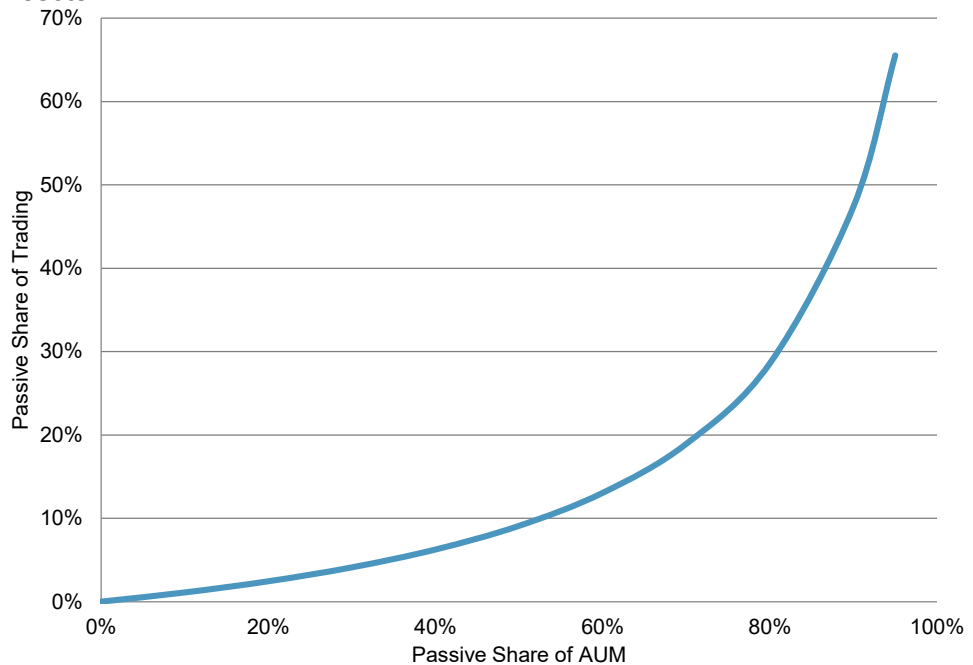
<sup>42</sup> See Smetters, Kent, "[Why Critics of Passive Investing Are Wrong](#)," *Wall Street Journal*, Sept. 24, 2017.

**dramatically without significantly diminishing the share of trading done by active investors.**<sup>43</sup> Exhibit 3 shows the nature of the relationship under conservative assumptions.

We posit in Exhibit 3 that there are two categories of assets, active and passive, and that turnover is 50% annually for the active assets and 10% annually for the passive assets.<sup>44</sup> As assets shift from active to passive, the share of trading done by the passive managers naturally rises, but is always less than the passive share of AUM. For example, if 20% of the assets are passive, active managers will do 95% of the trading. If the share of passive AUM doubles to 40%, active managers will still do 88% of the trading. Under Exhibit 3's assumptions, in fact, passive AUM share has to rise above 83% before active managers' share of trading drops below 50%.

**Exhibit 3: Passive Management's Share of Trading is Less Than Its Share of Assets**

Active managers' share of trading is much greater than their share of assets managed. Trading sets prices and adjusts valuations.



Source: S&P Dow Jones Indices LLC. Chart is provided for illustrative purposes. Assumes that passive turnover is 10% annually and active turnover 50% annually.

It is trading, and not asset management per se, that sets prices and putatively corrects misvaluations. If active trading makes for an efficient market, **indexing has a long way to go before market efficiency is impaired.**<sup>45</sup>

<sup>43</sup> See Ellis, Charles D, "[The Rise and Fall of Performance Investing](#)," *Financial Analysts Journal*, July/August 2014.

<sup>44</sup> These assumptions are quite conservative on both sides. Turnover for the S&P 500 has averaged 3.68% for the last 5 years, and active managers' average turnover is quite a bit higher than 50%. See, e.g., White, Amanda, "[Equity Portfolios' Tell-Tale Turnover](#)," Mar. 3, 2017.

<sup>45</sup> Vanguard founder John Bogle recently opined that indexing's market share might rise to as much as 90% without damage to market efficiency. See Platt, Eric, "[Vanguard's Jack Bogle predicts passive investing takeover](#)," *Financial Times*, Oct. 27, 2017.



### Unavailable Shares

One way to test our intuition about the interaction of passive ownership and market efficiency comes from a natural experiment. The S&P 500, like most indices, is float-weighted—in other words, a stock’s weight in the index depends not on its total capitalization, but on the amount of its capitalization that’s available for public investors to buy. Unavailable shares—e.g., founders’ control blocks, or government holdings—are not included in the index.<sup>46</sup> The largest such excluded block in the S&P 500 comes from Walmart Inc., where approximately half of the total capitalization is closely held (by members of the founding Walton family), and is therefore not part of the index.

Half of Walmart’s capitalization is held by a de facto one-stock index fund. Does anyone argue that Walmart is not efficiently priced?

Effectively, therefore, half of the capitalization of Walmart is held in a one-stock index fund owned by one family. Like other index funds, this figurative one doesn’t trade actively—it just sits there, presumably votes its proxies, and collects its dividends. If, as we’ve estimated, 20% of the U.S. equity market is indexed, that means that an additional 10% of the total capitalization of Walmart is held in funds tracking the S&P 500 and its competitors. Why, one wonders, should we be concerned about that 10%, when the 50% permanently off the market evokes not a whimper? **No one, to our knowledge, has ever argued that Walmart is inefficiently priced because half of its cap is closely held.**

### Correlations

A related criticism of passive management is the claim that the increase in index trading “contributes to...higher return correlations among stocks.”<sup>47</sup> This argument is of a piece with concerns about market efficiency—if correlations rise, it might imply that stocks are moving together simply because of their membership in a common index, without regard to the characteristics of the stocks themselves. In rebuttal, we submit Exhibit 4, which graphs the average pairwise correlation of the constituents of the S&P 500 between 1992 and 2017.<sup>48</sup> Correlations were relatively high during and after the 2008 financial crisis, but since then have been on a downtrend, finishing 2017 near their 26 year low. Importantly, note that correlations have been below their median level since mid-2016, despite the ongoing growth in passive assets. **Whatever the growth of index funds may have done, it has not driven correlations higher.**

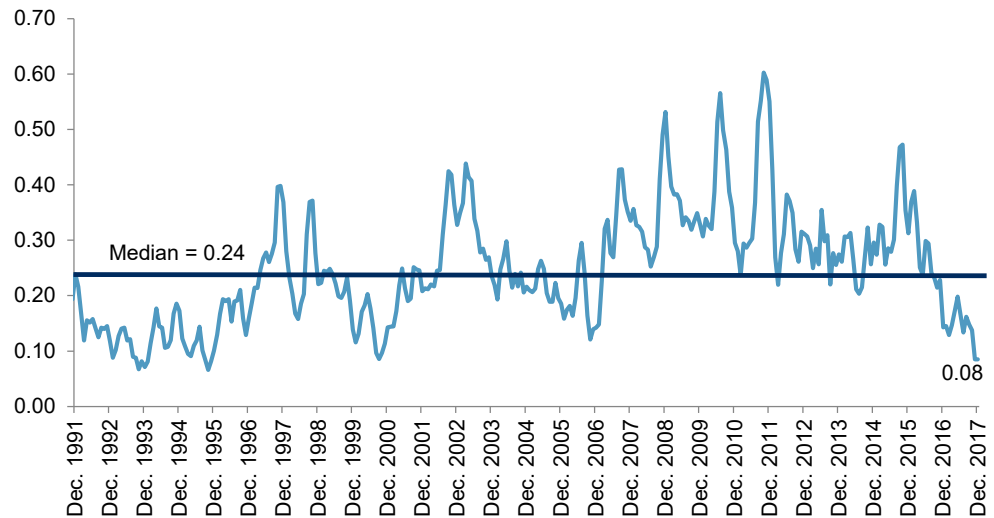
<sup>46</sup> Float weighting became common practice among index providers in the early years of this century, largely in response to the realization that stocks with less than 100% availability would be squeezed upward by the growth of passive assets under management. Float adjustments are typically much greater outside the U.S.

<sup>47</sup> Sullivan, Rodney N. and James X. Xiong, “[How Index Trading Increases Market Vulnerability](#),” *Financial Analysts Journal*, March/April 2012.

<sup>48</sup> See Edwards, Tim and Craig J. Lazzara, “[At the Intersection of Diversification, Volatility and Correlation](#),” April 2014.

**Exhibit 4: S&P 500 Correlation Has Recently Been Near Its All-Time Low**

At the end of 2017, correlations were near an all-time low, while index fund assets were at an all-time high.



Source: S&P Dow Jones Indices LLC. Data from Dec. 31, 1990, to Dec. 31, 2017, plotting three-month moving average of monthly correlations. Past performance is no guarantee of future results. Chart is provided for illustrative purposes.

### Corporate Activity and Macroeconomic Price Discovery

Even in a world completely dominated by passive investors, we shouldn't overlook the role played by corporate issuers in driving market efficiency. Corporations take part in price formation via stock issuance, buybacks, and mergers. Additionally, corporations have a unique advantage: "Issuers not only have the means to play an equilibrating role, they are also the agents who most likely possess the requisite information."<sup>49</sup>

Finally, it's important to **recognize the role that index vehicles play in setting market prices at a macro level**. The most frequently-traded security in the U.S. is an ETF tracking the S&P 500, and S&P 500 futures are among the world's most actively-traded derivative contracts. **The active trading of these passive vehicles is itself an expression of investor sentiment and thus contributes directly to price discovery**. Thanks to arbitrageurs, that discovery is then inevitably reflected in the index's component securities. In that sense, therefore, index vehicles may be price takers at a microeconomic level, but help to set prices at a macroeconomic level.

### APPROACHING EQUILIBRIUM

"The test of a first-rate intelligence is the ability to hold two opposed ideas in the mind at the same time, and still retain the ability to function."<sup>50</sup> Here are two opposed ideas, both of which we believe to be true.

<sup>49</sup> Cornell, Bradford, "[Passive Investing and Market Efficiency](#)," June 20, 2017.

<sup>50</sup> Fitzgerald, F. Scott, "[The Crack-Up](#)," *Esquire*, February 1936.

Some active management is required in order for prices to approximate fair value.

- The average active manager will underperform most of the time.<sup>51</sup> This gives asset owners an incentive to move assets from active managers to index funds. If it continues indefinitely, this trend will endanger the survival of active management.
- Some active management is needed in order for prices to approximate fair value; index investors therefore have an interest in the preservation of at least some of their active competitors. If there are no active managers, market efficiency will suffer.

The tremendous recent growth of passive investing prompts a natural question: what might the ultimate equilibrium between active and passive management look like? Academics have been concerned with this question for many years.<sup>52</sup> We suggest a simple and intuitive way of thinking about the problem.

<b>Exhibit 5: If the Majority Underperform by a Little, the Minority Can Outperform by a Lot</b>		
	<b>SCENARIO B</b>	<b>SCENARIO C</b>
Total Market Cap (\$ Trillion)	20.0	20.0
Percentage Actively Managed (%)	80%	80%
Value Actively Managed (\$ Trillion)	16.0	16.0
Value Outperforming (\$ Trillion)	8.0	4.0
Value Underperforming (\$ Trillion)	8.0	12.0
Losers' Underperformance (%)	4.00%	2.67%
Winners' Outperformance (%)	4.00%	8.00%
Total Underperformance (\$ Billion)	320	320

Source: S&P Dow Jones Indices LLC. Table is provided for illustrative purposes.

Exhibit 5 is an extension of Exhibit 2. We ended Exhibit 2 with Scenario B, in which the \$20 trillion equity market was 80% actively managed and 20% passively managed. Of the \$16 trillion managed actively, equal amounts were managed by below-average and above-average managers. We assumed that the average underperforming manager underperformed by 4% per year. Then the total alpha available for the above-average managers to harvest was \$320 billion (4% of \$8 trillion). This is consistent with our earlier argument that there is no natural source of alpha: the outperformance of the winners is provided by the underperformance of the losers.

<sup>51</sup> Soe, Aye M. and Ryan Poirier, "[SPIVA U.S. Scorecard](#)," Year-End 2017.

<sup>52</sup> See, e.g., Grossman, Sanford J. and Joseph E. Stiglitz, "[On the Impossibility of Informationally Efficient Markets](#)," *The American Economic Review*, June 1980.

But Scenario B is too simplistic. Although the total outperformance of the winners comes from the underperformance of the losers, **it's not necessary that winners and losers manage the same quantity of assets**. In Scenario C, we assume that three-quarters of the actively-managed \$16 trillion underperforms—so that \$12 trillion is run by below-average managers, and \$4 trillion is run by above-average managers. If the losers underperform by an average of 2.67%, their gross underperformance amounts to the same \$320 billion we had in Scenario B. But now, the winners outperform by an average of 8%.

Outperformance and underperformance need not be symmetric. If a majority of assets underperform by “a little,” the minority can outperform by “a lot.”

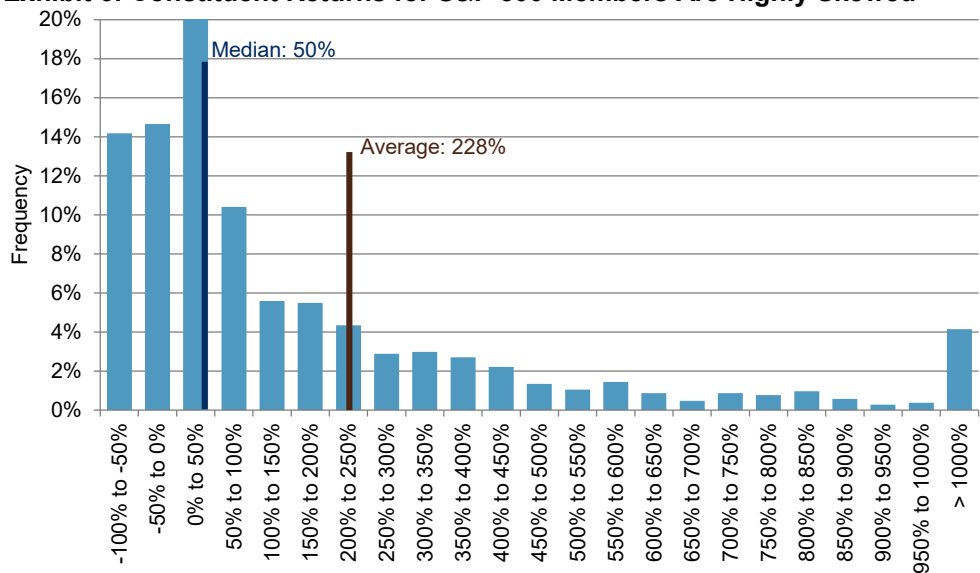
What this example illustrates is that, while the aggregate under- and outperformance remain constant, their **distribution need not be symmetric**. In Scenario C, a large majority of active managers underperforms by a relatively small amount. This enables a minority to outperform by a much larger amount.

This is, of course, a stylized example, and admittedly imprecise, not least about the exact definition of “relatively small.” A good working definition of “relatively small” would be “not so large that you're in jeopardy of being summarily fired.” **If relative performance losses are acceptable, the risk of an active manager being replaced by an index fund diminishes, and a rough equilibrium between active and passive AUM might be maintained.**

Equilibrium between active and passive requires that the majority of assets underperform.

The nature of the asymmetry is critical to achieving equilibrium. Exhibit 5 shows an underperforming majority and an outperforming minority. Computationally, those positions could be reversed. If \$4 trillion of actively managed assets *underperformed* by 8%, then the remaining \$12 trillion could *outperform* by 2.67%. The trouble isn't arithmetical, it's behavioral: lagging by 8% is so egregious that the managers who did it wouldn't survive for long. **If there is to be a stable asymmetry, it has to be one where the absolute value of the average underperformance is tolerably small. This requires that the majority of assets underperform.**

**Exhibit 6: Constituent Returns for S&P 500 Members Are Highly Skewed**



Source: S&P Dow Jones Indices LLC, FactSet. Data from Dec. 31, 1997, to Dec. 29, 2017. Past performance is no guarantee of future results. Chart is provided for illustrative purposes.

Stock prices are positively skewed. Active managers start with a disadvantage, which produces a majority of underperformers.

Majority underperformance, of course, is **consistent with the observed behavior of both active manager performance and equity market returns**. As Exhibit 6 demonstrates, U.S. equity returns are positively skewed over time. Active managers typically hold only a small minority of the names in an index. Every stock they select has a 50/50 chance of being above median, but when returns are skewed, they have less than a 50/50 chance of being above average. Active stock selection therefore starts with a disadvantage—a disadvantage that results in **a majority of underperformers and a minority of outperformers**.<sup>53</sup>

## FINAL THOUGHTS

**The growth of index funds and passive management has been one of the most significant developments in modern financial history.** The dollars saved by the customers of index funds—in terms of reduced fees and reduced active underperformance—now certainly must be reckoned in the hundreds of billions. This benefit did not materialize out of thin air, of course—fees saved by index customers are fees not received by active managers.

It is not surprising, therefore, that active managers would mount a stubborn resistance to the growth of index funds. Some of their commentary is risible and can easily be dismissed, but we take issue even with the more substantive complaints. Common ownership has not been shown to lead to collusive behavior; passive managers are not demonstrably poor stewards of their customers’ assets; if the equity market is in a bubble, it was not

<sup>53</sup> See Soe and Poirier, *op. cit.* and Ganti and Lazzara, *op. cit.*, pp. 9-10. See also Lazzara, Craig, “[The Skew Is Not New](#),” Feb. 22, 2018.

inflated by index funds; and there's no evidence that passive management has damaged market efficiency. **The growth of index funds in itself evidences the value that passive management delivers to the investment community.**

We anticipate that index funds will continue to take market share from active managers. This trend may eventually diminish. An equilibrium between active and passive management would require that the majority of actively managed assets underperform by a relatively small amount, enabling a minority of assets to outperform by more.

<b>S&amp;P DJI RESEARCH CONTRIBUTORS</b>		
Charles Mounts	Global Head	<a href="mailto:charles.mounts@spglobal.com">charles.mounts@spglobal.com</a>
Jake Vukelic	Business Manager	<a href="mailto:jake.vukelic@spglobal.com">jake.vukelic@spglobal.com</a>
<b>GLOBAL RESEARCH &amp; DESIGN</b>		
<b>AMERICAS</b>		
Aye M. Soe, CFA	Americas Head	<a href="mailto:aye.soe@spglobal.com">aye.soe@spglobal.com</a>
Dennis Badlyans	Associate Director	<a href="mailto:dennis.badlyans@spglobal.com">dennis.badlyans@spglobal.com</a>
Phillip Brzenk, CFA	Director	<a href="mailto:phillip.brzenk@spglobal.com">phillip.brzenk@spglobal.com</a>
Smita Chirputkar	Director	<a href="mailto:smita.chirputkar@spglobal.com">smita.chirputkar@spglobal.com</a>
Rachel Du	Senior Analyst	<a href="mailto:rachel.du@spglobal.com">rachel.du@spglobal.com</a>
Bill Hao	Director	<a href="mailto:wenli.hao@spglobal.com">wenli.hao@spglobal.com</a>
Qing Li	Director	<a href="mailto:qing.li@spglobal.com">qing.li@spglobal.com</a>
Berlinda Liu, CFA	Director	<a href="mailto:berlinda.liu@spglobal.com">berlinda.liu@spglobal.com</a>
Ryan Poirier, FRM	Senior Analyst	<a href="mailto:ryan.poirier@spglobal.com">ryan.poirier@spglobal.com</a>
Maria Sanchez	Associate Director	<a href="mailto:maria.sanchez@spglobal.com">maria.sanchez@spglobal.com</a>
Kelly Tang, CFA	Director	<a href="mailto:kelly.tang@spglobal.com">kelly.tang@spglobal.com</a>
Hong Xie, CFA	Director	<a href="mailto:hong.xie@spglobal.com">hong.xie@spglobal.com</a>
<b>APAC</b>		
Priscilla Luk	APAC Head	<a href="mailto:priscilla.luk@spglobal.com">priscilla.luk@spglobal.com</a>
Utkarsh Agrawal, CFA	Associate Director	<a href="mailto:utkarsh.agrawal@spglobal.com">utkarsh.agrawal@spglobal.com</a>
Liyu Zeng, CFA	Director	<a href="mailto:liyu.zeng@spglobal.com">liyu.zeng@spglobal.com</a>
Akash Jain	Associate Director	<a href="mailto:akash.jain@spglobal.com">akash.jain@spglobal.com</a>
<b>EMEA</b>		
Sunjiv Mainie, CFA, CQF	EMEA Head	<a href="mailto:sunjiv.mainie@spglobal.com">sunjiv.mainie@spglobal.com</a>
Leonardo Cabrer, PhD	Senior Analyst	<a href="mailto:leonardo.cabrer@spglobal.com">leonardo.cabrer@spglobal.com</a>
Andrew Innes	Associate Director	<a href="mailto:andrew.innes@spglobal.com">andrew.innes@spglobal.com</a>
<b>INDEX INVESTMENT STRATEGY</b>		
Craig J. Lazzara, CFA	Global Head	<a href="mailto:craig.lazzara@spglobal.com">craig.lazzara@spglobal.com</a>
Fei Mei Chan	Director	<a href="mailto:feimei.chan@spglobal.com">feimei.chan@spglobal.com</a>
Tim Edwards, PhD	Managing Director	<a href="mailto:tim.edwards@spglobal.com">tim.edwards@spglobal.com</a>
Anu R. Ganti, CFA	Director	<a href="mailto:anu.ganti@spglobal.com">anu.ganti@spglobal.com</a>
Hamish Preston	Senior Associate	<a href="mailto:hamish.preston@spglobal.com">hamish.preston@spglobal.com</a>
Howard Silverblatt	Senior Index Analyst	<a href="mailto:howard.silverblatt@spglobal.com">howard.silverblatt@spglobal.com</a>

## GENERAL DISCLAIMER

Copyright © 2018 by S&P Dow Jones Indices LLC, a part of S&P Global. All rights reserved. Standard & Poor's®, S&P 500® and S&P® are registered trademarks of Standard & Poor's Financial Services LLC ("S&P"), a subsidiary of S&P Global. Dow Jones® is a registered trademark of Dow Jones Trademark Holdings LLC ("Dow Jones"). Trademarks have been licensed to S&P Dow Jones Indices LLC. Redistribution, reproduction and/or photocopying in whole or in part are prohibited without written permission. This document does not constitute an offer of services in jurisdictions where S&P Dow Jones Indices LLC, Dow Jones, S&P or their respective affiliates (collectively "S&P Dow Jones Indices") do not have the necessary licenses. All information provided by S&P Dow Jones Indices is impersonal and not tailored to the needs of any person, entity or group of persons. S&P Dow Jones Indices receives compensation in connection with licensing its indices to third parties. Past performance of an index is not a guarantee of future results.

It is not possible to invest directly in an index. Exposure to an asset class represented by an index is available through investable instruments based on that index. S&P Dow Jones Indices does not sponsor, endorse, sell, promote or manage any investment fund or other investment vehicle that is offered by third parties and that seeks to provide an investment return based on the performance of any index. S&P Dow Jones Indices makes no assurance that investment products based on the index will accurately track index performance or provide positive investment returns. S&P Dow Jones Indices LLC is not an investment advisor, and S&P Dow Jones Indices makes no representation regarding the advisability of investing in any such investment fund or other investment vehicle. A decision to invest in any such investment fund or other investment vehicle should not be made in reliance on any of the statements set forth in this document. Prospective investors are advised to make an investment in any such fund or other vehicle only after carefully considering the risks associated with investing in such funds, as detailed in an offering memorandum or similar document that is prepared by or on behalf of the issuer of the investment fund or other vehicle. Inclusion of a security within an index is not a recommendation by S&P Dow Jones Indices to buy, sell, or hold such security, nor is it considered to be investment advice.

These materials have been prepared solely for informational purposes based upon information generally available to the public and from sources believed to be reliable. No content contained in these materials (including index data, ratings, credit-related analyses and data, research, valuations, model, software or other application or output therefrom) or any part thereof (Content) may be modified, reverse-engineered, reproduced or distributed in any form or by any means, or stored in a database or retrieval system, without the prior written permission of S&P Dow Jones Indices. The Content shall not be used for any unlawful or unauthorized purposes. S&P Dow Jones Indices and its third-party data providers and licensors (collectively "S&P Dow Jones Indices Parties") do not guarantee the accuracy, completeness, timeliness or availability of the Content. S&P Dow Jones Indices Parties are not responsible for any errors or omissions, regardless of the cause, for the results obtained from the use of the Content. THE CONTENT IS PROVIDED ON AN "AS IS" BASIS. S&P DOW JONES INDICES PARTIES DISCLAIM ANY AND ALL EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE, FREEDOM FROM BUGS, SOFTWARE ERRORS OR DEFECTS, THAT THE CONTENT'S FUNCTIONING WILL BE UNINTERRUPTED OR THAT THE CONTENT WILL OPERATE WITH ANY SOFTWARE OR HARDWARE CONFIGURATION. In no event shall S&P Dow Jones Indices Parties be liable to any party for any direct, indirect, incidental, exemplary, compensatory, punitive, special or consequential damages, costs, expenses, legal fees, or losses (including, without limitation, lost income or lost profits and opportunity costs) in connection with any use of the Content even if advised of the possibility of such damages.

S&P Dow Jones Indices keeps certain activities of its business units separate from each other in order to preserve the independence and objectivity of their respective activities. As a result, certain business units of S&P Dow Jones Indices may have information that is not available to other business units. S&P Dow Jones Indices has established policies and procedures to maintain the confidentiality of certain non-public information received in connection with each analytical process.

In addition, S&P Dow Jones Indices provides a wide range of services to, or relating to, many organizations, including issuers of securities, investment advisers, broker-dealers, investment banks, other financial institutions and financial intermediaries, and accordingly may receive fees or other economic benefits from those organizations, including organizations whose securities or services they may recommend, rate, include in model portfolios, evaluate or otherwise address.





# Investment Structure

Presentation to  
Pennsylvania Review Commission  
September 2018

*Matt Clark*

*South Dakota Investment Council*

# Overview

## Goal

- Add value over the long term

## Governance

- Role of staff, Council, Legislature and Governor
- Business-like environment

## Process

- Focus on long-term value
- Internal management of most assets
- Risk measurement for severe environments

## People

- Recruited as interns from area universities and trained internally
- Research coverage redundancy to promote internal discussion and continuity
- Compensation linked to added value

# Goal

Goal is to add value over long term versus index returns

- Difficult for most to outperform market index benchmarks
- Accomplishment provides most resources to meet needs
- Everyone must agree on goal to have chance to succeed

Daily efforts focus on drivers of success over the long term

- Common sense long-term contrarian culture
- Willingness to endure short-term underperformance
- Valuation competencies

# Governance

## Investment Council and Retirement System have separate boards

- Council members appointed based on investment and business experience
- Retirement System Executive Director is member of Investment Council and State Investment Officer is member of Retirement System Board to aid coordination

## Legislature and Governor

- Legislature appoints majority of Council members and approves budget
- Governor recommends budget and appoints two Retirement System trustees

## Council

- Select State Investment Officer and maintain non-political environment
- Establish investment policy, benchmarks, and ranges, and monitor compliance
- Approve annual budget, compensation methodology, and long-term plan

## Staff

- Recommend policies
- Implement investment programs within approved policies

# Business-like environment

## Majority of Council appointed by Exec. Board of Legislature

- Traditionally respected business leaders from across South Dakota

## Focus on maximum risk-adjusted return

- Prohibition against social investing considerations (exception for sanctioned countries)

## Long-term business plan

- Established under direction of Legislature in 1988 to create stable environment for internal management and alleviate turnover problems

## Investment Council funded from assets under management

- Funding shifted from general fund to managed assets in 1988
- Emphasis on unit cost

# Process

## Focus on long-term value

- Only reliable way to add value long term is to buy when cheap, sell when expensive
- Many investors would rather focus on short-term market movements
- Need long-term value measures, patience, confidence, continuous preparation

## Internal management

- Cost of internal management is lower than external active management cost
- Returns benefit from influence over internal staff to focus on long term
- Increased conviction comes from doing your own work
- Internal management is a lot more work than hiring outside managers

## Risk management

- Risk measurement focused on equity-like and bond-like risk
- Conventional statistical risk measures are adjusted to reflect higher real-world frequency and magnitude of adverse outlier events
- Risk managed by broad diversification and avoiding expensive assets
- Strong financial condition important to help weather difficult periods

# People

## Recruitment

- Intern program for top students from area universities
- Gauge aptitude for contrarian philosophy and cash flow modeling

## Training

- Understand long-term contrarian philosophy
- Develop cash flow modeling capability

## Research coverage redundancy

- Double coverage promotes internal discussion and continuity
- Analysts manage individual portfolios to heighten focus and accountability

## Compensation

- Based on private sector comparable positions with targeted discount
- Linked to added value through incentive compensation component

# Compensation linked to added value

## Encourage retention of successful staff

- Team is most attractive to other organizations when winning
- Shifts compensation higher when people more sought after and down when losing

## Incentives encourage performance

- Multiyear timeframes encourage investing for the long term
- Counters underperformance risk that can discourage efforts to add value

## Incentives paid only for added value

## Important to encourage added value in all markets

- Encourages adding value by reducing risk when markets expensive
- Added value in down markets more important than in up markets

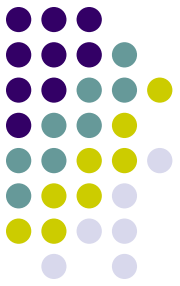


# PERSI CONVENTIONAL INVESTING

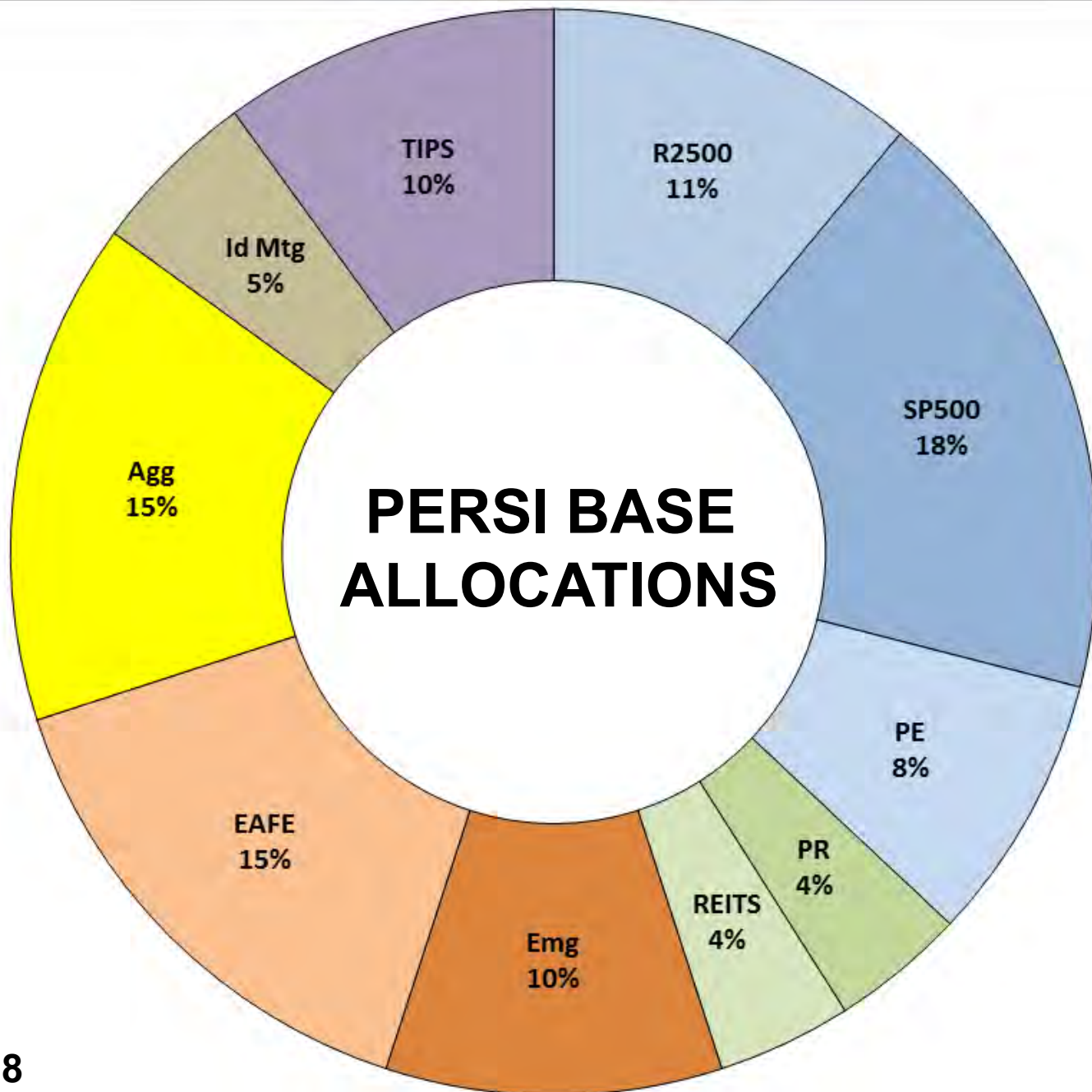


- **Simple**
  - Rely primarily on public markets as traditionally defined
  - 70/30 for 4%-5% real returns
- **Transparent –**
  - **Primarily liquid daily priced public securities**
  - Standard institutional private equity and real estate
- **Focused**
  - 10 traditional asset types
- **Patient (5-10 Year Time Horizon)**
  - Recognize markets are abnormal in nearer term
- Well established and easily explained tradition
- Produces Long Term Returns Equal to or Better than Alternative Approaches (e.g. Endowment Model)

# PORTFOLIO DECISIONS



- **Determine Basic Equity/Fixed Split**
  - 70/30 FOR 3%-5% REAL RETURNS
- **Home Country Bias**
  - US BIAS
- **Additional Diversification and Other Changes**
  - 10 Traditional Asset Types
- **Monitor Drift and Rebalancing**
- **Active/Passive Management Impact**
  - 50% Indexed, 35% Traditional Active, 15% Private



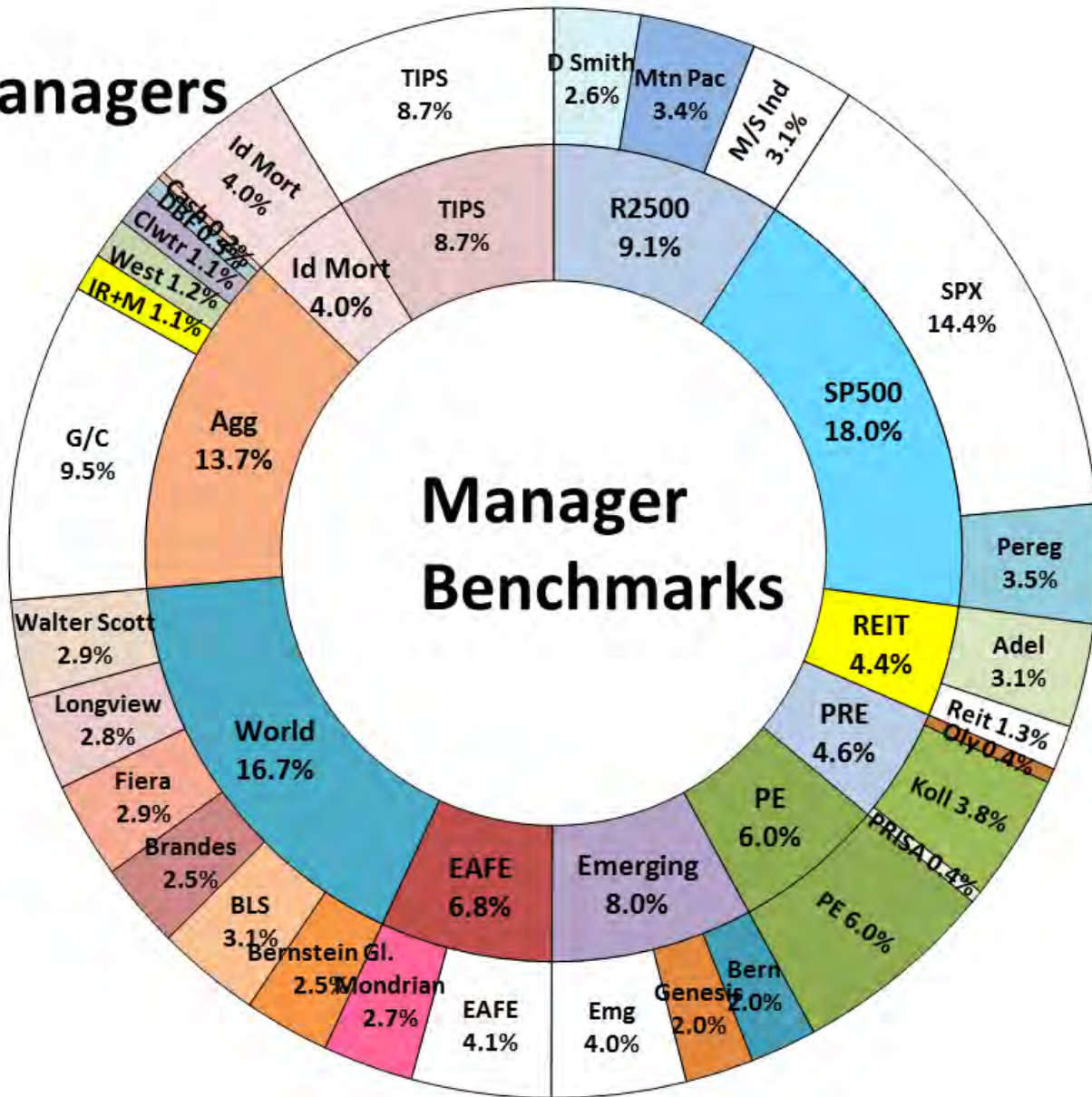
Since 1998

# Managers



- **Core Passive – 50%**
  - Basic Exposure
  - Cost Control
  - Risk Control, Rebalancing, Easy Transitions
- **Active Public Managers – 35% Private -15%**
  - Clear Styles or Concentrated Portfolios
    - No “Black Boxes”
  - No “Nine Box” Structures
  - “No Whining” Rule
    - Control Cash through Drift
    - “Guidelines” are Manager Expectations in Normal Times
  - Concentrated Relationships
    - Public – 18
    - Private -22
    - Real Estate - 2

# Managers

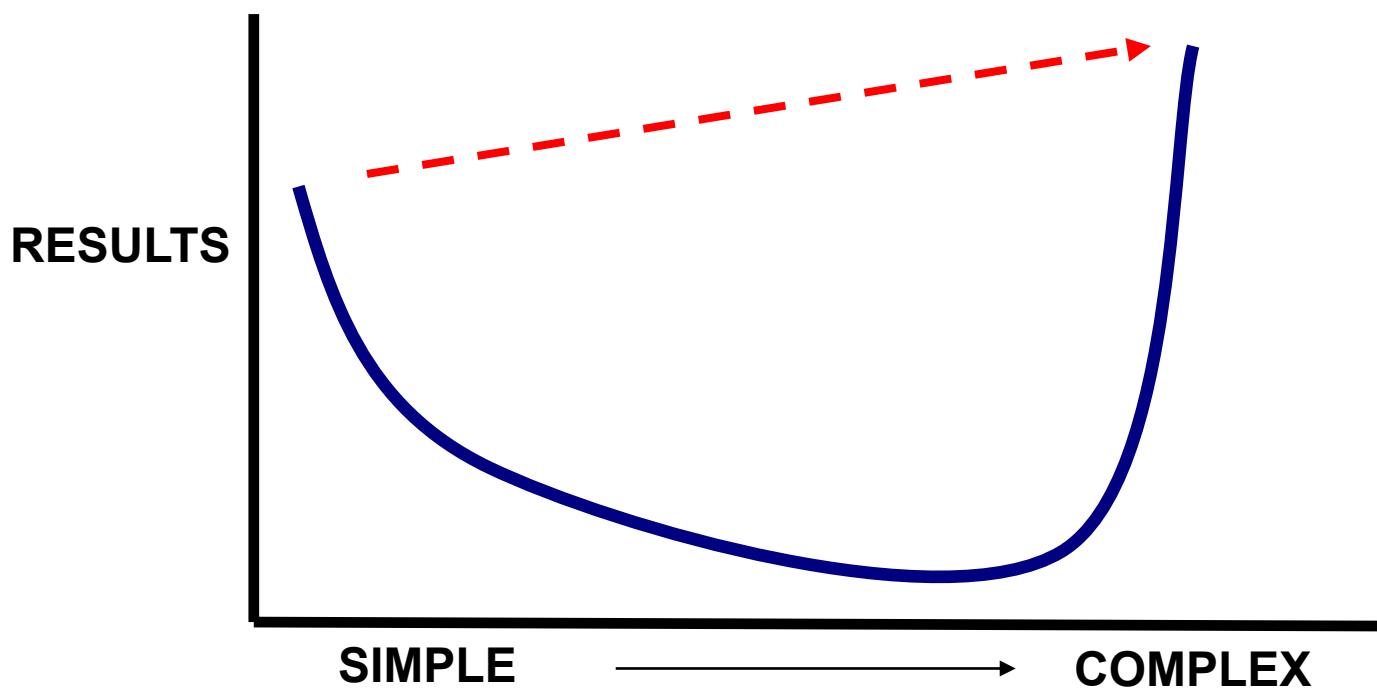


# WHY CONVENTIONAL FOR PERSI?



- **Conservative Return Needs**
  - **PERSI only needs market returns – 7.0% Nominal 4.0% Real**
  - **No evidence complexity adds to returns**
- **Resource Constraints**
  - **Small staff and public five member Board**
  - **In-house budget appropriated**
  - **All actions public**
- **Control**
  - **Simpler the portfolio, easier to monitor and operate**
- **Other**
  - **Easier to explain with well-understood concepts**
  - **Inexpensive (< 30 Basis Points)**
  - **Constituency has accepted through crises – has shown patience**
  - **Past was a mess: 1992 60% funded, bottom of peer universe**
  - **Competitive Returns, both in normal and crisis periods**

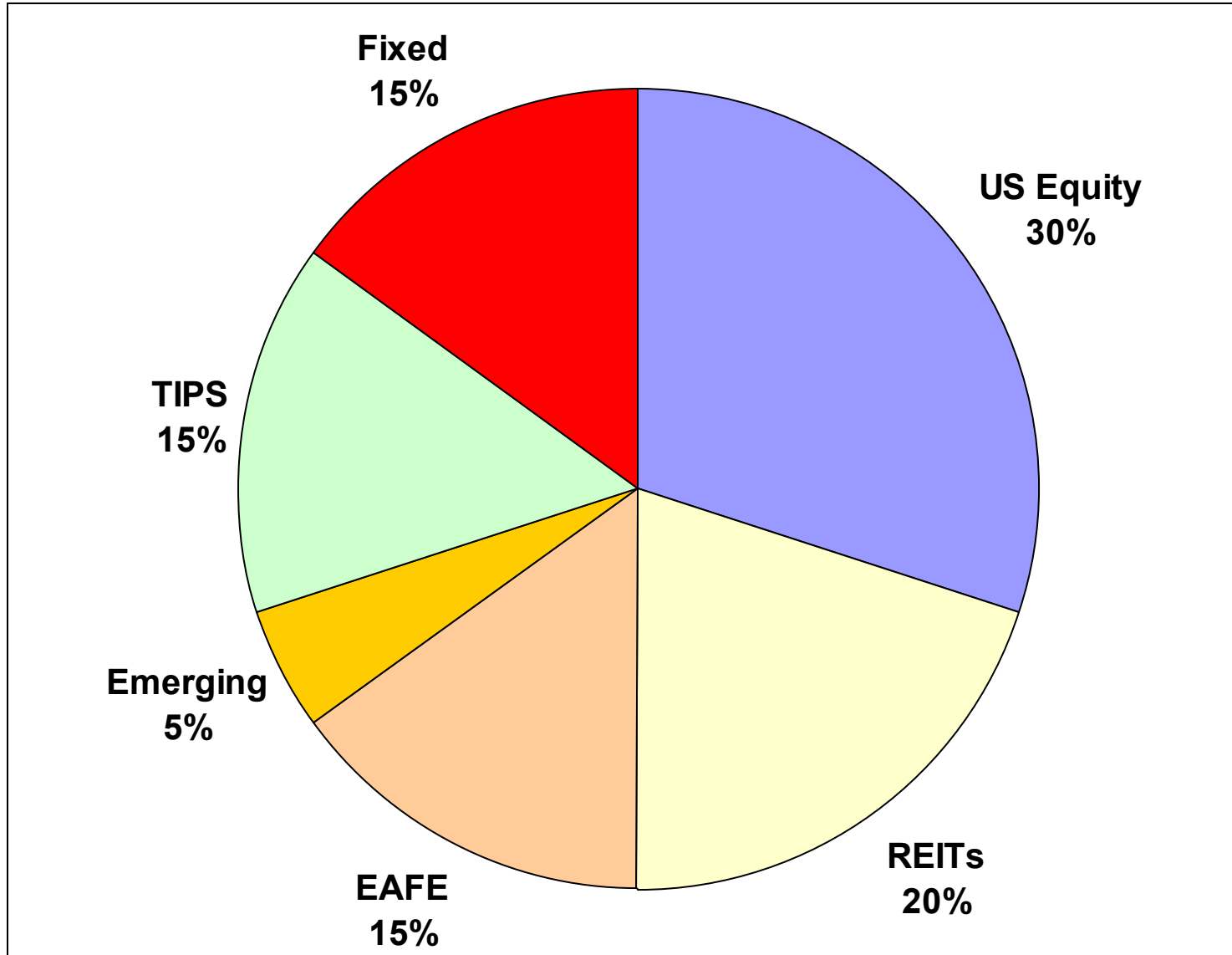
# THE SWENSEN “J” CURVE



**“Few institutions and even fewer individuals exhibit the ability and commit the resources to produce risk-adjusted excess returns. . . . No middle ground exists. Low-cost passive strategies suit the overwhelming number of individual and institutional investors without the time, resources, and ability to make high-quality active management decisions. The framework of the Yale model applies to only a small number of investors with the resources and temperament to pursue the grail of risk-adjusted excess returns.”**

**Dr. David Swensen The Yale Endowment 2013 Annual Report at p. 15 (emphasis added)**

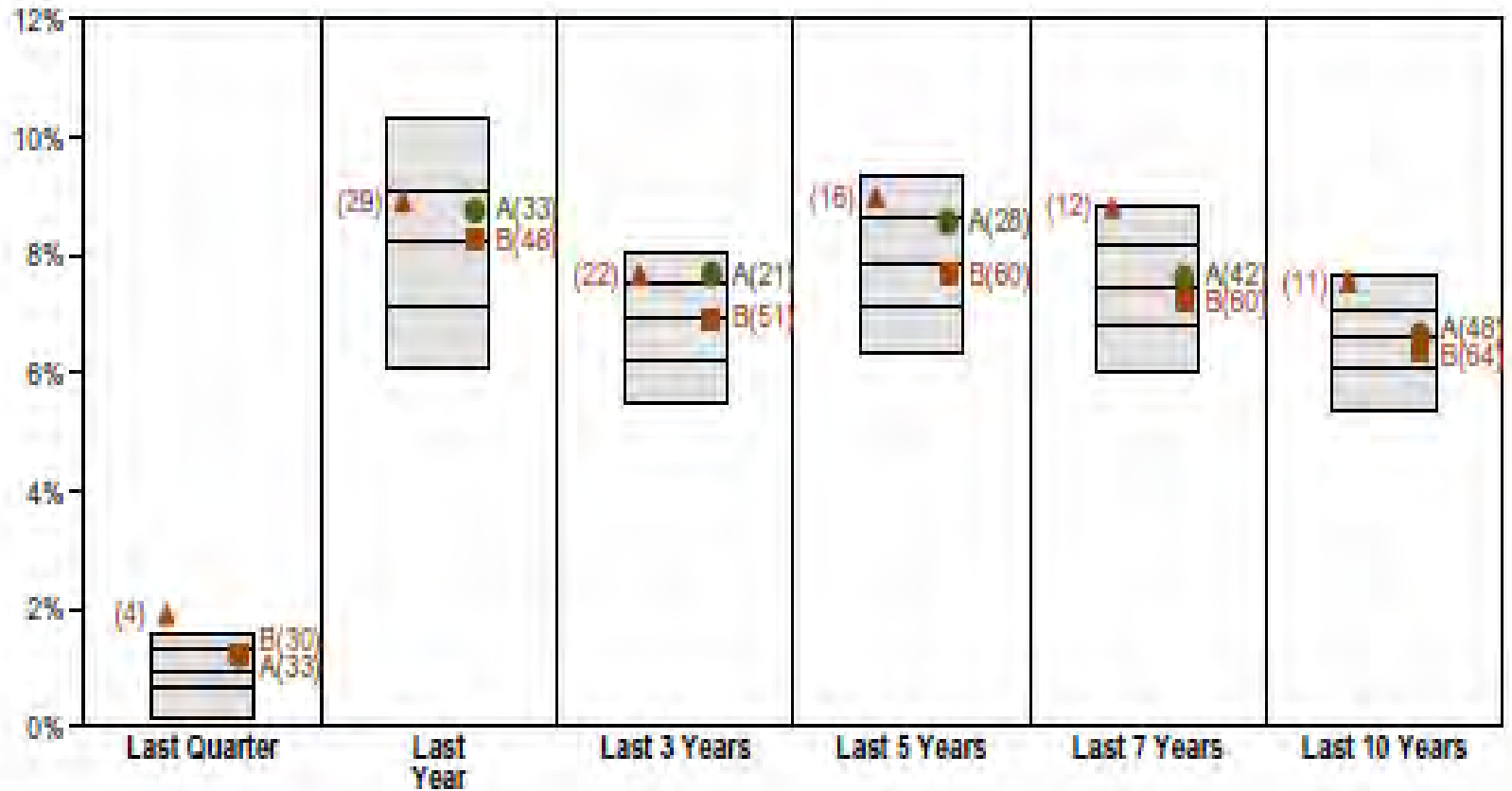
DAVID SWENSEN **UNCONVENTIONAL SUCCESS**: A  
FUNDAMENTAL APPROACH TO PERSONAL INVESTMENT, Free  
Press, 2005





June 30, 2018

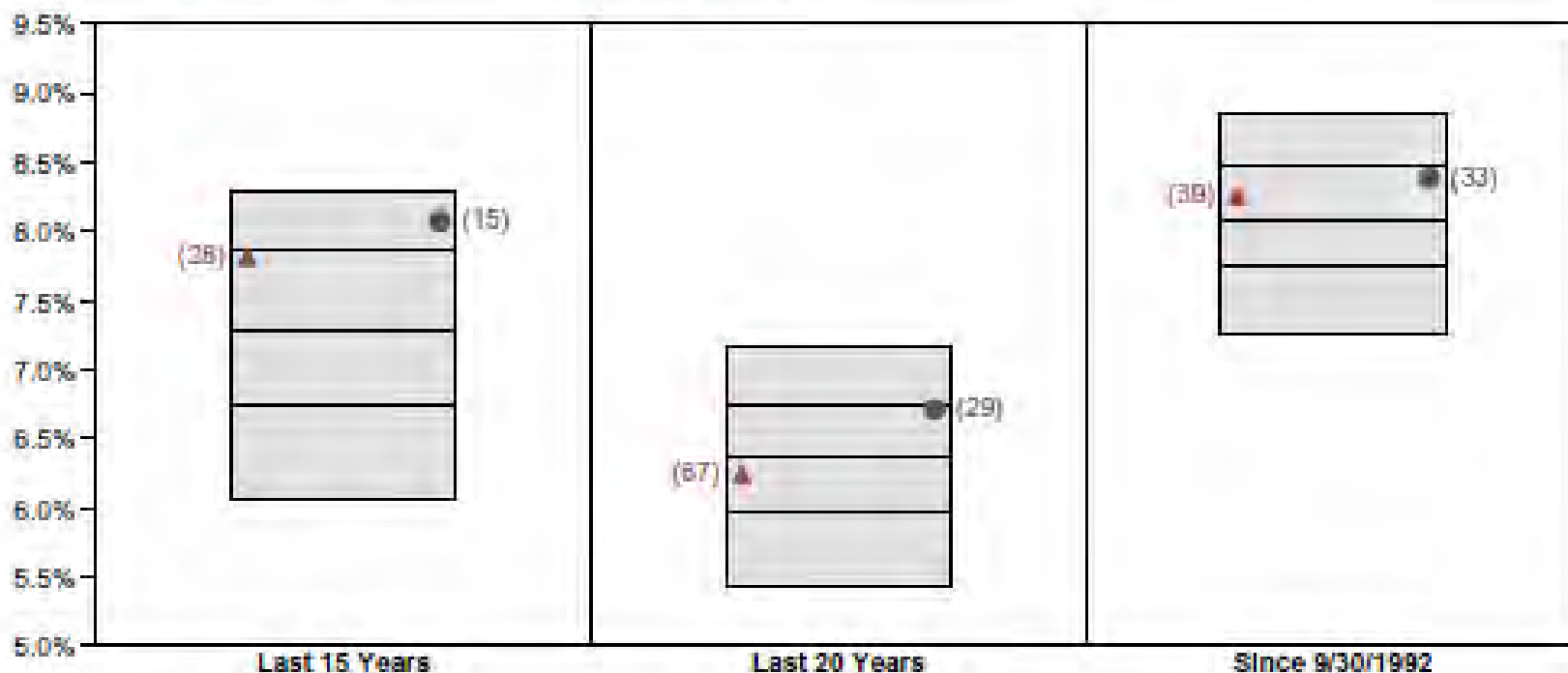
Performance vs Callan Public Fund Sponsor Database (Gross)



10th Percentile		1.60	10.31	8.07	9.34	8.85	7.65
25th Percentile		1.34	9.09	7.54	8.66	8.18	7.05
Median		0.95	8.23	6.96	7.87	7.44	6.61
75th Percentile		0.64	7.15	6.24	7.14	6.80	6.11
90th Percentile		0.13	6.06	5.49	6.32	6.05	5.35
Total Fund	● A	1.21	8.74	7.67	8.56	7.61	6.64
Policy Target	■ B	1.24	8.27	6.91	7.67	7.22	6.37
LT Target	▲	1.91	8.90	7.66	8.98	8.80	7.54

June 30, 2018

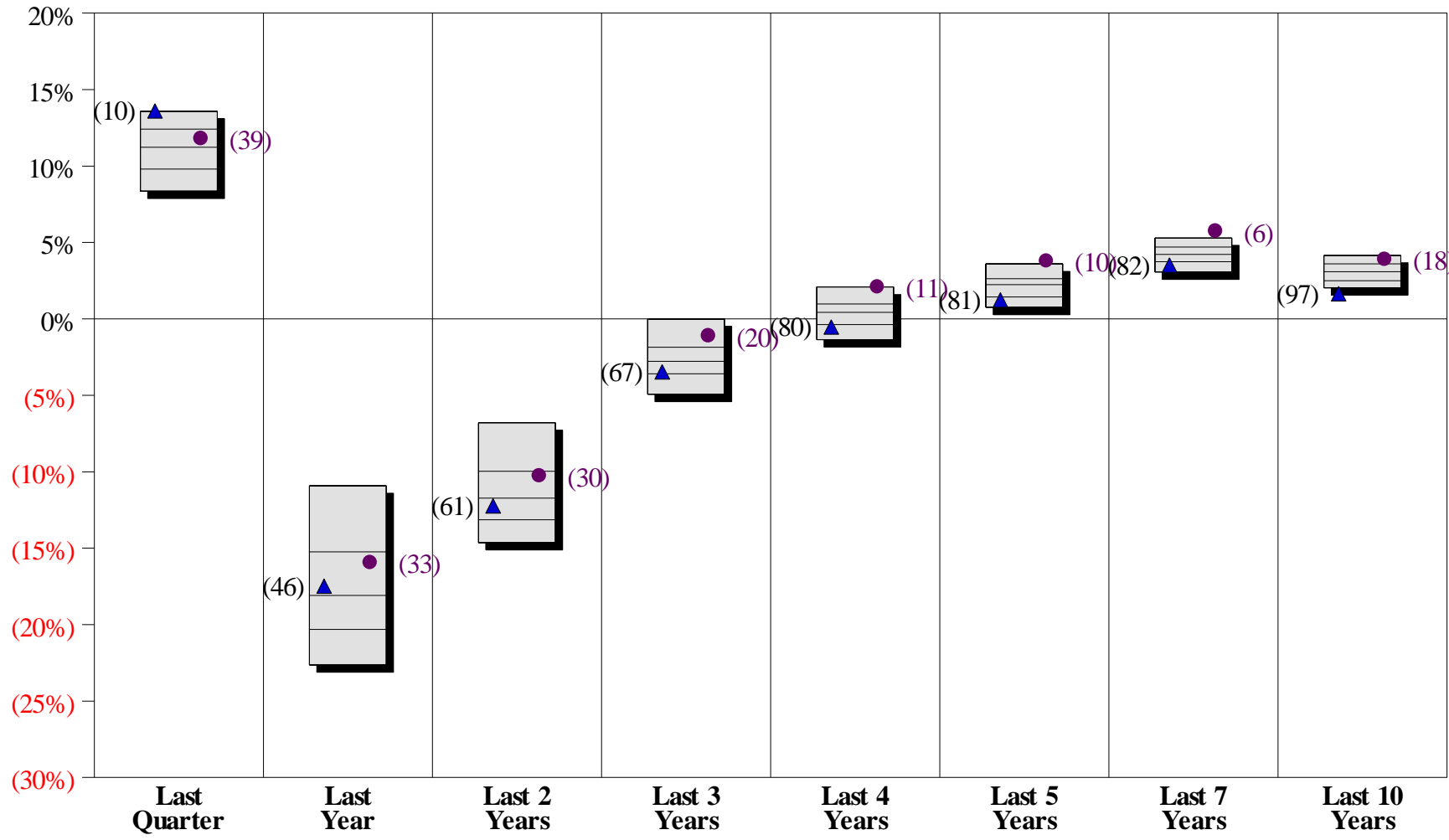
Performance vs Callan Public Fund Sponsor Database (Gross)



10th Percentile	8.29	7.15	8.86
25th Percentile	7.88	6.75	8.48
Median	7.29	6.37	8.08
75th Percentile	6.74	5.97	7.75
90th Percentile	6.07	5.42	7.27
<b>Total Fund</b> ●	8.07	6.71	8.39
<b>LT Target</b> ▲	7.81	6.24	8.26

**June 30, 2009**

**Performance vs CAI Public Fund Sponsor Database**



	<b>Last Quarter</b>	<b>Last Year</b>	<b>Last 2 Years</b>	<b>Last 3 Years</b>	<b>Last 4 Years</b>	<b>Last 5 Years</b>	<b>Last 7 Years</b>	<b>Last 10 Years</b>
10th Percentile	13.58	(10.92)	(6.79)	(0.01)	2.08	3.59	5.29	4.15
25th Percentile	12.41	(15.24)	(9.97)	(1.85)	0.98	2.63	4.70	3.59
Median	11.23	(18.09)	(11.73)	(2.77)	0.42	2.25	4.21	3.08
75th Percentile	9.80	(20.32)	(13.15)	(3.60)	(0.38)	1.43	3.74	2.50
90th Percentile	8.36	(22.64)	(14.64)	(4.93)	(1.37)	0.75	3.07	2.03
<b>Total Fund</b> ●	11.70	(16.04)	(10.36)	(1.19)	2.00	3.70	5.64	3.79
<b>Total Fund Target</b> ▲	13.60	(17.48)	(12.23)	(3.46)	(0.53)	1.24	3.52	1.65

# SWENSEN PEER RANKINGS

Total Funds: Foundations and Endowments  
 BNY Mellon Universe – June 30, 2012 (236 Funds)



	1 Yr	2Y	3Y	4Y	5Y	7Y	10Y
<b>Return %</b>	<b>4.1</b>	<b>13.7</b>	<b>15.9</b>	<b>5.0</b>	<b>2.9</b>	<b>6.1</b>	<b>8.0</b>
<i>Yale</i>	<i>4.7</i>	<i>13.0</i>	<i>11.6</i>	<i>1.2</i>	<i>1.8</i>	<i>8.1</i>	<i>10.6</i>
<b>Median</b>	<b>0.2</b>	<b>9.4</b>	<b>10.6</b>	<b>2.4</b>	<b>1.5</b>	<b>5.1</b>	<b>6.6</b>
<b>Rank</b>	<b>7</b>	<b>2</b>	<b>1</b>	<b>5</b>	<b>16</b>	<b>22</b>	<b>15</b>
<i>(1 Highest)</i>							
<i>Yale</i>	<b>6</b>	<b>5</b>	<b>15</b>	<b>73</b>	<b>43</b>	<b>4</b>	<b>1</b>

ENDING June 30,  
2014

ENDING December 31,  
2013

ENDING March 31, 2014

FUNDS	5 Year		5 Year		5 Year
<b>Swensen</b>	<b>14.7%</b>	New Zealand	<b>16.2%</b>	<b>Swensen</b>	<b>17.3%</b>
Columbia	<b>14.2%</b>	<b>Swensen</b>	<b>15.5%</b>	Median PF	<b>14.5%</b>
Princeton	<b>14.0%</b>	Median PF	<b>12.6%</b>	CalPERS (net)	<b>13.0%</b>
Yale	<b>13.5%</b>	Ontario Teach	<b>12.4%</b>	GIC	<b>12.4%</b>
Notre Dame	<b>13.2%</b>	Norway	<b>12.0%</b>	Aust Fut Fund	<b>11.2%</b>
MIT	<b>13.2%</b>	APFC	<b>11.2%</b>	PSP	<b>11.0%</b>
Median PF	<b>13.1%</b>	CalPERS (net)	<b>10.9%</b>	CPPIP	<b>10.0%</b>
Stanford	<b>13.1%</b>	Temasek	<b>10.9%</b>	BC	<b>9.4%</b>
Dartmouth	<b>13.0%</b>	Caisse Depot	<b>10.0%</b>		
Penn	<b>12.8%</b>	Alberta	<b>8.8%</b>		
Chicago	<b>12.6%</b>	OMERS	<b>8.4%</b>		
CalPERS	<b>12.5%</b>	KIC	<b>8.3%</b>		
Cornell	<b>11.7%</b>	ATP	<b>7.5%</b>		
Harvard	<b>11.6%</b>				
Brown	<b>11.5%</b>				

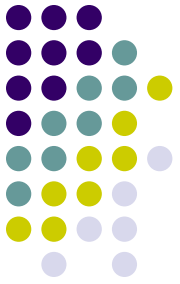
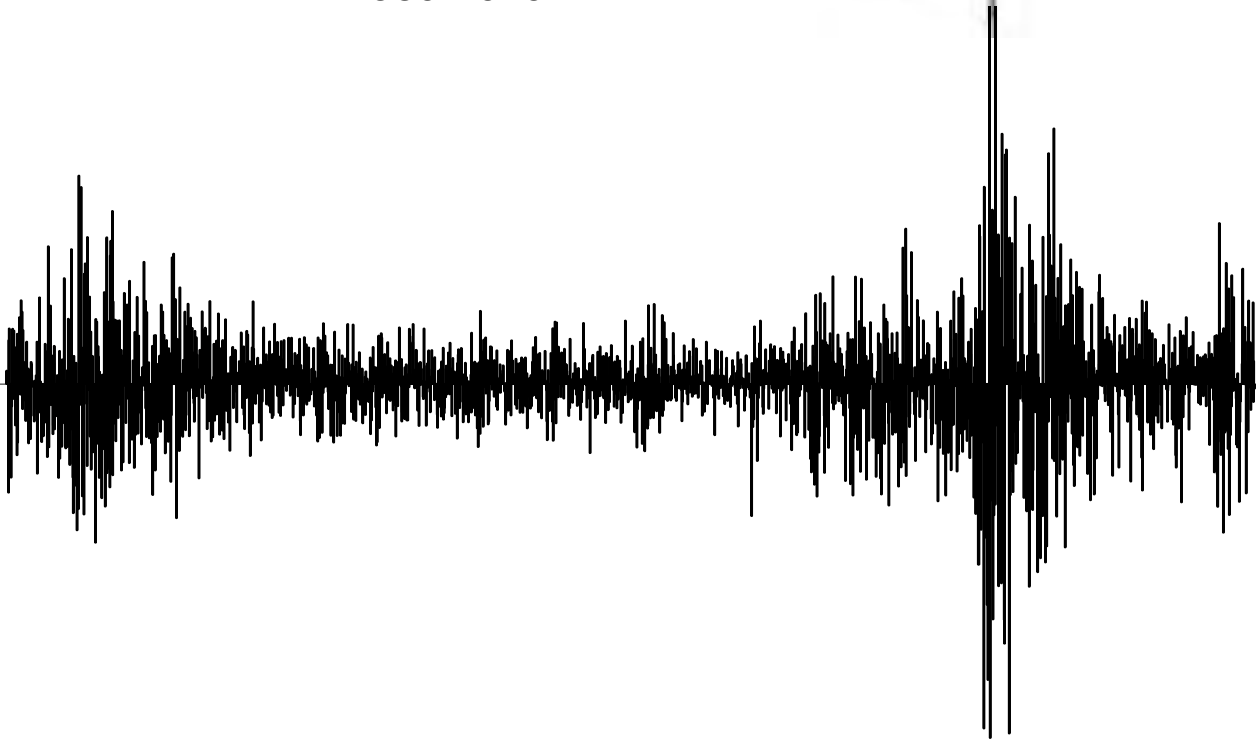
# PROBLEMS WITH STANDARD APPROACH: EMOTIONAL EXHAUSTION NEED PATIENCE



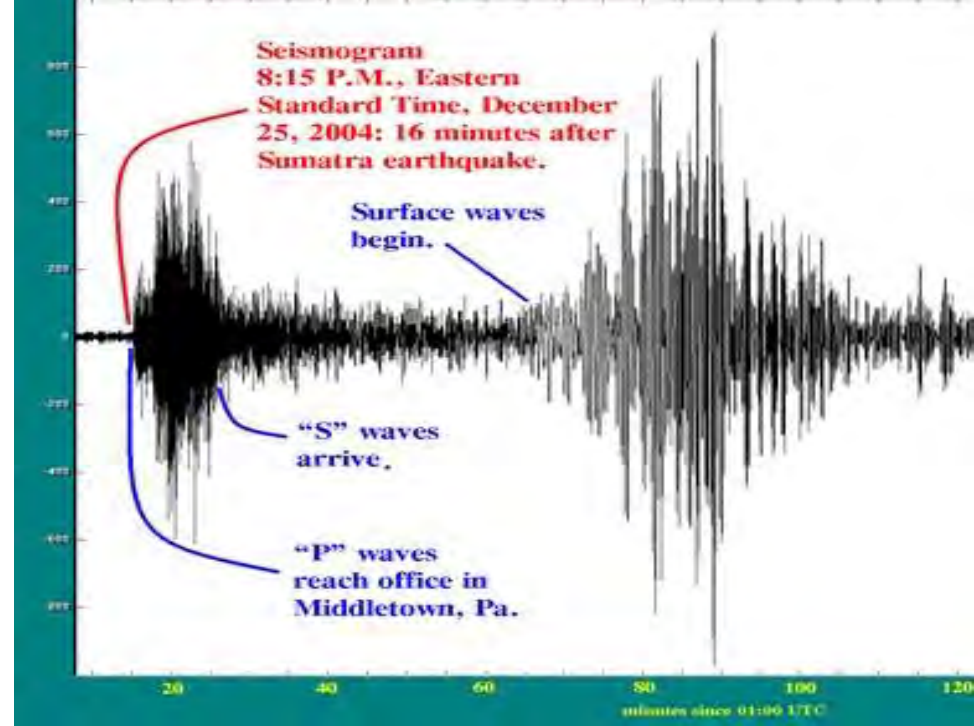
- **Need to wait 5-20 years for results**
- **Dependent on “Equity Risk” and Return**
  - Must accept short term roller coaster volatility
- **Abandon quest for higher than market returns**
  - The Vegas Effect
- **Boring**
  - Harder to do nothing rather than something – “CNBC disease”
- **Assumptions do not apply in shorter term (1-4 Years)**
  - Markets not efficient or rational
  - Prices are not random in “coin tossing sense”
  - Risk often not related to return
  - Diversification no protection in crisis: just equities, government bonds, and cash
  - Problem of complex markets and complex adaptive systems in near term:
    - Mandelbrot and Hudson, *The (Mis)Behavior of Markets*, (Basic Books 2004)
    - Phillip Ball, *Critical Mass* (Farrer, Strauss and Giroux 2004)
    - Nassim Taleb, *The Black Swan (2<sup>nd</sup> Ed)* (Random House 2007)



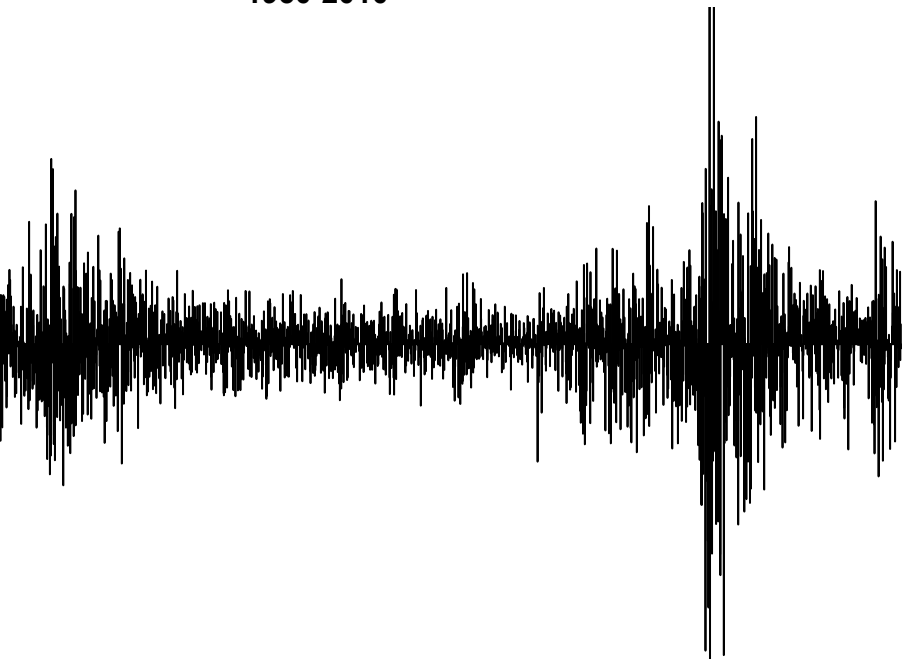
**Daily S&P Price Movements  
1950-2010**



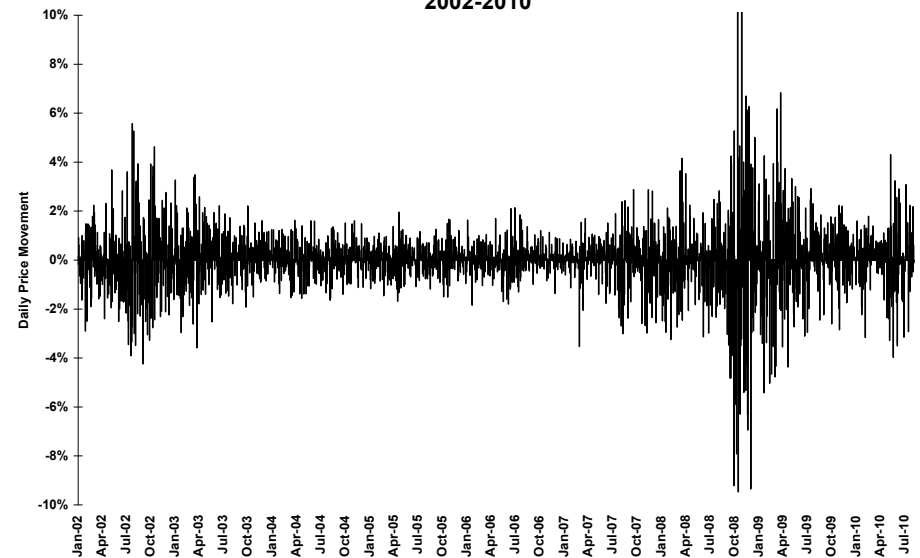




Daily S&P Price Movements  
1950-2010



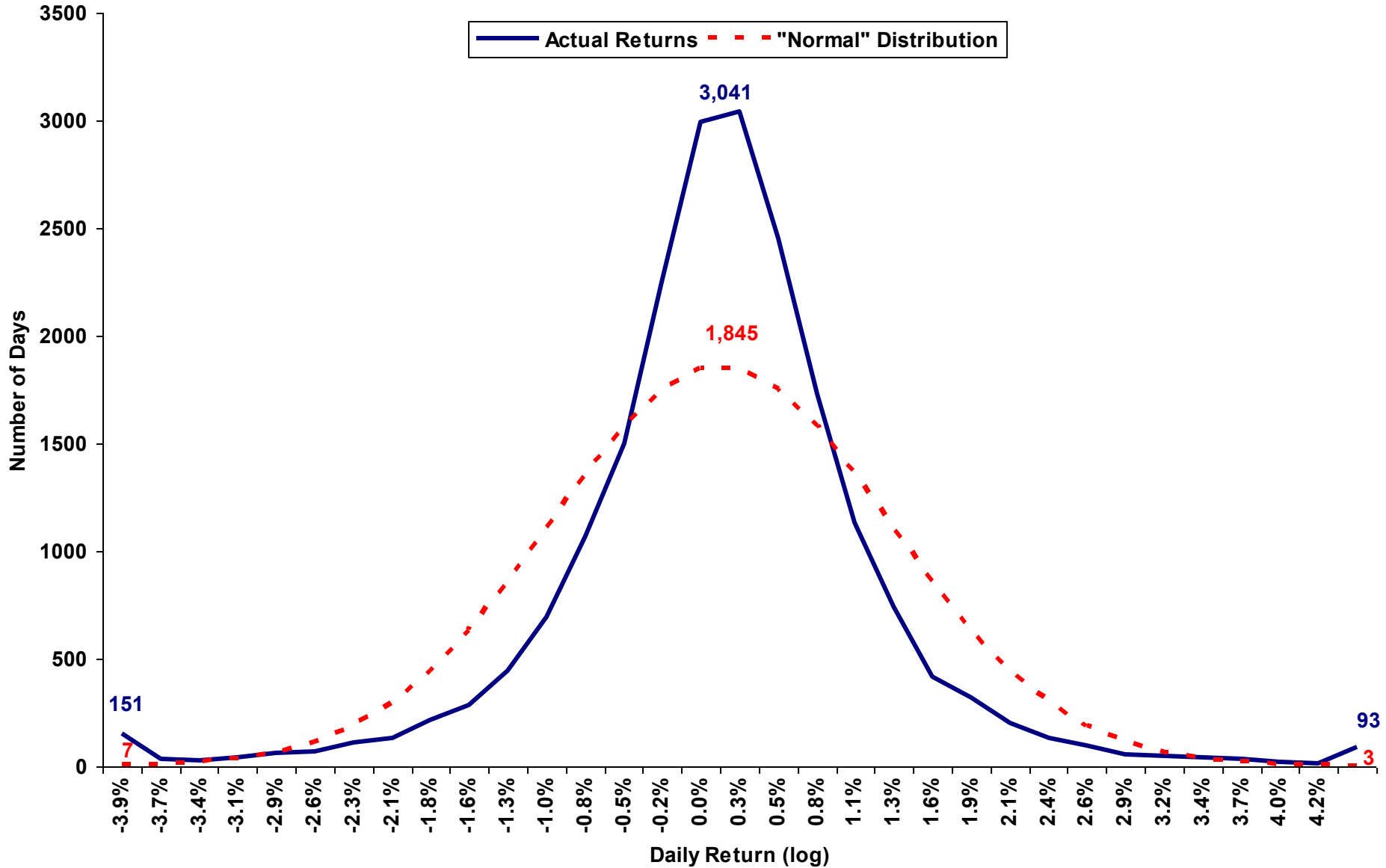
Daily S&P Price Movements  
2002-2010





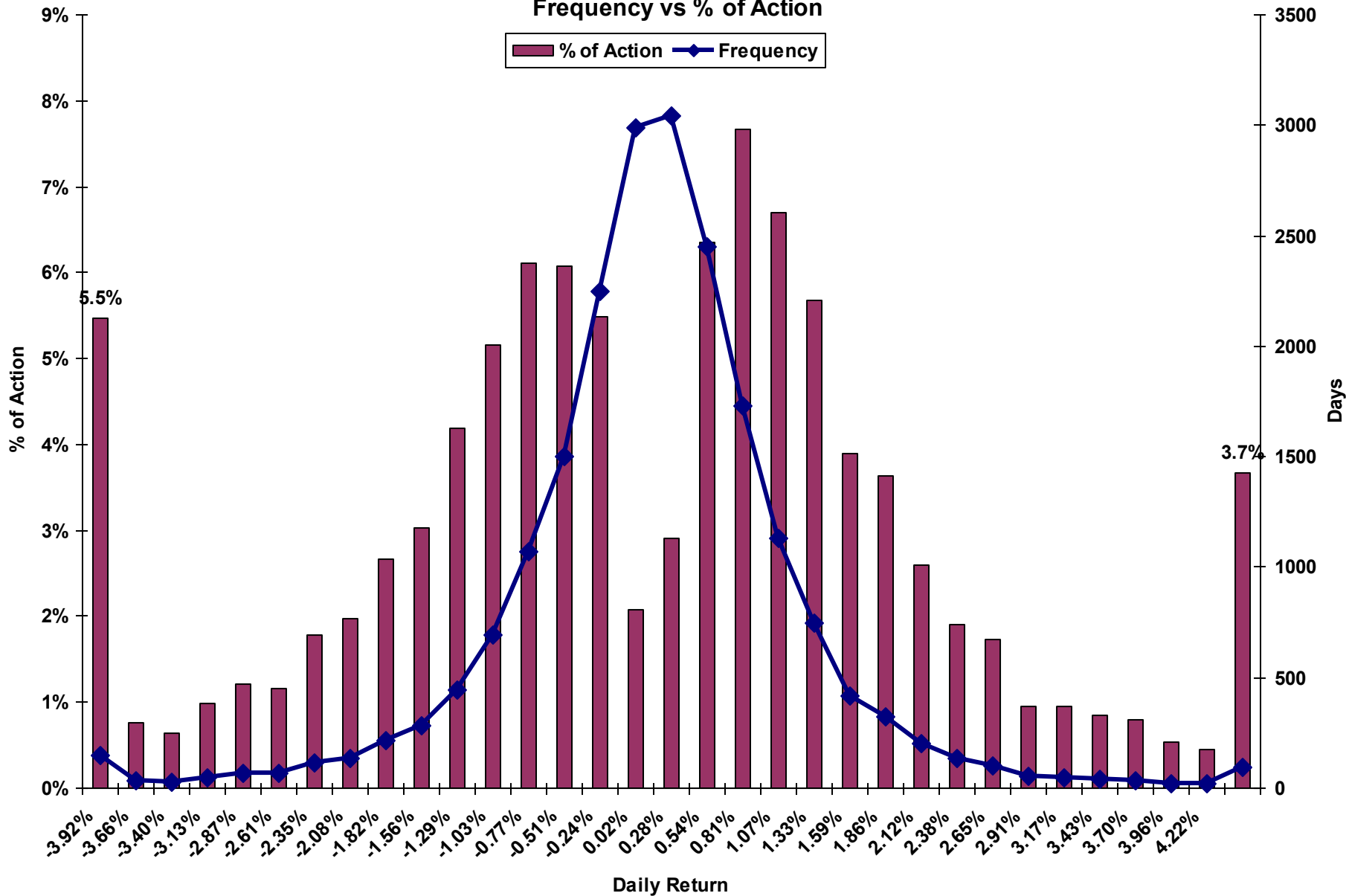
# Daily Dow Jones Returns vs. Expected

## October 1928 - December 2010 (3.5 Standard Deviations)

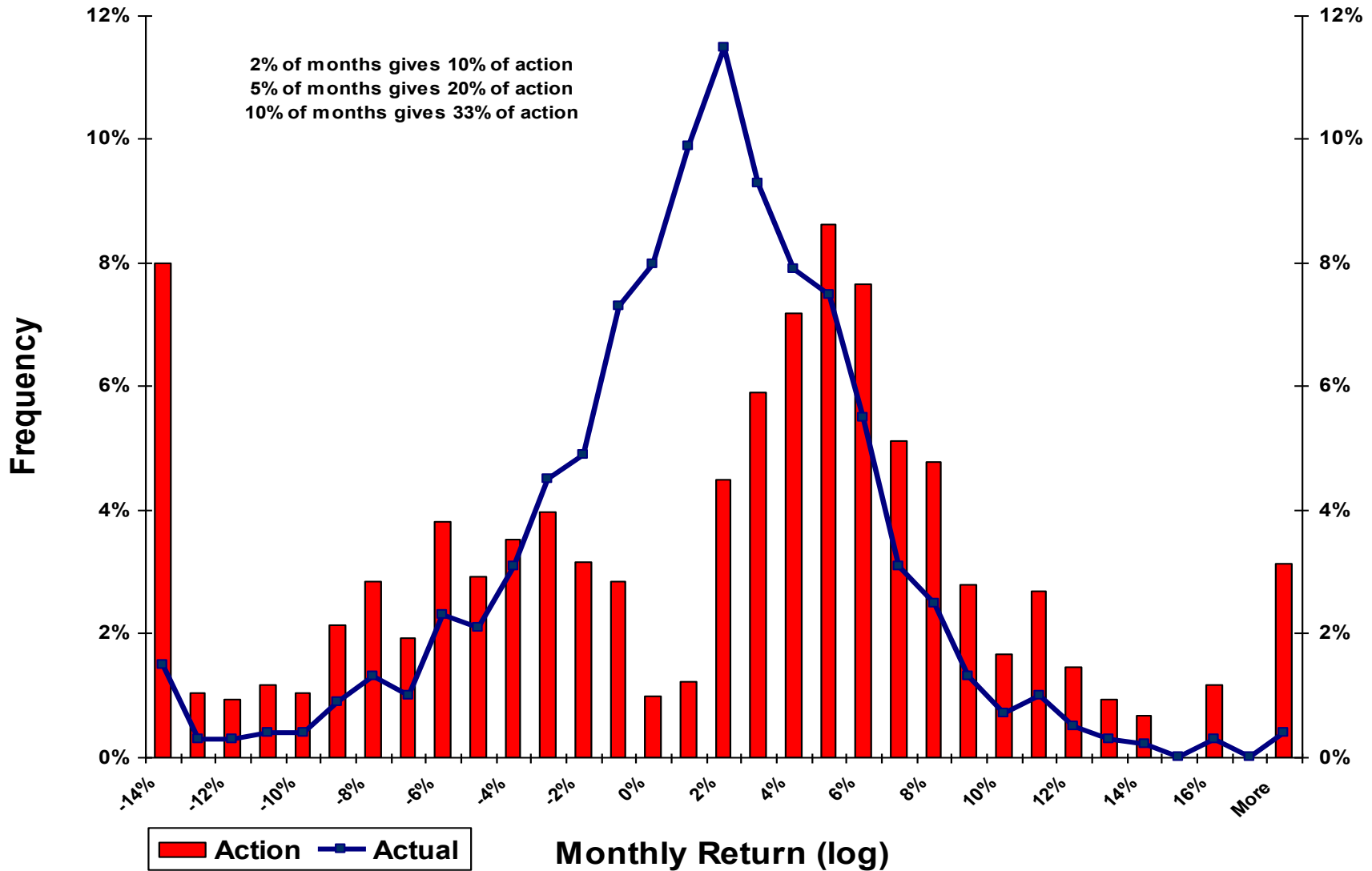


# Dow Jones Daily Returns 1928-2010

## Frequency vs % of Action

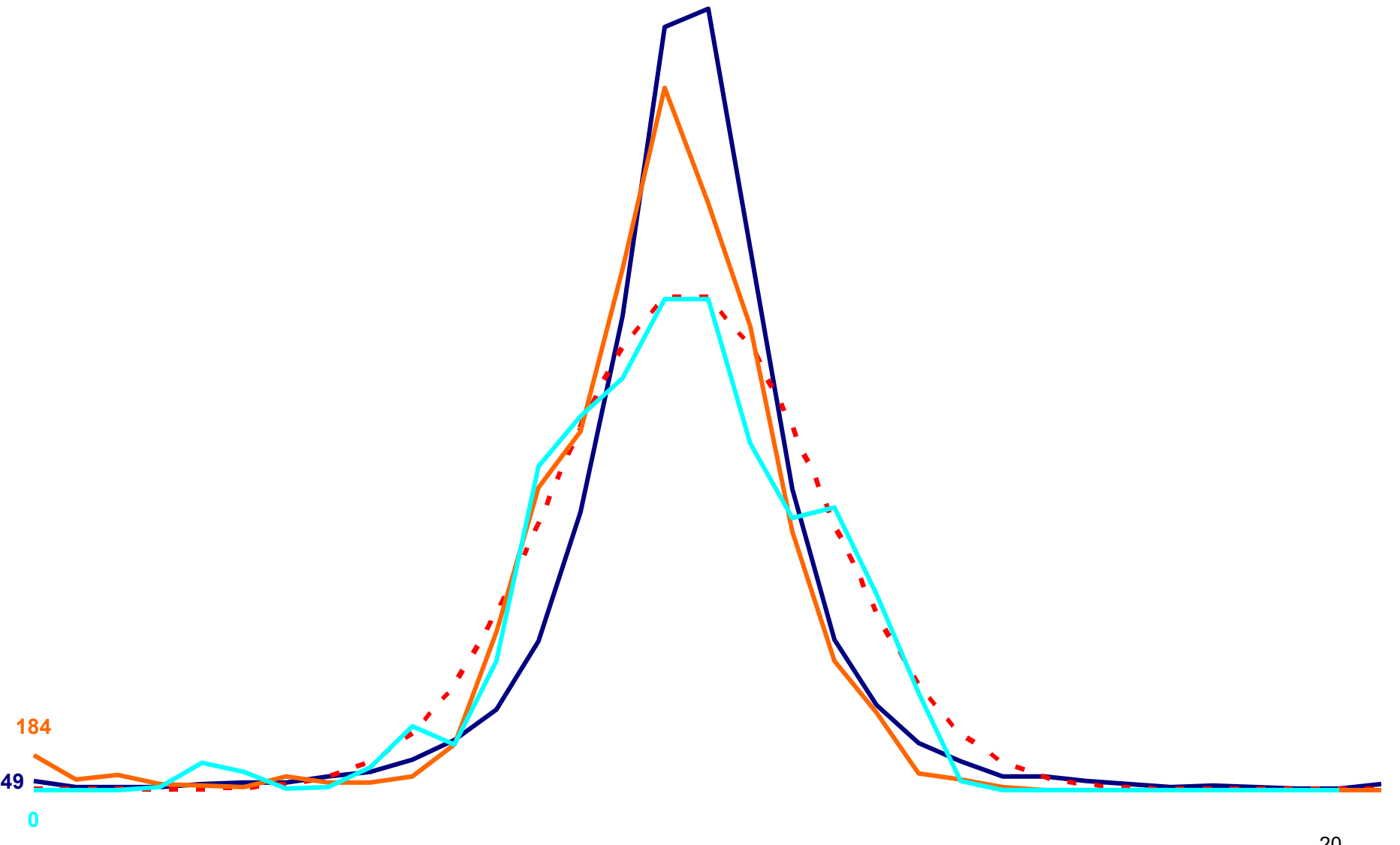
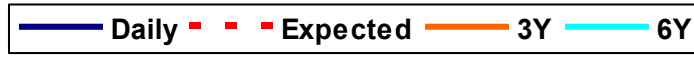


# Frequency vs Action in Monthly Returns 1926-2008 (log)



Source: Actual returns from Ibbotson's *Stocks, Bonds Bills and Inflation*, as of 12/31/08. Expected returns generated randomly using Ibbotson data. Past performance is not a guarantee of future results.

# SHAPE OF ROLLING DOW JONES DISTRIBUTIONS 1928-2010 (Log)

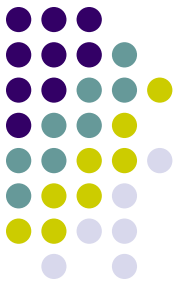


APPENDIX I



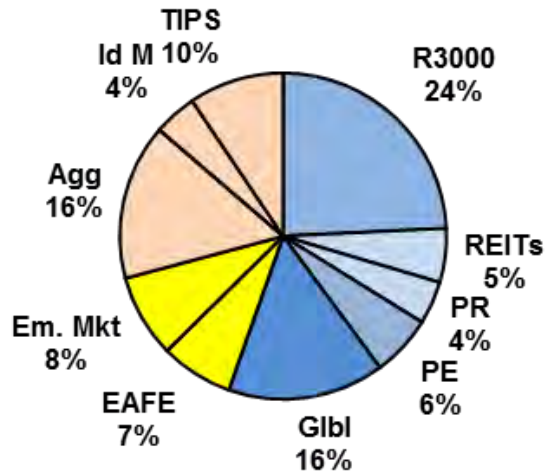
# REBALANCING

# DRIFT AND REBALANCING



- Drift
  - Equity Bias for Long Term Return and Cash Reinvestment
- Occasional rather than Strict Rebalancing
  - Non-Linear Benefits from “Free Lunch”
  - Macro Consistency/ Active Management Issue
    - Everyone can’t do a mean reversion strategy at once
  - Benefits only in 10-30 year period
    - Longer Periods (30+ years) should never rebalance: stocks should become main asset
    - 40 basis points a year over 10 years, not consistently
  - Needs to be monitored

## Benchmark Allocations



	Month	3 MO	FYTD	1 Yr	2 Yr	3 Yr	4 Yr	5 Yr
Total Fund	1.8%	3.7%	12.1%	12.8%	6.0%	6.1%	7.8%	9.1%
No rebalancing	1.4%	3.0%	12.7%	12.7%	5.9%	6.4%	8.4%	10.7%
Benchmark (55-15-30)	1.4%	3.0%	12.4%	12.6%	6.2%	6.6%	8.6%	10.8%
PERSI rebalancing	1.4%	3.0%	13.1%	13.3%	6.4%	6.9%	9.0%	11.1%

**MAY 31, 2017**



# THE ALTERNATIVES

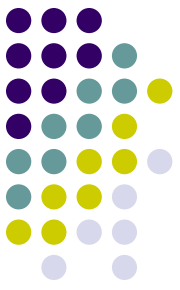
**ENDOWMENT MODEL**  
**RISK BASED PORTFOLIOS**  
**RISK BUDGETING**  
**RISK PARITY**  
**RISK FACTORS**





“Kristopher "Kip" McDaniel, Editor-in-Chief and EVP, aiCIO; Ken Frier, CIO, UAW Retiree Medical Benefits Trust; Eugene Podkaminer, Vice President, Capital Markets Research Group, Callan Associates; and Andrew Ang Columbia Business School ***share a hearty laugh over the poor souls still using the asset class model.***”

Picture and Caption aiCIO Alert 12/16/2013 (emphasis added)



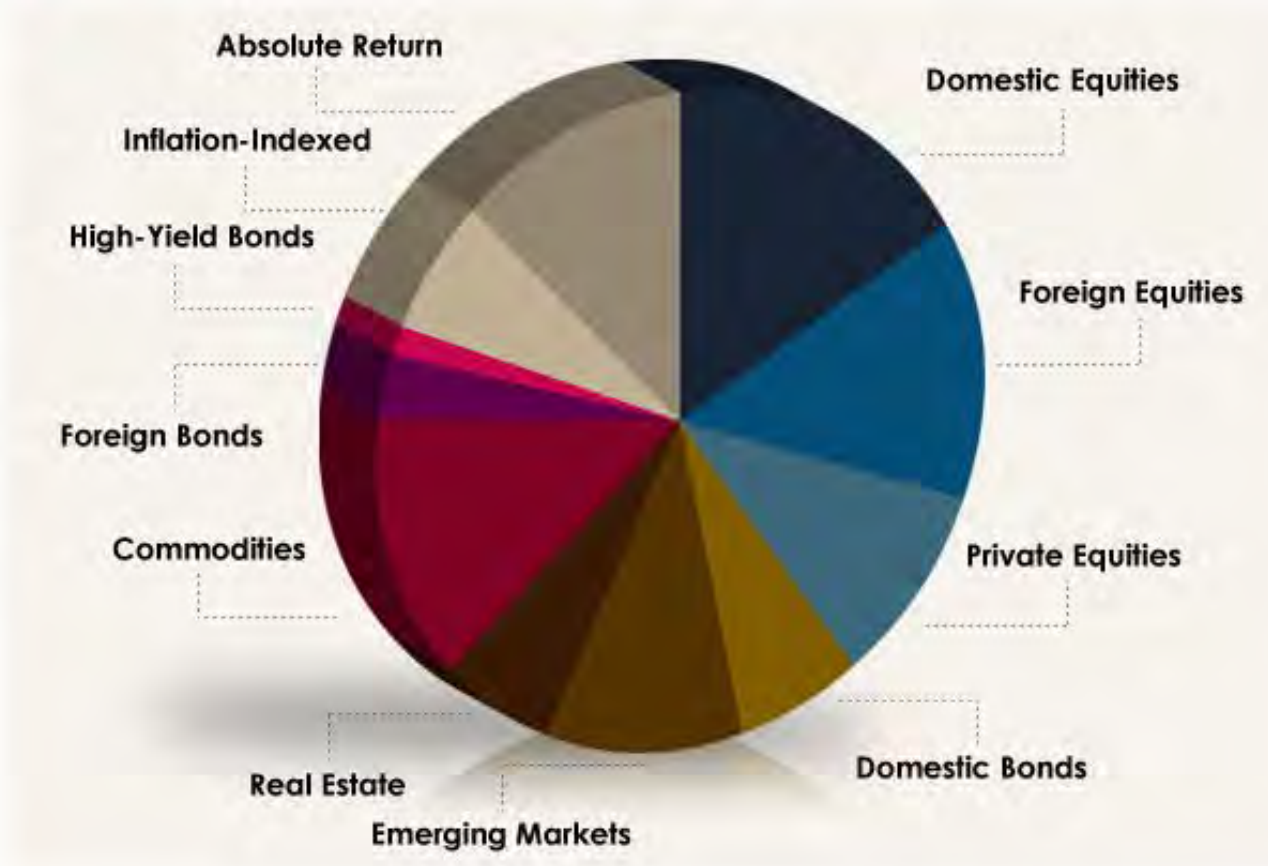
# The “Endowment Model”

- **Reduces Exposures to Public Securities**
  - Few Investment Grade Bonds, Reduced Public Equities
  - Discourages “Buy and Hold” Public Securities
- **Reliance on Intense Active Management**
  - Hedge Fund, Opportunistic Investment
- **Greater Investment in Private and Illiquid Vehicles**
- **Belief in Commodities and other non-traditional assets (Timber, Infrastructure) as “real return” asset types**
- **Often re-structures the fund into investment factors rather than asset classes**
  - Separation of “beta” (market) and “alpha” (manager skill)
  - Inflation, credit exposure, interest rates, special opportunities
- **Attempts to Manage through a Crisis**
  - Changing allocations for “new” investment environment
  - Delay or soften rebalancing to await calmer times

2008



Non-Cash Asset Allocation



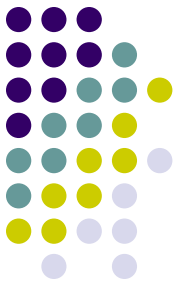
# Example: ENDOWMENT MODEL FAILED STRESS TEST OF 2008-2009 Conventional Investing Passed



- **More volatile than simple portfolios**
  - Extra “diversification” failed – no place to hide
  - Lost 10% more than simple funds in FY 2009
    - Harvard -27.3%, Stanford -25.9%, Yale -24.3%
    - PERSI -16.3%, Nevada -15.7%, Median Public -16.9%
- **Active opportunistic and absolute return strategies devastated**
  - Hedge funds (-15% to -20%) vs fixed income (+6.0%)
  - Government bonds in conventional approach did their job
- **Liquidity disappeared when needed most**
  - Hedge funds gated, margin calls on leveraged strategies and portable alpha, no access to private assets
  - Sold liquid investments or borrowed at worst time
- **Opportunity Lost**
  - Unable to rebalance, missed rebound and 2%-3% rebalancing gain
- **Headline risk (e.g. Madoff and Westridge)**
- **Resource risks: Incentive compensation and resources restricted**
- **Need to pick top quartile or top decile managers consistently**
- **Institutions crippled and taking years to recover**
  - **Many still below levels at Lehman Bankruptcy**
  - Conventional approach had moderate losses and recovered quickly
    - -16% in 2009, all losses from Lehman recovered in 17 months (September 2008 to February 2010)

# RESPONSE TO 2008-2009

## RISK CENTRIC ASSET ALLOCATION



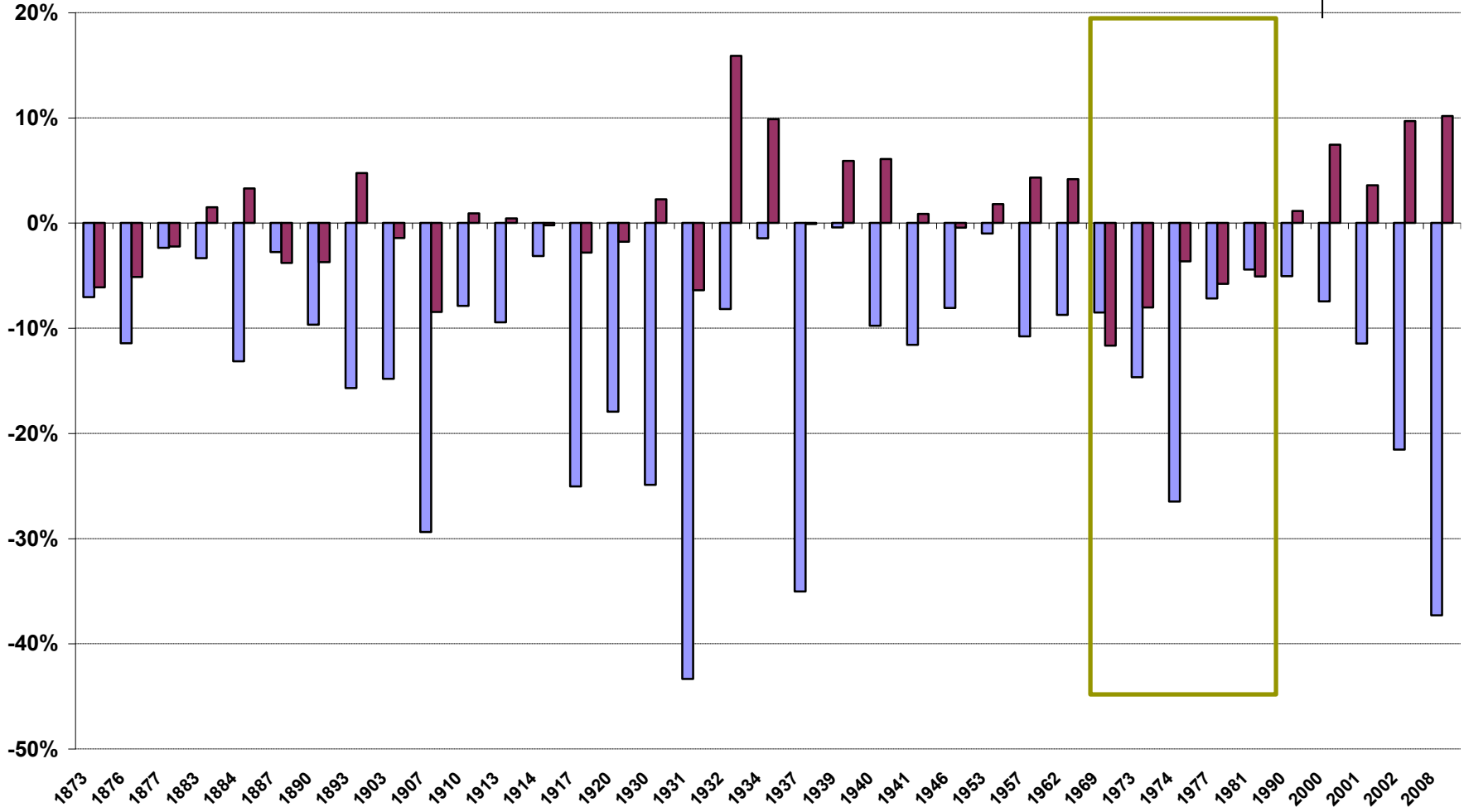
- Risk Budgeting
  - Attempts to Control Volatility
  - Problem of Time Frame – No Unit of Risk
  - Volatility and Diversification Paradox
- Risk Parity
  - Reduce dependence on equities, maintain return by leveraging bonds and other assets
  - Problem: Works when leverage works, fails when doesn't
- Risk Sleeves
  - Recast Asset Classes and group by “macro risks and returns”
  - Problem – no agreement on risk factors. Two current approaches
    - **Re-slice the pie (e.g., real assets, corporate exposure, etc.)**
      - But still have overlapping pieces
    - **Add new factors (e.g., volatility, political risk, etc.)**
      - But no real history, difficult to benchmark and invest

# Levered Bonds and Risk Parity only worked consistently in last 20 years



## Levered Bond Returns in Down Stock Years 1871-2010

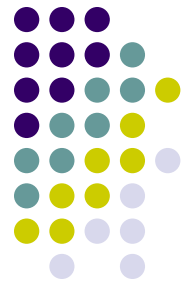
Stock Levered Bond



But previous 20 years would have been a disaster, and in most of the big stock crashes



# RISK SLEEVE STRUCTURES (2013)



## CalPERS

1. Growth
2. Income
3. Liquidity
4. Real Assets
5. Inflation
6. Abs. Rtn.
7. Multi

## Janus Institutional

### Equity

1. Systematic
2. Emerging
3. Size
4. Value

### Fixed

1. Credit
2. Duration
3. Momentum

### Currency

1. Carry
2. Momentum

### Commodity

1. Relative Value
2. Momentum
3. Roll Yield

## CalSTRS (Jan 2013)

1. Growth Risk
2. Interest Rate
3. Going-In Yield
4. Inflation
5. Liquidity
6. Market Leverage
7. Regulatory/Govt
8. Unexplained

## BlackRock

1. Real Rates
2. Inflation
3. Credit
4. Liquidity
5. Political
6. Economic

## Alaska Permanent Fund

1. Company Exposure
2. Cash and Interest Rates
3. Real Assets
4. Special Opportunities

## Danish Pension PKA (Equity Premia includes)

1. Developed Markets
2. EM Markets
3. Frontier Markets
4. Small Cap
5. Low Volatility
6. Dividends
7. Implied Volatility
8. Momentum
9. Value
10. Quality
11. Merger Arb
12. Liquidity
13. "Tactically Traded Risk"

## ATP

1. Interest Rates
2. Credit
3. Equities
4. Inflation
5. Commodities

## Norway

1. Term
2. Credit Aa
3. Credit Baa
4. Credit HY
5. FX Carry
6. Liquidity
7. Value/Growth
8. Small/Large Cap
9. Momentum
10. Volatility

## PCA (Jan 2013)

1. Growth
2. Private Growth
3. Absolute Return
4. Growth Diversify
5. Inflation
6. Interest Rates
7. Interest Rate  
Uncertainty

## SDCERA

1. Growth
2. Stable Value
3. Real Assets

# THE PERSI INVESTMENT PORTFOLIO

June 29, 2018

## Introduction

PERSI is a conventional reasonably diversified institutional investor that assures the delivery of market returns through the patient use of simple, transparent, and focused investment vehicles. PERSI believes more aggressive approaches carry greater long-term dangers than the problematic shorter term opportunities warrant. As a result, we are committed to a “conventional investment” approach for the foreseeable future (at least 5-7 years) and have completed the basic structure of the portfolio we prefer for the long term.

This direction is the continuation of a consistent approach over the past decades, and includes consideration of a number of factors – including some that are:

- return based (market returns are more than sufficient to meet PERSI’s conservative liabilities, there is no evidence that over time more complicated or complex investment strategies add to return for the great majority of institutional investors, and such additional efforts historically have, on average and for PERSI in particular, actually subtracted from market returns),
- resource based (small staff for the foreseeable future, potential Board turnover with different levels of investment knowledge, in-house budgets controlled by legislature),
- control based (complex portfolios are opaque and difficult for constituents to understand and Board members to fully comprehend and control when board time consists of ten meetings a year with an hour or two per meeting devoted to investment issues), as well as
- other factors (conventional investing uses adequately well understood concepts, is easier to explain to legislatures and other constituencies when markets decline, has a well-established literature and tradition, is relatively inexpensive, etc.).

This approach is in contrast to that taken by a number of other investment institutions, often termed “the endowment model”, a number of “risk-centric” approaches that have sprung up since the Great Recession and market collapse of 2007-2009 (risk budgeting, risk parity, risk factors or sleeves), as well as a proliferating number of “factor” and other approaches. Recognizing that there is no “one true way” to invest, PERSI has chosen the conventional investing framework as the one most appropriate for its particular situation.

This paper is a staff document that describes the implementation of the Board’s Investment Policy. The rest of this paper describes the underlying beliefs as understood by staff, a high level



overview of what is meant by “conventional investing”, and sets out in some detail the framework that is used by staff in looking at the PERSI portfolio.

### **General Investment Beliefs**

While there are a number of investment approaches that are being followed today by the investment community, PERSI’s approach is founded upon a set of underlying investment beliefs concerning the management of its portfolio. These are:

1. "Conventional investing" (as generally discussed later) is the best framework for management of PERSI’s portfolio. This is particularly the case due to the size of the portfolio, the staff resources available, the potentially changing nature of the membership of the Board over the next few years (which will include non-investment professionals), and the relative infrequency and shorter length of Board meetings. In contrast, what has been termed the "endowment model" (exemplified by the Yale portfolio) and the various "risk centric" and factor portfolio construction approaches (risk budgeting, risk parity, and risk factors (or "sleeves")) require too many resources, are too opaque, have problematic return prospects for the vast majority of funds, and are not approaches that will be followed or explored for at least the next 5-7 years.

2. The goal of diversification of the portfolio has generally been met with the current asset types contained in the portfolio: namely, U.S. equities, international developed market equities, international emerging market equities, REITs, private equity, private real estate, government and sovereign debt, inflation protected securities (TIPS), credit debt instruments, private debt (the Idaho Commercial Mortgage program), and cash. Addition of other asset types or “sub asset class” investments (emerging market debt, bank loans, MLPs, infrastructure, commodities, gold, etc.) will not be occurring for the foreseeable future [although active managers are authorized to occasionally use instruments from some of these other types in attempts to outperform broader mandates, such as allowing a bond manager to occasionally use dollar emerging market debt in attempting to outperform their general fixed income benchmark].

3. Investment decisions and considerations will be taken with the time horizon of at least 5-7 years, and usually longer. Consequently, investment approaches that aim to enhance returns over the near or medium term (quarterly to 3-4 year time periods), often termed "tactical asset allocation", are not employed (although strict rebalancing may be impacted at various times). Particularly, "hedge funds”, quantitative "black box" strategies (e.g. "130/30") and other short term oriented strategies (tail risk insurance, covered call option writing, portable alpha, “crisis risk offset”, etc.) will not be employed.

## **Overview of “Conventional Investing” and the PERSI portfolio: Simple, Transparent, Focused and Patient**

Conventional investing as implemented in the PERSI portfolio emphasizes the values of simplicity, transparency, focus, and patience. It relies primarily on general public markets as traditionally identified (global equities and investment grade fixed income) with additions of some private investments (real estate, local commercial mortgages, and private equity). It maintains a consistent presence in those markets, rebalancing as appropriate to keep percentage positions relatively constant over time. The approach depends on market movements, not active management, for success and in the core positions stays primarily in instruments that can be readily sold and confidently priced. It favors public and independently verifiable daily pricing for non-private instruments. It depends on surviving market volatility and long-term postures for long-term success, rather than short term efforts to fight market volatility.

### **Simple**

The PERSI portfolio relies on long-term market returns to meet its investment goals. The portfolio as a base position has major exposures to the public markets of US large and small capitalization equities, international developed market equities, emerging markets equities, real estate securities (REITs), inflation-indexed securities (TIPS), investment grade bonds and straightforward, government guaranteed mortgage securities. The portfolio maintains a consistent presence in those markets, rebalancing as appropriate and particularly after volatile market movements.

The investment discipline is relatively simple and easy to follow, and does not tactically allocate the portfolio in any significant way over near term periods. The combinations of these exposures are designed to give a high probability of achieving the returns needed over long periods of time. As one of the simpler and less complicated approaches in the industry, this approach also allows a citizen Board and a small staff to exercise knowing control over the portfolio. This satisfies a key and long standing provision in PERSI’s investment policy which states that “In making individual investment policy decisions, the Board will have as an overall goal a flexible, simplified structure with clear roles and accountability. . . . The Board will favor a structure that accommodates a citizen Board and a small staff.”

PERSI has a real return (above inflation) need in the 3.75%-5.0% range. For base statutory benefits, the real return need is 3.75%, derived from the actuarial nominal net return goal of 7.0%, which in turn is based on an inflation assumption of 3.25%. Higher inflation than anticipated would mean that salaries will be higher than currently projected; therefore benefits (which are generally based on ending salary levels) would be higher than anticipated, and the portfolio would require higher returns than assumed. On the other hand, lower inflation would lead to lower salaries, with lower benefit payments, and would not require as high a nominal return. In addition, statutory benefits include a 1% Cost Of Living Allowance (COLA). COLA’s above 1% can be discretionarily awarded to the extent that long-term returns are consistently above the 3.75% real return rate. Full COLAs could be achieved with real returns around 5% over multi-decade periods.

These return goals result in a portfolio consisting of roughly 70% equity positions and 30% fixed income positions, consistent with the historical long term multi-decade returns of equities in the 5%-7% real return range, and fixed income returning 1%-2% above inflation.

### **Transparent**

Conventional investing and PERSI rely on transparency as the primary risk control. Index funds provide the base position, primarily in the larger more liquid markets for broad basic exposures and as the primary vehicles for portfolio rebalancing and transitions (as well as cost control). PERSI maintains around 45% - 50% of its portfolio in capitalization weighted passive index funds. The portfolio active public security managers (about 30%-35% of the portfolio) usually have broad mandates, with a preference for managers with either clear styles or concentrated portfolios (as much if not more for risk control and transparency than clear additional return benefit). Because the style or portfolio is very clear and transparent with daily and independently priced securities or funds, activity can be monitored contemporaneously, unexpected behavior if it occurs is instantly clear, and explanations for unexpected behavior can be quickly determined. The portfolio concentrates the relationships to relatively few in number (around 20 public managers, around 20 private equity relationships, and a few real estate agents). “Black box” investing is avoided, and there is a strong preference for public securities or funds that can be independently daily priced. Private strategies (about 15%-20% of the portfolio) are in areas that would be understandable to reasonably intelligent people who may not have extensive investment training.

### **Focused**

Conventional investing recognizes that the benefits of diversification basically disappear after 10-11 asset types are used in the portfolio, and that the benefits of moving from 4 asset types to 5 are much greater than from 44 to 45. Further, it believes a position needs to be at least 5% (and preferably at least 8%-10%) of the portfolio in order to have any noticeable impact on either the risk or the return of the entire portfolio. Conventional investing and PERSI therefore focus any extra efforts on a few initiatives that are to be held for the long-term.

In addition to diversification reasons, PERSI has added private assets (both equity and real estate) in an attempt to capture an illiquidity premium (and to realize the annual smoothing benefits recognized by the practices of actuaries and accountants). There is a dedicated manager and index fund for publically traded real estate investments (REITS). The real estate exposure (both public and private) is combined with a TIPS mandate to increase near to medium term (1-5 year) inflation protection. PERSI also has maintained for decades a larger than typical exposure to emerging markets for long-term growth prospects. PERSI also maintains a greater weight to small capitalization U.S. equities than larger capitalization US equities when its public U.S. securities portfolio is viewed by itself (a consequence of the use of active managers).

Special opportunities (such as the Idaho Commercial Mortgage Program) might occasionally be added, but PERSI would only add that type of investment if the return and risk profiles were so clear as to overcome the bias in favor of overall portfolio simplicity, transparency, and focus. Special opportunities are expected to be rare if generally available to institutional investors and, to date, the only special opportunity in the PERSI portfolio is the long-standing Idaho Commercial Mortgage Program.

PERSI therefore has focused its investments to 11 basic asset types: Large Cap U.S. equities (S&P 500), Small Cap U.S. equities (Russell 2500), Private Equity, Private Real Estate, Public Real Estate (REITs), Developed International Markets (EAFE), Emerging Markets, Investment Grade Bonds (Aggregate and Government/Credit), Inflation Index Bonds (TIPS), Idaho Commercial Mortgages, and Cash.

## **Patient**

Conventional investing and PERSI accepts capital market volatility and accepts that the volatility will often be greater than the standard tools assume (which posit “normal”, or bell-shaped curve random market movements (“Gaussian”)). But, we do not try and actively maneuver the portfolio to avoid suspected or feared major moves in the various capital markets. The approach is rather to make the portfolios sturdier, and work to ensure that the liabilities that are being funded can be easily met over the much longer term while being maintained at acceptable levels through short term turbulence. PERSI views attempts to avoid that volatility and reach for shorter term gain as more likely leading to greater danger and disruption than the potential (and elusive) rewards justify. Avoiding tactical moves in volatile markets is analogous to staying put in a known sound structure rather than running around wildly during a severe earthquake. PERSI looks to returns over 5-7 years or more, and does not tactically maneuver the portfolio based on shorter term views.

Patience is a requirement of all successful investment approaches – not just traditional investing. As even one of the acknowledged gifted active investors – Warren Buffet – said

“In the investing business, if you have an IQ of 150, sell 30 points to someone else. You do not need to be a genius. You need to have emotional stability, inner peace and be able to think for yourself, [since] you’re subjected to all sorts of

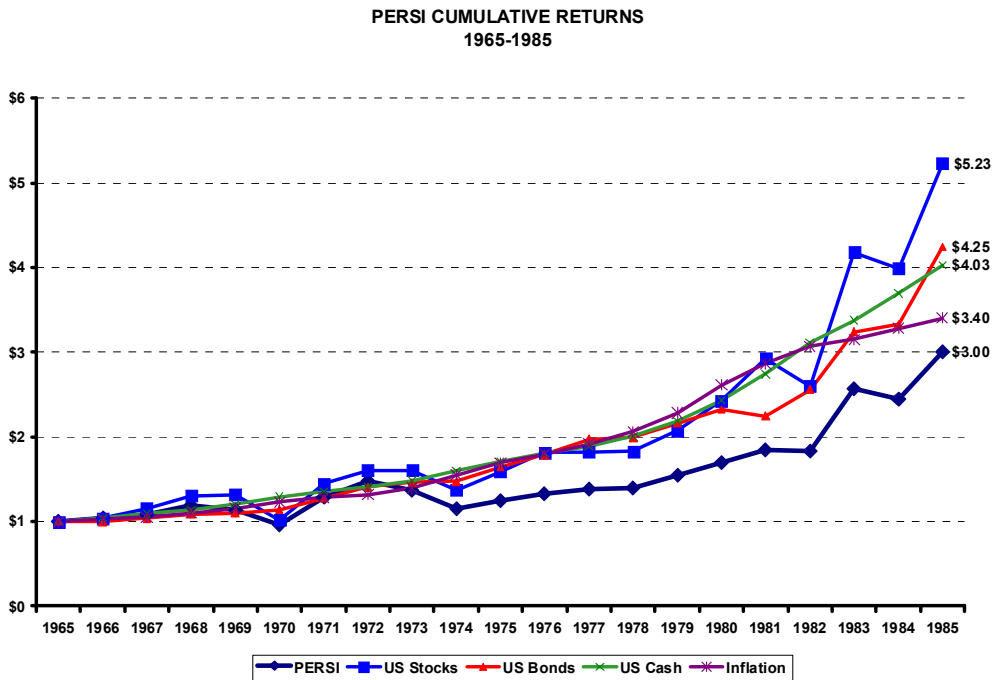
stimuli. It's not a complicated game; you don't need to understand math. It's simple, but not easy. . . Emotional makeup is more important than technical skill.”

Buffett FAQ. <http://www.buffettfaq.com>

Therefore, we believe a conventional approach is appropriate given likely PERSI resources and is sufficient for meeting PERSI's modest liabilities. It has a record of demonstrated success since its adoption in the early 1990s not only in absolute returns, but also in comparison with peer institutions. In addition, however, PERSI had previously tried a more aggressive, actively managed, and tactically allocated approach for much of its early history. That ended in a near disaster for the fund.

## LESSONS LEARNED: PERSI 1965-1992

For the first two and a half decades of its history PERSI tried to maximize its investment opportunities and tried a number of different approaches to investment management. PERSI was founded in 1965, and from its inception through 1992 relied primarily on active management, tactical asset allocation, and opportunistic investing. The results were a near disaster - from its founding in 1965 through 1992, PERSI's cumulative returns lagged that of each and every asset class, including cash. Through 1985, PERSI's total fund did not even keep pace with inflation:



As a result, as of mid-1992, PERSI's peer performance was at the bottom of peer rankings.

# RANKINGS IN THE TUCS PUBLIC FUND UNIVERSE

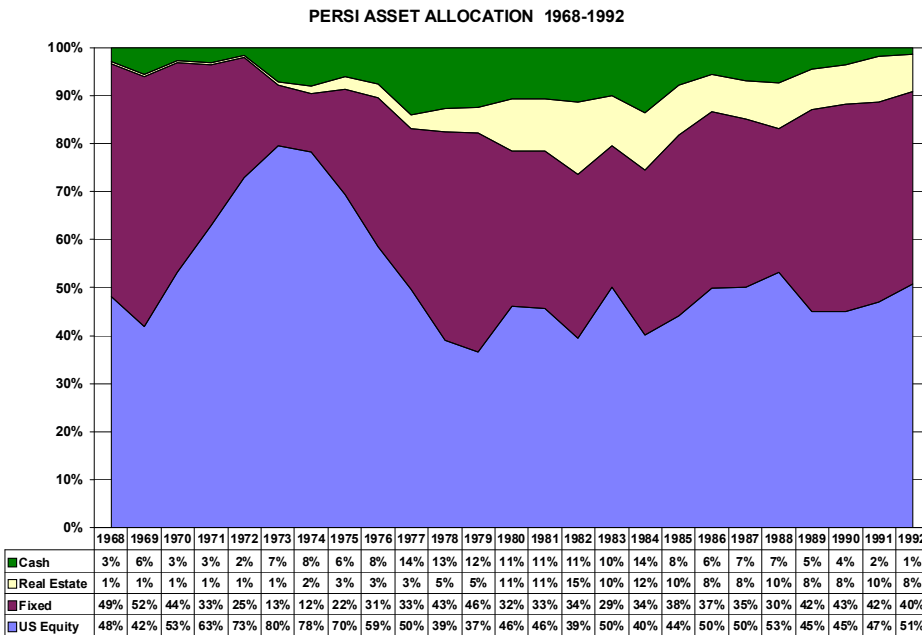
## Percentile Rankings over Period

(1 is highest, 100 is lowest)

	1Yr	2Yrs	3Yrs	4Yrs	5Yrs	7Yrs	10Yrs
9/30/92	99	90	90	79	99	99	99

[TUCS is the Trust Universe Comparison Service, and was the database used by PERSI in the 1980s and early 1990s]

Until 1987, PERSI invested its assets through outside trust and insurance companies (called “funding agents”) reaching a total of eight by 1986. These agents exercised “full discretion in investment activities”, with investment policy “influenced to a degree by frequent consultation with the Retirement Board concerning total portfolio composition and current economic considerations.” (PERSI Tenth Annual Report at p. 17). The result was that during that period PERSI’s overall portfolio essentially chased trends. Over the first 27 years of PERSI’s existence, the equity allocation moved radically, ranging from 42% to 80% and back to 37% again:



For example, much like the recent reaction of many pension funds to the Great Collapse of 2007-2009, PERSI reacted to adverse market conditions of 1973-1974 by increasing reliance on active management, radically pulling back its equity exposure, increasing exposure to other asset types, and covering all of these active investment movements under the rubric of “diversification”. As the Tenth Annual Report (1975) stated after noting the “adverse investment results” of 1973-1974: “With a long-term objective of an optimum rate of return foremost in mind, the Board has not only further diversified in the number of funding agents [investment managers] but has also moved in the direction of further diversifying the portfolio and reducing the ratio of equity investments.” PERSI’s equity allocation subsequently declined from 78%-80% in 1973-1974 to 37% by 1979, just in time to miss the succeeding annualized ten year equity return of almost 13% from 1975 and an annualized five year equity return of 16.5% from 1979.

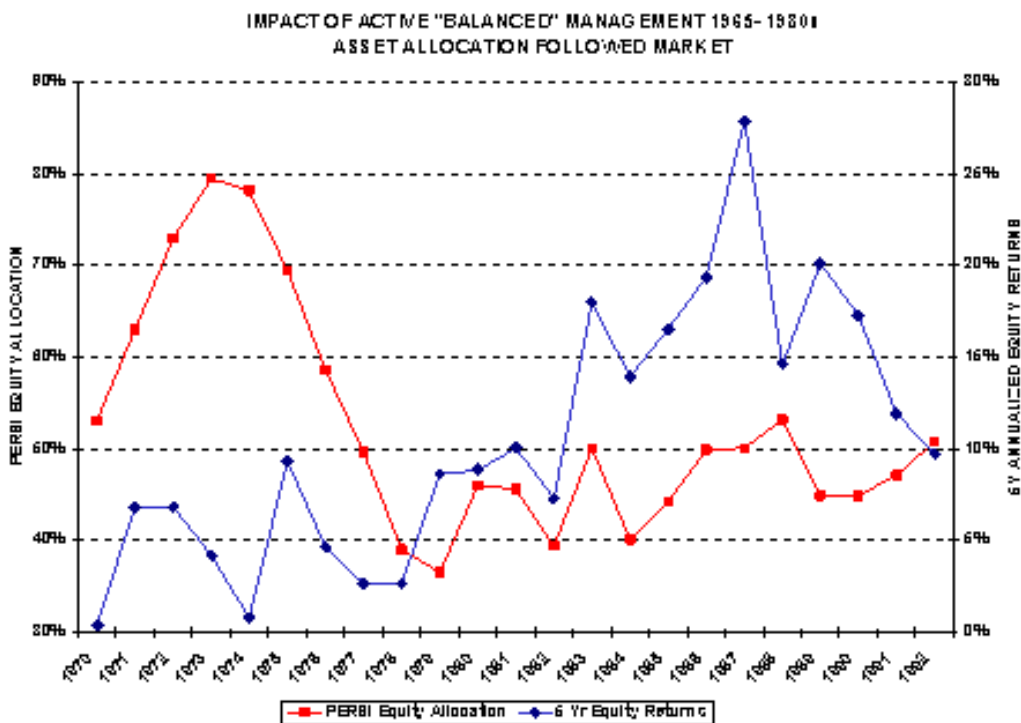
Results were so poor, in fact, that PERSI was instructed NOT to issue annual reports in the mid-1970s. As the Thirteenth Annual Report stated in its opening (December 1, 1978): “At the suggestion and request of a former administration, the Annual Report of the Public Employee Retirement System was discontinued following publication of the Eighth Annual Report for the period July 1, 1972 to July 1, 1973.” (At p. 1 – the Eleventh and Twelfth Annual Reports covering fiscal years 1976 and 1977 were never issued, and there is some indication as stated in the quoted sentence that the Ninth and Tenth Annual Reports covering fiscal years 1974 and 1975 were withdrawn after the fact).

The 1980s did not improve the investment stance of the fund. In addition to previous concerns, PERSI experienced major turnover and change in the management of its investment activities - with five major changes in overall investment management in the six years prior to late 1992. By FY 1986 PERSI had divided its investment funds among eight “funding agents” –essentially traditional broad institutional investment managers [such as four Idaho bank trust departments, insurance companies, and other institutional managers] - who “shall be granted full discretion in making investment decisions” (Twenty-First Annual Report at p. 56)]. In September of 1986, however, the Board fired all of the funding agents and gave the entire portfolio (except for real estate and the Idaho Mortgage Program) to the Frank Russell Trust Company who assumed full responsibility for “selecting managers and replacing them when appropriate” within the general asset allocation set by the Board (Twenty-Second Annual Report at 9).

Because of cost, lack of transparency, hidden costs and commissions, and other concerns, this change caused a large amount of public controversy and reaction. Then Chairman Rudd and the following long-serving chairman Jody Olson were both appointed during this period, and the result was a major change in the investment approach of the fund to reliance on an in-house investment staff and the beginning of a complete overhaul of the investment portfolio – including legislation that, among other impacts, “facilitated full disclosure of PERSI investment activities, . . .exempted investment advisory personnel from the personnel commission, [and] . . . changed the definition of “funding agent,” by broadening the definition to include investment management firms and individual investment managers.” [Twenty-Fourth Annual Report (FY1989) at p. 17]. As the introduction of that annual report noted: “There have been many changes in PERSI in this fiscal year. Some have been very visible, others not.” (Id. at p. 1).

The overhaul initially did not proceed smoothly, with the next three years seeing three different chief investment officers: Phil Halpern (1990), John Hart (1991), and Paula Trener (1992). Each CIO concentrated on different investment portfolio goals, with the result that different investment goals were emphasized in different periods. By the end of 1992 PERSI was searching for its fourth chief investment officer in four years.

In essence, changing investment management approaches and PERSI's reliance on intense active management and tactical asset allocation by its agents and the Board resulted in trend chasing, with equity allocations increasing from 40% to 80% after the bull markets of the late 1960s, collapsing back to 37% after the 1973-1974 market crash, then increasing to 50% after missing most of the bull market in equities of the early 1980s. The market crash in October of 1987 caused another reaction against equities, with a drop back to the mid 40% levels, and only gradually building back to only 50% by 1992:



PERSI ended FY 1992 far below its targeted equity allocation of 65% and with a funding level in the low 60% range. During most of this first 27 years PERSI left actual allocations to the vagaries of active judgments by its agents with the Board making ad hoc reactions whenever severe market events occurred. It deliberately attempted to be a top performing fund, with its primary and express goal of being in the “top one-third of its evaluation service’s universe of other funds” (Twenty-First Annual Report (FY 1986) at 55). If PERSI had consistently maintained any reasonable asset allocation (50% or more equities) during this period and had



simply and transparently applied them during those years its assets would be over \$3 billion higher today.

Over twenty five years ago PERSI deliberately moved away from reliance on intense, constant active management and attempts to tactically allocate assets in an opportunistic manner. Instead of adopting whatever current investment approach is in favor (including the current trend to “outside CIOs” which is similar to the early reliance on bank trust departments), a consistent and stable management approach has been emphasized. We do not believe that a return to that reliance on active investing or any change in investment management direction is called for today. We do not believe that the new paradigms of modern trends in investment management have yet demonstrated that primary reliance on active management and opportunistic investing will lead to any happier ending for those believing the claimed investment skills of experts. Instead, PERSI simply aims to be a standard professional reasonably diversified institutional investor that assures the delivery of market returns through the patient use of simple, transparent, and focused investment vehicles. We do not pretend nor do we want to be anything more.

### **Conventional Investment Implementation – additional considerations**

Conventional investing and PERSI therefore first starts with Modern Portfolio Theory with a 10 year or more time frame, and begins with the 8 major public asset types (US Large Cap Equities, US Mid and Small Cap Equities, Public Real Estate (REITS), International Developed Market Equities (EAFE), International Emerging Market Equities, Government Bonds, TIPS, Credit Bonds and Cash. Positions are then taken in low-cost capitalization weighted indices to get basic, cheap exposures.

Next, attention is focused on surviving expected potential shorter term extreme volatility (such as that which occurred in 2007-2009). This is accomplished by assuring that the cash needs of the organization can survive a market disruption of at least three years. This is primarily achieved through sufficient cash holdings or near-certain cash flows (reasonably secure contributions to the organization) that can assure meeting known near term obligations, and also adjusting the liquid investments to assure the presence of readily marketable assets that would be available in a crisis (e.g., shifting otherwise desired basic allocations in private assets to publically traded assets). PERSI has a very stable stream of diversified government contributions that cover over 90% of its ongoing cash payments for benefits, and therefore has a stable three year time horizon—one that easily navigated the 2007-2009 crisis.

The next objective is to “Avoid the Big Mistake”. Conventional investing and PERSI takes as its base position that market returns with the appropriate equity/fixed mix are sufficient to meet obligations over the long term, and that any attempt to generate extra return should not jeopardize basic market returns. Therefore, conventional investing understands that in order to get at least market returns, one has to consistently be in the markets.

As a result, major tactical asset allocation moves in anticipation of “poor” or “great” market opportunities are viewed with great suspicion and are disfavored. In order to make a major tactical asset allocation move pay off, three decisions, not just one, have to be correct: (1) when to get out of an asset type; (2) when to get back in; and (3) where to put the money in the

meantime. An incorrect decision on any of these three can lead to severe losses (including the unexpected problems with “illiquid cash” that popped up in 2008-2009). Another consequence of this principle is that conventional investing never makes a major move in the middle of a crisis: instead, it “blindly” rebalances during volatile market moves, and doesn’t try and time markets instead of following previously agreed upon disciplines. PERSI follows all of these disciplines, and does not implement tactical asset allocation procedures or employ managers with shorter term orientations (thus avoiding hedge funds).

## **Rebalancing**

PERSI follows standard institutional practice and occasionally rebalances its portfolio. There is no universally accepted rebalancing procedure, with some arguing that standard rebalancing practices are not appropriate at all (See, for example, William F. Sharpe, Investors and Markets: Portfolio Choices, Asset Prices, and Investment Advice, Princeton University Press 2007 at Chapter 8.9.2).

Rebalancing essentially relies on the idea of mean reverting markets, which can take a few years to occur. Rebalancing hurts when markets trend and helps when markets revert with volatility. And, the practical impact is somewhat limited – at most about 40 basis points a year over a decade, but not in each and every year. (This is one of the reasons that Dr. Sharpe says rebalancing is not appropriate – first, that the market information carried by a severe move should be listened to but, second, that it is not “macro consistent” in that everyone cannot engage in a mean-reverting rebalancing strategy and still have the markets clear. He sees it as solely an active management belief, and not a portfolio discipline. PERSI actually agrees with this analysis in large part, but the “discipline” is common and also helps guide Boards in times of crisis).

Even if markets mean revert, one gets more “bang from the buck” by waiting for very major market moves rather than a number of incremental ones. The gain from rebalancing is not linear – for example the gain after a 10% drop is more than after a 1% drop, and much more from a 50% drop than a 10% drop. (100 down to 90, rebalance, and back to 100 gains 11%, but down to 50 and back to 100 makes 100% - more than 5 times the 10% drop).

Finally, there are transaction costs and, if a portfolio has more than a few “asset classes” - particularly if there are a couple of private asset types (like real estate and private equity) - then the portfolio becomes a “Rubik’s Cube” and practically very confusing to manipulate. Even then, with material private and illiquid allocations one can’t rebalance in time of extreme stress.

So, PERSI uses a more informal rebalancing approach. PERSI has net cash flows out monthly, and will rebalance back towards target with those cash flows (using passive index funds in the main liquid categories). Otherwise, for normal market moves PERSI will tend to rebalance once a year (around the close of the fiscal year). PERSI will actively rebalance when there is a really volatile market move, or huge uncertainty (such as in October of 2008 and then again in February of 2009, for example). We will also tend to let equity allocations by benchmark stay above target both because of an equity bias and because it is a means to put manager cash (which

usually runs to about 2% of the overall portfolio) to use. On the other hand, PERSI will rebalance more quickly when bonds are over target.

When rebalancing, PERSI will tend to move to the middle of the range when making major rebalancing moves rather than moving simply to the edge of the range.

Since this involves some ongoing judgment calls, it is important to have an ongoing measurement system in order to determine whether significant errors are being made. PERSI's measurement system is as follows. First we aggregate all the assets into three general categories (using the manager mandates): US equities (which includes global equity, REITS, private equity, and private real estate), international equities (including emerging markets), and fixed income (including TIPS, our commercial mortgage program, etc.).

Then we take the basic reference strategic asset allocation of 55% Russell 3000, 15% MSCI EAFE, and 30% Bloomberg-Barclay's Aggregate as the reference allocation. Then three numbers are tracked:

- (1) What would the return have been if the fund had strictly rebalanced to those proportions at the start of each month without any transaction cost and assuming index returns were achieved ("Strict rebalancing"),
- (2) What would the return have been over various time periods (yearly up to 20 years or more) if the fund had not rebalanced at all during the time periods and index returns had been achieved ("No rebalancing"); and
- (3) What were the actual proportions of those three in the fund at the start of the month by manager allocation, and what would the return have been if index returns had been achieved ("Actual Rebalancing").

Over time, the "actual" numbers should be between "no-rebalancing" and "strict rebalancing" or above both. If the "actual rebalancing" ever runs behind both for a prolonged period of time, PERSI would consider another approach.

For example, over the last 1 year period ending this month, no rebalancing of a 55-15-30 portfolio would have produced a return of

**9.1%**

Strictly rebalancing at the start of every month of those three assets without transaction costs would have returned

**9.0%**

Index returns using our actual proportions over the past year – the "actual rebalancing"- would have given returns of

**9.2%**

(Other actions changed the total portfolio return for the trailing one year period to

**8.7%**

but that is because of emerging markets, TIPS, global equity, and other policies moving the fund away from three simple asset classes).

For the last five years the numbers have been: no rebalancing

9.0%

Annually, strictly rebalancing,

9.1%

and annually, actual rebalancing

9.5%

Consequently, PERSI's more informal approach has produced acceptable results, and change is not indicated.

(PERSI also keeps track of underweighting or overweighting various other investment actions to be discussed next, such as emerging markets, global equities, private equity, real estate, TIPS, Idaho commercial mortgages, etc. Since a number of those allocations (particularly the private ones) are less controllable on a monthly basis, this is more informational, although they need to be tracked, considered and acted on if consistent poor returns are the result.)

### **Additional Investment Efforts: Beyond “the Basics”**

After these basic steps and attitudes have been established, additional actions depending on resources and Board preferences have been taken by PERSI over the years. These extra actions have been taken either because of demonstrated return premiums or other similar reasons.

For example, there are a number of long-term “return premiums” that have been identified by academic research. An “illiquidity premium” from investing in private assets has been identified, for example, and provides a basis for investing in private equity and private real estate. A small cap and value premium have also been identified (although recently questioned), along with momentum, carry (e.g., buying higher yielding currencies and selling lower yielding currencies), selling volatility (e.g., selling puts), minimum variance, and others that apparently are found from time to time. See, generally, Antti Ilmanen, Expected Returns (Wiley Finance 2011). PERSI has implemented some of these biases, but by no means all. Nor has PERSI made these biases central to long-term success.

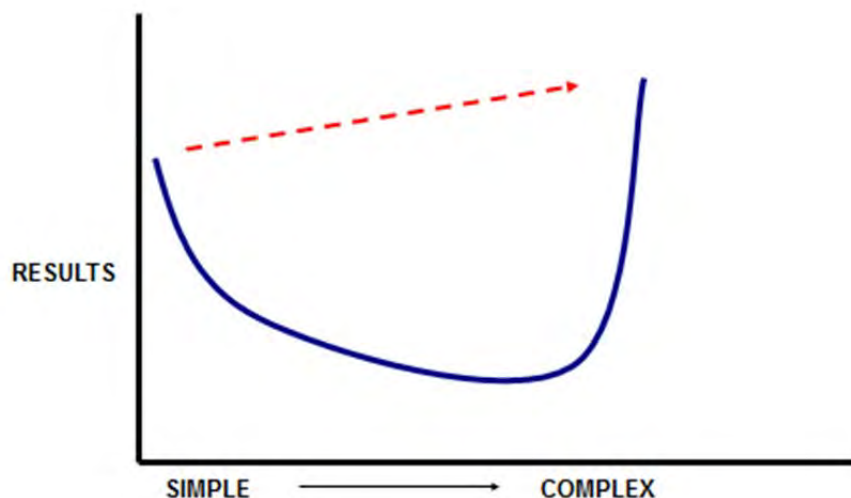
The problem is that even the identified excess return areas have proven to be extremely difficult to practically harvest consistently, or can lead to underperformance for prolonged periods of time. For example, a number of studies have shown that the illiquidity premium (and more) is usually harvested by the private equity general partners. Consequently, on average institutional investors actually pay out more in fees and carry than the premium (particularly since the losers don't pay back any losses on underperformance). All of the extra premium areas usually require payment of higher fees and greater transaction costs than simple cap-weighted passive investing. Further, none of the discovered premiums deliver excess returns consistently. For example, the “value” premium regularly disappears for years at a time – as the “death of value investing” cries heard in the late 1990s demonstrated and the experience of the last decade indicates.

All of these additional areas add complexity and require time for Boards and staffs, and are often not worth the extra effort unless there is a clear organizational commitment or belief in a certain additional approach that can survive changing Boards and staffs over the years that may occur before the extra efforts pay off. One of the most valuable resources of an investment

organization is not the assets in the portfolio, but the time required of the Board and staff. After the basics have been accomplished, additional investment efforts in more complex areas have to expressly trade off the requirement of additional resources and time compared to the often problematic longer-term return benefits.

Dr. David Swensen, the CIO of Yale and godfather (or direct father) of the “Endowment Model”, in fact, cautions the vast majority of institutional and private investors NOT to attempt to reach for most of these extra returns because of the problems of insufficient resources, extra fees, transaction costs, difficulty of long term commitment, and other barriers. David Swensen, “Unconventional Success” (Free Press 2005). In a 2011 Guest Lecture to Robert Shiller’s Financial Markets Course at Yale (Open Yale Courses, <http://oyc.yale.edu/economics/econ-252-11/lecture-6>) he describes (toward the end) what might be called the “Swensen J Curve”:

## THE SWENSEN “J” CURVE



Dr. Swensen believes that simple conventional portfolios can perform quite well and successfully. He also believes that very complex “endowment portfolios”, if done extremely well, can outperform basic conventional investing. But, he cautions against the assumption that if one simply adds complexity a bit at a time, the performance will improve linearly. In fact, he asserts it is only the very, very excellent and well-resourced practitioners of endowment investing – the investing “1%” – that can actually do better:

“Few institutions and even fewer individuals exhibit the ability and commit the resources to produce risk-adjusted excess returns. ... No middle ground exists. Low-cost passive strategies suit the overwhelming number of individual and institutional investors without the time, resources, and ability to make high-quality active management decisions. The framework of the Yale model applies to

only a small number of investors with the resources and temperament to pursue the grail of risk-adjusted excess returns.”

Dr. David Swensen, The Yale Endowment 2013 Annual Report at p. 15

Everyone else, including almost all professional institutional investment organizations, will do much worse for their entry into more complex investing, and that for that vast majority, the more complex the portfolio, the worse the result.

As noted previously, PERSI has a few additional areas of investment beyond basic passive investment in large cap equity and standard investment grade fixed income. All were taken for reasons of basic diversification from three to ten asset types. In addition, each asset area was chosen for an added reason: either likely additional long-term return or additional inflation protection. All have been in place for at least 15 years, and up to 35 years. Consequently they also represent areas with a demonstrated comfort level by the various Boards and constituencies of PERSI. They are:

- Private real estate (late 1970s)(illiquidity premium, inflation protection)
- Small and Mid-cap US equity bias (1980s)(long term return premium, consequence of use of active management)
- Idaho Commercial Mortgages (late 1980s)(local investment and additional return)
- Emerging markets (late 1980s)(long term return premium)
- Private Equity (early 1990s)(long term return premium and smoothing of returns)
- Public real estate (REITS) (1997)(additional medium term inflation protection)
- TIPS (1998)(near term inflation protection)

### **Problems with Conventional Investing: Fighting Boredom and Emotional Exhaustion**

The problem with conventional investing is that it requires extreme patience – an organization must be able to ride through extremely volatile markets without taking major action (except rebalancing) in anticipation of benefits over rolling 5-10 year time periods. This has proven to be practically impossible for many, if not most, organizations. Accepting shorter term roller coaster volatility is emotionally trying. In addition, conventional investing is very dependent on equity risk and return for meeting long term goals, while active management and those advocating alternative approaches often promise an ability to make equivalent returns in other asset types (including through leverage or security selection) over much shorter time frames. Third, one abandons the quest for higher than market returns, and has to read about the reported successes of the occasional winners in the “CNBC” view of the world. Finally, conventional investing values inaction – keeping to a basic market posture without much alteration during both good and trying times. For many organizations, it has proven to be harder doing nothing than doing something.

There is an old saying in investing that there are three ways to make money in the markets: one is physically exhausting, one is intellectually exhausting, and one is emotionally exhausting. The physically exhausting path is to work harder than everyone else - usually to try and find an

“edge”. But there are only so many hours in a day, and finding legal extra information is getting more difficult by the day with the rewards diminishing almost by the second. The intellectually exhausting path is to be noticeably smarter than anyone else in the market, but by definition this only happens to a very few. Being smart, well-resourced, articulate, and previously successful simply gets one in the institutional investment game – winning that game consistently in the future requires much more.

The emotionally exhausting path is that advocated by conventional investing, and requires facing periods of crisis with organizational equanimity. It is easier said than done.

### **The Conventional Investment Framework and the PERSI Portfolio**

A conventional investment framework looks at an investment portfolio with five basic questions (and in order of importance):

- (1) What should be the basic equity/fixed income allocation?
- (2) What home country bias, if any, is desired?
- (3) What steps should be taken to diversify the portfolio (usually to 10-11 asset types) with what expected consequences?
- (4) How has that diversified posture been maintained or has there been drift because of rebalancing (or lack thereof) and/or tactical asset allocation?

Finally and least important,

- (5) How much active management will be used, and with what firms?

The focus – too often lost – should be on those decisions that drive over 95% of portfolio results – the ones taken by the Board and staff in portfolio construction and maintenance. These are the first four questions relating to the posture of the portfolio in the capital markets. Unfortunately, most analysis often concentrates on the final, and usually least important, question – how active management individually or collectively may or may not have beaten the relevant benchmarks for those managers over recent periods of time. But the benchmarks (and allocations to that particular area of the capital markets) is usually a given in the analysis – the portfolio as determined by the individual manager benchmarks is assumed as the starting point.

Instead, PERSI believes that a Board or staff should concentrate on determining and then following the impact of their decisions on the portfolio since: (1) these are the major decisions in their control; and (2) usually almost all of the portfolio results (both absolute returns and returns relative to peers) are driven by those first four allocation decisions.

### **Steps 1 and 2 – Setting the basic equity/fixed allocation and home country bias**

The starting point is determining the basic equity/fixed income allocation, with the second choice being the desired “home country bias”.

Here an extreme example is what could be called the “Widow Buffett” allocation. Warren Buffett, in his 2013 Letter to Shareholders, described perhaps the simplest portfolio structure imaginable (at p. 28):

[T]he “know-nothing” investor who both diversifies and keeps his costs minimal is virtually certain to get satisfactory results. Indeed, the unsophisticated investor who is realistic about his shortcomings is likely to obtain better long-term results than the knowledgeable professional who is blind to even a single weakness. . . .

Nevertheless, both individuals and institutions will constantly be urged to be active by those who profit from giving advice or effecting transactions. The resulting frictional costs can be huge and, for investors in aggregate, devoid of benefit. So ignore the chatter, keep your costs minimal, and invest in stocks as you would in a farm.

My money, I should add, is where my mouth is: What I advise here is essentially identical to certain instructions I’ve laid out in my will. One bequest provides that cash will be delivered to a trustee for my wife’s benefit. (I have to use cash for individual bequests, because all of my Berkshire shares will be fully distributed to certain philanthropic organizations over the ten years following the closing of my estate.) ***My advice to the trustee could not be more simple: Put 10% of the cash in short-term government bonds and 90% in a very low-cost S&P 500 index fund. (I suggest Vanguard’s.) I believe the trust’s long-term results from this policy will be superior to those attained by most investors – whether pension funds, institutions or individuals – who employ high-fee managers.***

Warren Buffett, 2013 Letter to Shareholders, at 28 (emphasis added).

Thus for his wife after his passing, Mr. Buffett has made the basic choice of 90% equities, 10% bonds with a 100% home country bias (for reasons he lays out elsewhere in the Letter). A similar starting point should be used for any investment portfolio, including PERSI’s. (This also sets a basic starting point for risk control and monitoring considerations. The Widow Buffett Portfolio is also very easy to track and determine if it is behaving as expected. Any further actions also require additional risk control actions that become increasingly difficult and opaque as complexity grows.)

Here PERSI has set a basic 70/30 equity fixed income split, with a strong home country bias traditionally expressed as 55% U.S. Equities (S&P 500 and R2500), 15% International Developed Markets (MSCI EAFE), and 30% U.S. Investment Grade Fixed Income (Barclay’s Aggregate).

### **PERSI’s Basic 70% Equity/30% Fixed Split**

The reason PERSI has chosen a 70% equity/30% fixed allocation as its base posture is entirely due to the nature of PERSI’s liabilities, and a need for a real (after inflation) return of 3.75% over decades in order to meet basic statutory liabilities. PERSI’s actuary assumes a 7.0% net nominal return for assets, and 3.25% inflation for its wage assumptions. If inflation and wages

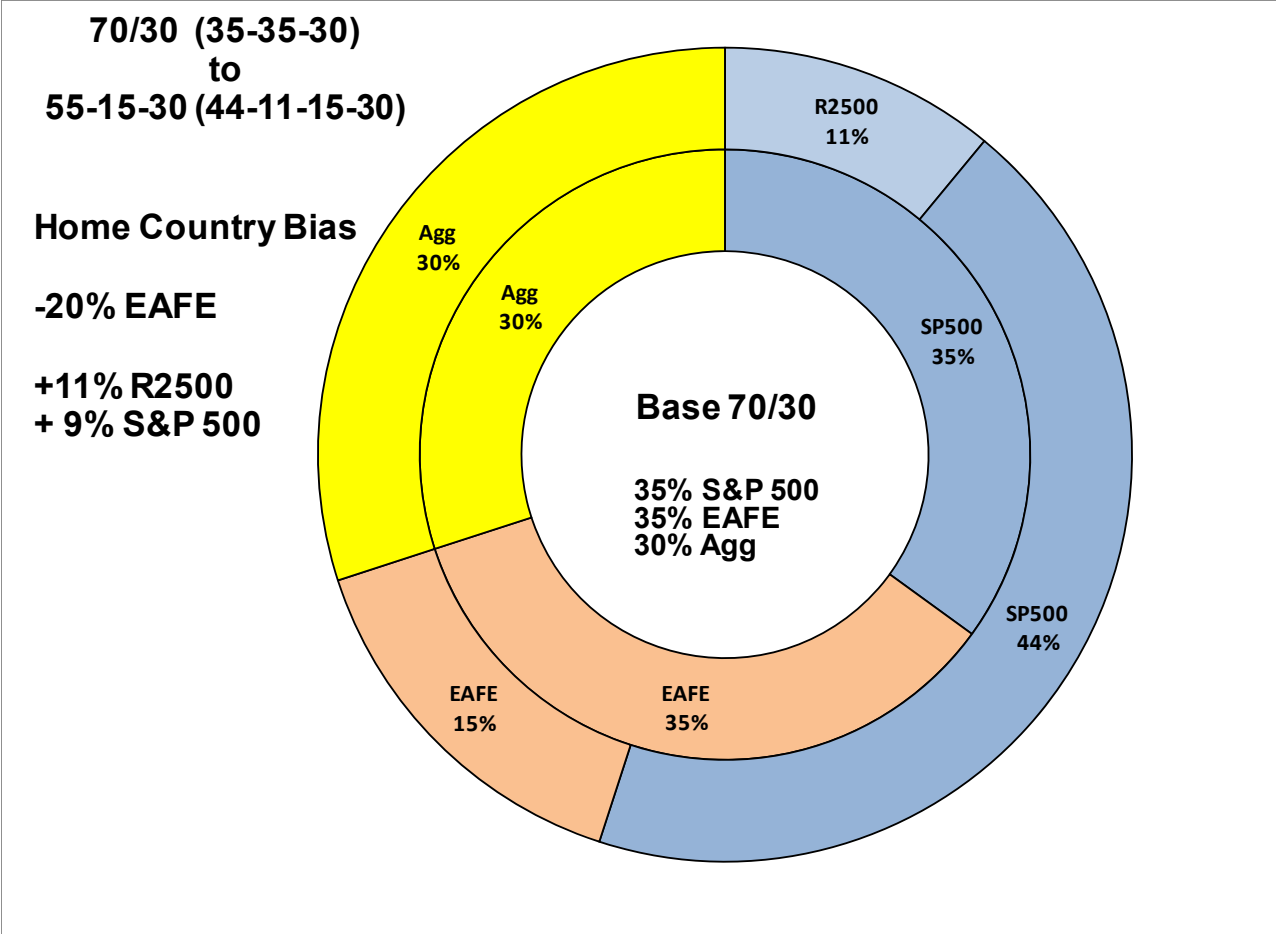


are higher than assumed, then active benefits will be higher than projected (and a greater return will be needed). But if inflation and wages are lower than assumed, then active benefits will be lower than projected (and a lower asset return can be tolerated). In addition, statutory benefits include the first 1% of inflation. Any higher inflation can be granted by the Board in its discretion, which can only occur if real returns are consistently higher than the basic 3.75%. Granting full COLA's would require a real return around 5%.

A 70% allocation to equities with a 30% allocation to bonds allows for achieving these goals. Over the past two centuries, and over rolling 20-30 years, equities have relatively consistently delivered real returns in the 5%-7% range, and fixed income has returned 1% to 3% fairly consistently. Therefore a 70/30 split would produce returns at the low end of 3.8% real (if both capital markets had 20 year returns at the low end of their historic range) to 5.7% real at the high end (if capital markets are jubilant). Thus a 70/30 split gives an excellent chance of meeting at least statutory benefits in poor capital markets (as occurred in the 2000s), while also giving a good chance of maintaining full purchasing power in good markets (as occurred in the 1990s),

**PERSI's Home Country (US) bias – 55% US equities, 15% International Equities, 30% U.S. Bonds**

PERSI has altered the roughly even split of US and international equities in the world capital markets to implement a relatively significant home bias towards U.S. equities. This has traditionally been expressed by PERSI as the "55-15-30" reference benchmark, meaning 55% U.S. Equities (S&P 500 and R2500), 15% International Equities, and 30% U.S. Bonds. With roughly 80% of the US equity market in large cap stocks (S&P 500) and 20% in mid or small capitalization stocks (R2500), this leads to the following home country bias:



[The exact percentage of US and international developed market equities in the World index fluctuates over time, and is usually in the 45%-55% range for US equities (and vice versa). For purposes of analysis and explication, a 50-50 split is used by PERSI for its reference benchmarks. Developed Market (EAFE) indices, the S&P 500 and the Russell 2500 are used as base positions to later isolate long-standing PERSI biases to emerging markets and smaller cap US stocks. There is often some minor benchmark disparity between the returns of the R3000 and the combined returns of the S&P 500 and the R2500, which need to be isolated in attributing performance].

This significant home country bias is due to three factors. First, PERSI liabilities are in U.S. dollars, and therefore most of its assets should be held in U.S. dollars. Second, PERSI's liabilities, as indicated above, are linked to U.S. inflation, and should be responsive to long-term movements in U.S. inflation. Since U.S. inflation is caused by higher U.S. prices, and higher U.S. prices are mainly charged by U.S. corporations, U.S. equities have been shown to respond to U.S. inflation quite well over longer periods of time (10-25 years). Finally, the U.S. equity capital market has historically been one of the best performing (and stable) equity capital markets in the world, and there is some reason to believe that that outperformance and additional safety over long periods of time is not just a historical accident.

## **PERSI'S STRATEGIC POLICY DIVERSIFICATION**

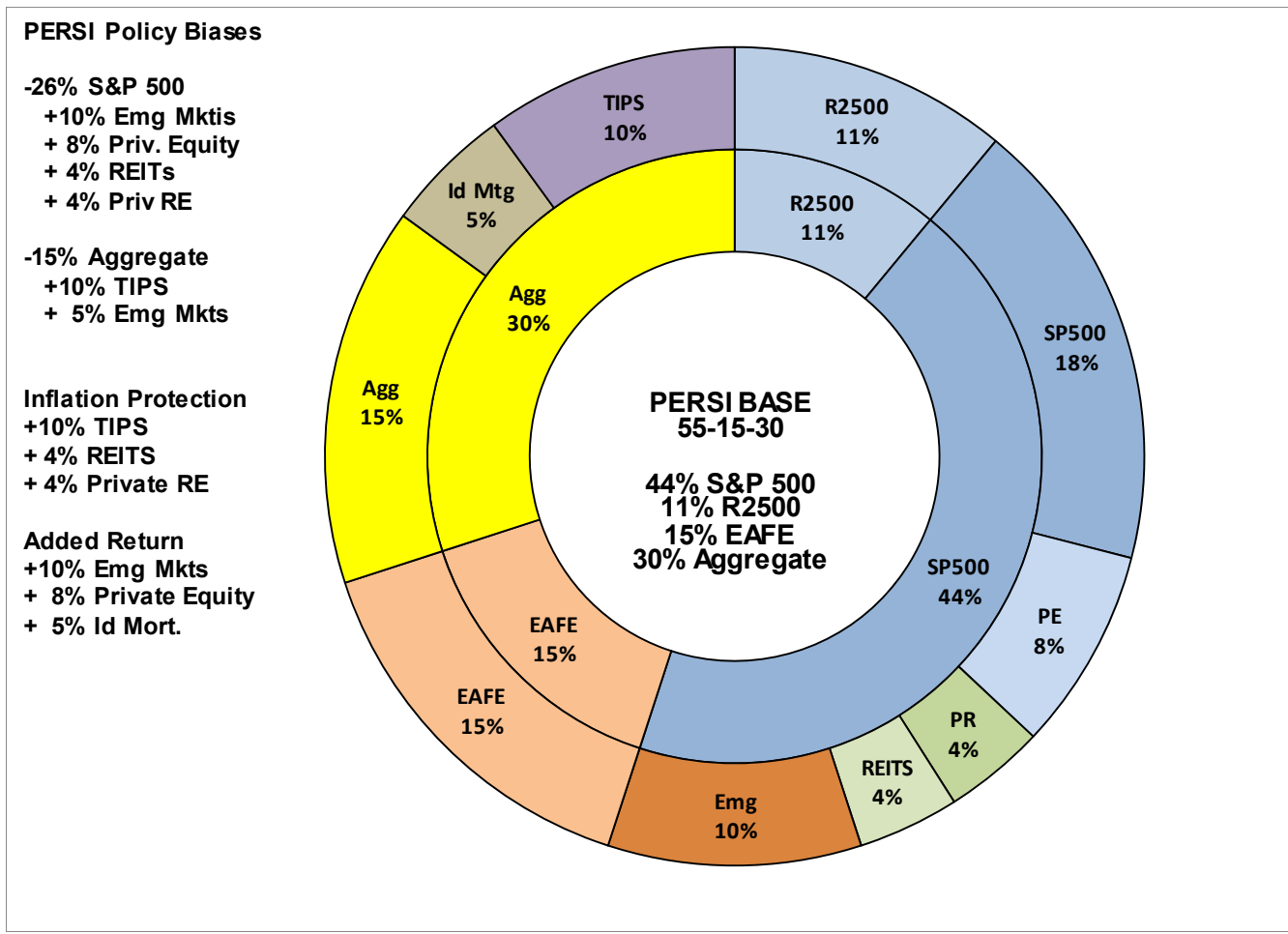
The next step is the basic diversification from the simple home bias portfolio to the 10-11 asset types that provide additional risk/return benefits. Here PERSI has evolved and maintained the following strategic assets for diversification and other purposes for a number of years

- a. 11% R2500
- b. 18% S&P 500
- c. 8% Private Equity
- d. 8% Real Estate
  - i. 4% REITs
  - ii. 4% Private Real Estate
- e. 10% Emerging Markets
- f. 15% EAFE
- g. 15% Aggregate
- h. 5% Idaho Mortgages
- i. 10% TIPS

In essence, this policy portfolio makes two major shifts (which will be important when analyzing performance) from the simpler “home bias” portfolio for purposes of diversification, inflation protection and added return:

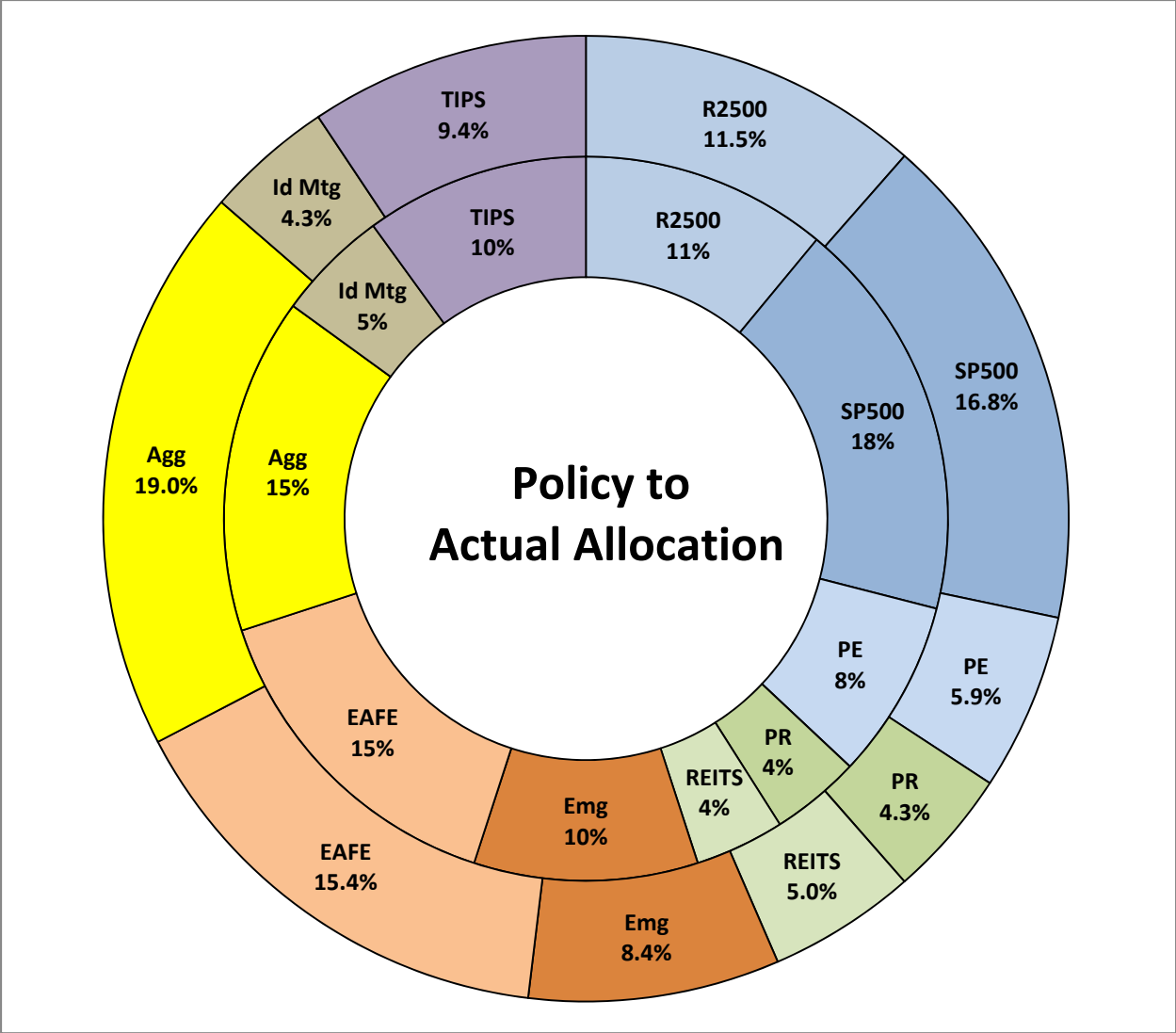
- a. It takes 26% from the S&P 500 and moves it into 10% Emerging Markets, 8% Private Equity, and 8% Real Estate (4% REITs and 4% Private) and
- b. Takes 15% from general investment grade bonds and moves it 5% to Idaho Mortgages and 10% to TIPS

As described earlier, and in addition to portfolio diversification, the movement to TIPS, REITs and Private Real Estate are primarily for additional inflation protection, and the addition of Emerging Markets, Private Equity, and Idaho Commercial Mortgages are aimed at long term added return.



**PERSI PORTFOLIO DRIFT**

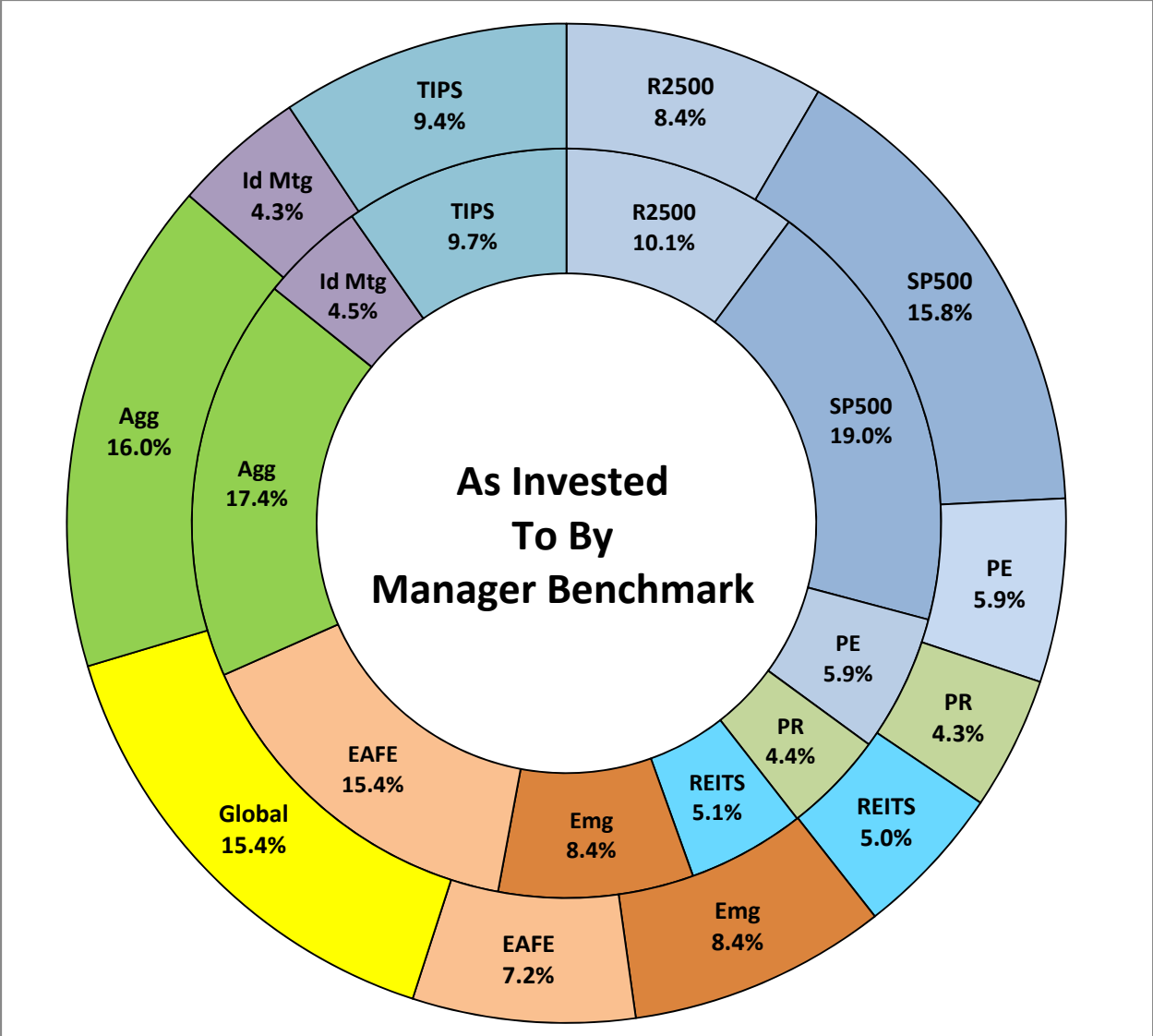
The next issue is how has the actual portfolio drifted from that basic diversified posture due to decisions not to strictly rebalance? The latest month's drift has been as follows



**PERSI USE OF ACTIVE AND PASSIVE MANAGERS**

The above numbers “look through” the portfolios of the actively and passively managed accounts to the underlying holdings as actually invested. Thus, cash held by managers is seen as bonds (“Agg”) and, more significantly, global (or “world”) equity mandates are broken down to their underlying holdings in EAFE, Emerging Markets, S&P 500, R2500, and cash.

In order to determine the impact of active and passive management on fund behavior, the “as invested” breakdown has to be recast to a breakdown by manager benchmark, with the biggest change made by including “World” (or global”) mandates. For the current month, this is as follows:

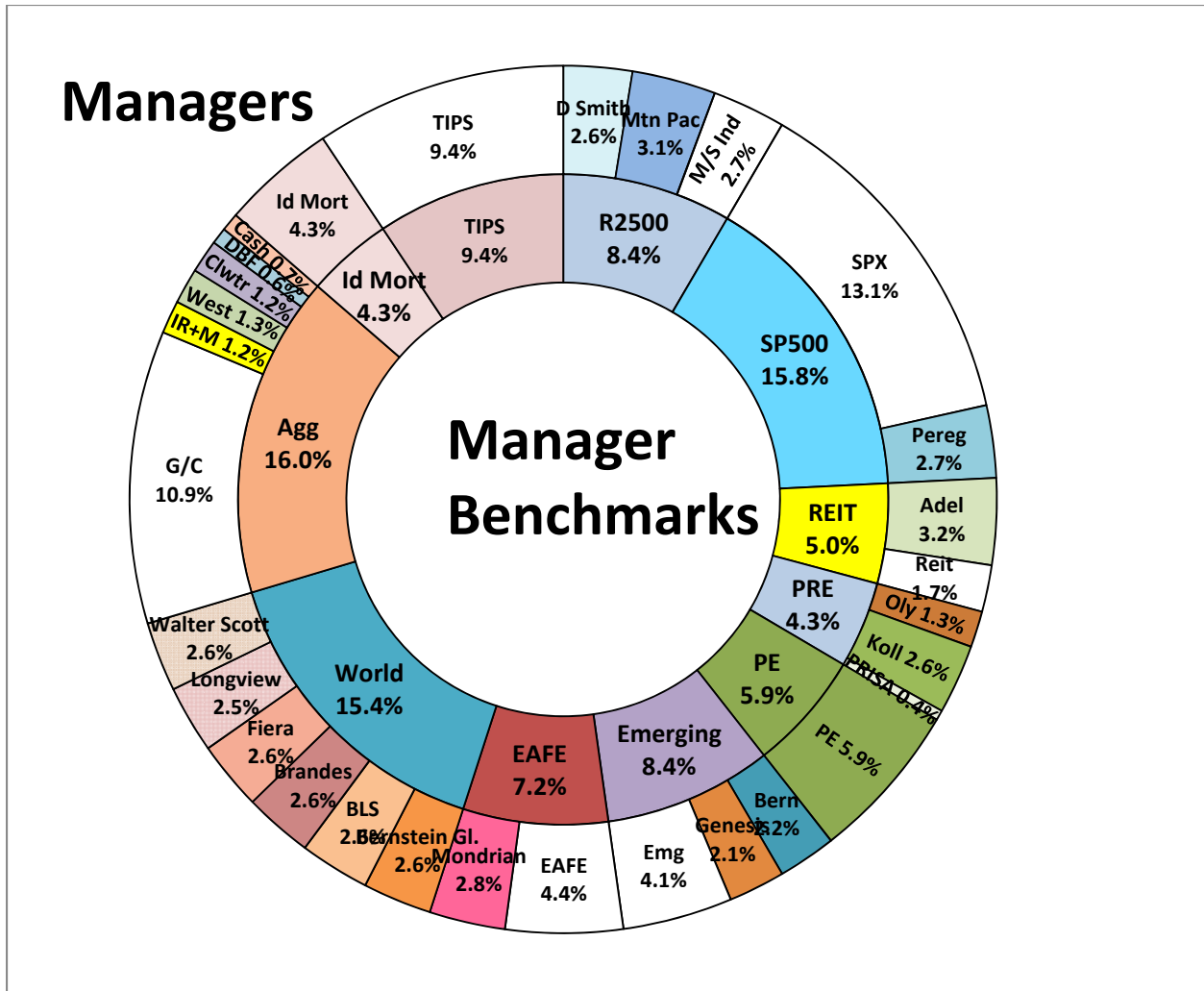


While a bit confusing, this breakdown shows generally how the global equity managers have deployed their money between international developed markets, emerging markets, and large and small cap US equities by subtracting the percentages in those areas in the outer “manager benchmark” ring from the inner “as invested” ring.

The final question is how have the actual assets been deployed among active and passive managers. The latest passive and the active manager lineup and allocations are set out below (White labels are passive index funds).

PERSI normally has approximately 50% of its assets in capitalization weighted index funds, and around 20 private equity relationships (not shown). PERSI also has historically maintained

about 20 public security relationships, and with equity managers has allocated about 3% to 4% of the portfolio to each manager. The managers generally either have concentrated portfolios or clear investment styles to allow clear explanations for periods of over or under performance (and to assure that nothing has changed in that manager’s approach to the markets).



## **CONCLUSION**

While any multi-billion dollar portfolio has a number of investments, the structure and performance of the portfolio can be either relatively simple to grasp or mind-numbingly complex. PERSI, over the years, has chosen to err on the side of a simpler, conventional structure. Our approach is not the only one available, and has been taken for reasons specific to PERSI.

At the core, a conventional framework is all that is needed given the conservative nature of PERSI's liabilities. PERSI only needs market returns in the general vicinity of capital market returns over the past 200 years in order to comfortably meet its liabilities. A conventional framework straightforwardly implemented has, in the past and likely for the foreseeable future, been the best and easiest way for any investor (institutional or otherwise) to generate good market returns. As a public agency, PERSI is unlikely to be able to garner the resources needed to be at the very top end of all institutional funds that have chosen to go down alternate and much more complex paths. Nor has it been shown that except for the very, very few, a more complex path has any reasonable chance of long-term success. In fact, available evidence tends to show that for the vast majority, each additional complex step reduces, rather than adds, to return.

As one of the best-funded retirement schemes in the world, PERSI has benefited from the simple, conventional path over the past 25 years, and until there is clear evidence to the contrary, intends to keep on the same path.





*With more than \$117 billion in total assets, SWIB is among the world's largest institutional investors.*

## **OUR AGENCY** Sophisticated Investment Management

With more than \$117 billion in total assets, the State of Wisconsin Investment Board (SWIB) is an independent state agency responsible for managing assets of the Wisconsin Retirement System (WRS), the State Investment Fund -- a pool of cash balances -- in addition to five separately managed funds. Sophisticated investment management strategies, forward-looking technologies and strong internal asset management make SWIB a leading investment organization. As a premier money manager, SWIB brings a disciplined, prudent and innovative approach to market opportunities. It consistently generates long-term investment returns and meets challenges in a constantly evolving investment landscape.

## **WISCONSIN RETIREMENT** Ranks Among the Best

The WRS is nearly 100 percent funded, placing it in an elite class of the country's best funded public employee retirement systems. The WRS, with assets of more than \$108 billion, comprises 93 percent of SWIB's assets under management. SWIB shares WRS responsibilities with the Department of Employee Trust Funds (ETF), which administers individual benefits.



**622,000**

More than 622,000 participants: current and former employees of Wisconsin's state agencies and most local governments; 1,535 state and local government employers contribute to the WRS



**70%**

Investment performance generally accounts for over 70 percent of WRS income; 30 percent comes from employer and employee contributions



**9TH**

9th largest public pension fund in the US; 25th largest public or private pension fund in the world

## **INVESTMENT STRATEGY** Disciplined, Balanced and Long-Term

SWIB invests first to protect the pension plan from the impact of another major market downturn and then to earn reasonable returns. The investment strategy considers the unique design of the WRS among public pension plans. Members share in the investment risk and annuitants do not have automatic cost of living adjustments, so SWIB implemented a strategy that is designed to weather a variety of economic environments. This helps keep annuities and contribution rates stable. SWIB relies on professional, internal investment management, diversification, and long-term investment strategies to achieve its goals. SWIB protects and grows the funds that WRS participants rely on to have a more confident financial future. Providing a strong, steady economic pillar for the people – and state – makes SWIB a trusted investment management organization.

As a forward-thinking organization, SWIB invests in its future. To manage more assets internally, SWIB completed one of the most transformative technology projects by a public or private pension fund in 2017.

## **HIGHER PERFORMERS** Add Value to Wisconsin

Attracting and retaining award winning professionals helps SWIB to beat its one-, five- and ten-year benchmarks. Institutional Investor recognizes SWIB as “home to top talent in American public investing.”

### Culture of Innovation

“Good teamwork is vital both to successfully implement a challenging and multi-layered technology project, but also for an organization like SWIB to thrive in the ever-competitive world of investment. A vital part of this is empowering staff, by cascading authority down from the board.”

- Institutional Investor Network, January 2018



### **\$759 MILLION**

Over the past five years, by combining investment returns with cost optimization efforts, SWIB has earned \$759 million above market returns for the Core Trust Fund as of Dec. 31, 2017.



### **SOLID PERFORMANCE**

SWIB's performance for the WRS beat the one-, five- and ten-year benchmarks as of Dec. 31, 2017.



### **62%**

SWIB uses its own team to invest approximately 62% of assets for multiples less than what it would pay external managers to do the same work as of Dec. 31, 2017.



### **RECOGNITION**

SWIB has been recognized by the investment industry for teamwork and innovation. Most recently, SWIB was awarded Technology User of the Year as well as Team of Year by Institutional Investor.

**LEARN MORE ABOUT SWIB:** Visit [www.swib.state.wi.us](http://www.swib.state.wi.us). Call 608-267-9057 or toll free 800-424-7942.

**Pennsylvania Public Pension Management and Asset Investment Review Commission**

**Harrisburg, PA, September 20, 2018**

**Ashbel C. Williams, Executive Director & Chief Investment Officer**

**Florida State Board of Administration (SBA)**

- I. While we have separately provided a summary intro to the SBA, I believe that sharing SBA's mission & vision statement and a high level view of the potential benefits of an effectively managed centralized investment function will help you conceptualize the issues you are weighing.
  - a. Our mission is to provide superior investment management and trust services by proactively and comprehensively managing risk and adhering to the highest ethical, fiduciary and professional standards. Our vision is to be the best public sector investment and administrative service provider while exemplifying the principles of trust, integrity and performance.
  - b. As Executive Director & CIO, my priority is to build and maintain our organization's team, culture, reputation, credibility and resources at a strength that empowers mission and vision fulfillment. This is consistent with the Trustees' delegation of authority to the Executive Director & CIO. Our most visible output is investment results, the goodness or inadequacy of which is readily seen. What is less visible is the team building, policy and strategy formation, risk management and execution. If the team, culture, processes and resources are right, the probability of investment outcomes that earn trust, enhance the SBA's reputation and build brand value is vastly enhanced. The result is a virtuous cycle where our credibility and performance help garner critical policy support from key SBA stakeholders (Trustees, Legislature, local governments, beneficiaries, taxpayers, media, etc.), which in turn, positions us as a serious, stable, and desirable investment partner in the marketplace. This enables us to build well-aligned relationships with other exceptional organizations and capture superior deal flow with more favorable terms and pricing, driving the performance that earns trust, enhances reputation and builds brand value. I make it my business to ensure that the SBA executes effectively at all levels of this cycle.
- II. Considerations relating to consolidation of state investment activities
  - a. Ability to manage multiple mandates - The specialized human and other resources associated with successfully formulating, implementing and sustaining investment policies and strategies are substantial and can be levered to manage multiple investment mandates or programs. Significant economies of scale will likely be captured.
    - i. Investment policy statements and portfolio guidelines can be customized as appropriate for various "clients", exactly as private asset management firms serve multiple clients. Providing investment services does not require managing the programs whose assets are being managed.

- ii. Top management, portfolio management, legal services, risk, compliance, portfolio accounting support and custody for the various mandates can be centralized.
- b. Fiduciary focus, professional competence, prudence and a long term perspective are requirements. Good investment organizations are meritocracies; interests must be aligned, excellence rewarded and deficiency dealt with.
- c. Successful pension systems share three characteristics, reasonable benefits, responsible funding and prudent investment. We are focusing here only on the investment side, but if benefits or funding are imprudently managed, there are ramifications for investment policy.
  - i. Investment returns can be thought of as “rents on capital”; the highest rents are commonly paid on capital that is willing to tolerate illiquidity, volatility or both. Assets reflecting these traits include, in descending order of expected return, venture capital, private equity, public equity, real estate, private debt, public debt and cash.
  - ii. A pension funds ability to maximize returns by investing in asset classes that pay high “rents” can be constrained if funding status is sufficiently weak that the risk of short term market adversity could impair the ability to timely meet benefit obligations.
  - iii. History clearly shows that the most common cause of acute and or chronic pension underfunding is not poor investment results or excessive benefits, it is the failure of plan sponsors to make actuarially indicated payments. The fix for this is funding. The notion of taking on more investment risk to earn one’s way out of underfunding is imprudent and fraught with peril.
  - iv. Florida’s constitution requires annual full funding of the FRS’s actuarial normal cost. Generally speaking, the legislature has been very responsible on funding and provided for reasonable benefits. The SBA has invested prudently and met long term objectives.
- d. Risk management and oversight must earn the confidence of stakeholders. The amounts of money involved and consequences of failure are such that earning and maintaining credibility is critically important. SBA combines the risk oversight business models of private asset management firms and public investment organizations to provide a “belt and suspenders” approach including:
  - i. Independent Audit Committee – appointed by SBA Trustees, meets publicly no less than quarterly
  - ii. Investment Advisory Council - appointed by SBA Trustees, meets publicly no less than quarterly
  - iii. Chief Risk & Compliance Officer, leads risk and compliance team.
  - iv. Chief Audit Executive, leads internal audit team
  - v. Inspector General, takes lead on any allegations of impropriety and conducts investigation as needed.
- e. The value of competent, experienced professional staff cannot be overstated. SBA has established a compensation system that aligns interests of employees and stakeholders and ensures that compensation is competitive and incentivizes the right behaviors. It

contains safeguards that penalize negative behaviors and has a multi-year payout for the earned incentive portion of comp of those eligible. Leaving the SBA or committing risk or compliance violations leads to forfeiture of any unpaid incentive.

- III. Prudent, well documented investment policy is central to success. It provides the compass to manage consistently and follow investment discipline designed to maintain diversification and maintain a rational focus when emotions may suggest otherwise. A sound process for policy development assures sound policy and cements acceptance and shared ownership among all parties to decision making.
- a. SBA's Executive Director & CIO is responsible for preparing Investment Policy Statements (IPS) for the various funds we manage. This is accomplished using internal staff, supported by an independent third-party fiduciary investment consultant. The consultant helps ensure that policies reflect current best practices.
  - b. FL statutes require SBA's Investment Advisory Council review and approve IPS changes prior to Trustees' consideration. This is done in public meeting; all related materials are public records.
  - c. SBA Trustees consider proposed IPS or changes in public meetings; all related materials are public records.
  - d. Well documented policy provides the operating standards against which oversight, risk and compliance management are conducted.
  - e. Policy reflects risk tolerance through target asset allocation percentages and allowable variance around the policy target allocations.
  - f. Portfolio guidelines augment investment policy statements, providing more granular detail such as allowable securities, credit quality, concentration limits, leverage constraints or other strategy specific metrics.
  - g. The Trustees serve as a high level policy board, not an operating investment committee. All operating investment and administrative decisions are delegated by administrative rule to SBA's Executive Director & CIO. This focuses accountability and fosters efficient, merit driven investment decision making.
- IV. An increasing portion of SBA assets are managed in house, currently 43% across the global equity, fixed income, and real estate asset classes, up from 36% since 2009. This holds down costs but requires competent, stable professional talent and support for portfolio and risk analytics, trading, systems, portfolio accounting, compliance, etc. Long-term evidence is that the SBA has been effective in achieving desired investment results, within stated risk tolerances.
- a. All of SBA's major investment mandates have outperformed benchmarks over short, intermediate and long terms. For the 10 years ended 6.30.18, net of all costs, SBA is in the 5<sup>th</sup> percentile of the TUCS Top Ten Defined Benefit Plan Universe and has added \$9.4 billion over benchmark.
  - b. Total costs for the SBA are among the lowest in the industry, 48.4 basis points.

# Overview of the State Board of Administration of Florida



The State Board of Administration (SBA) is created by the Florida Constitution and is governed by a three-member Board of Trustees (Trustees), comprised of senior elected officials, the Governor as Chair, the Chief Financial Officer, and the Attorney General. The Trustees, by law, have ultimate oversight. They delegate authority to the Executive Director & Chief Investment Officer by administrative rule to provide the strategic direction and execution of the day-to-day operations. The Executive Director & CIO manages more than 200 professional investment and administrative support staff.

The SBA is an apolitical organization with a professional investment management staff and a strong record of delivering positive risk-adjusted returns on investments. The SBA is required to invest assets and discharge its duties in accordance with Florida law and in compliance with fiduciary standards of care. Under state law, the SBA and its staff are obliged to:

- Make sound investment management decisions that are solely in the interest of beneficiaries and investment clients.
- Make investment decisions from the perspective of subject-matter experts acting under the highest standards of professionalism and care, not merely as well-intentioned persons acting in good faith.

As a fiduciary, the SBA manages assets and provides administrative services that maximize the return on investments while prudently managing risk, controlling costs and providing appropriate diversification. SBA's financial performance is numerically measured and statistically evaluated against accepted industry benchmarks, making it easy to assess success and maintain accountability.

The SBA combines the best private sector and government oversight structures including external advisory bodies, an independent audit committee, an internal chief risk and compliance officer, internal audit capability, and an inspector general.

## Councils, Advisory Boards, and Commissions

The Trustees appoint volunteers to several statutory oversight entities who have specific knowledge and expertise relevant to SBA duties.

**Investment Advisory Council (IAC)** - The IAC provides independent policy oversight of SBA's funds and major investment responsibilities, meets at least quarterly to discuss general policies, and the appropriateness of investment strategy and policy for achieving long-term objectives. The Board of Trustees appoints nine members to serve on the IAC. Members are appointed for four-year terms, subject to senate confirmation, pursuant to Section 215.444(2), Florida Statutes.

**Audit Committee (AC)** - The AC assists the Trustees in fulfilling their oversight responsibilities. Three members are appointed and serve four-year terms, and meet at least quarterly. The AC provides independent oversight in the areas of financial reporting, internal controls and risks assessment, audit processes, and compliance with laws, rules, and regulations.

**Florida Hurricane Catastrophe Fund Advisory Council** - The Council provides the Trustees with information and advice with its duties related to the Florida Hurricane Catastrophe Fund (FHCF). The Trustees appoint a nine-member advisory council that consists of an actuary, a meteorologist, an engineer, a representative of insurers, a representative of insurance agents, a representative of reinsurers, and three consumers.

**Florida Commission on Hurricane Loss Projection Methodology** - The Commission is a panel of experts to provide actuarially sophisticated guidelines and standards for the projection of hurricane losses. The Commission consists of 12 appointed members.

## Additional Advisory Resources

In addition to the internal staff employed by the SBA and the oversight entities mentioned above, independent external investment, legal and other advisory consultants and auditors are utilized on both a retainer and special project basis.

**Investment Consultants** are fiduciaries (essentially the ERISA fiduciary standards of care) in fulfilling their contractually assigned duties. The SBA requires investment consultants to submit an annual independence and compliance disclosure certification.

**Performance and Cost Measurement** - The SBA maintains relationships with firms that provide independent measurement services to assist in evaluating the cost effectiveness of certain components of the SBA's investment programs.

**Special Projects** - On a regular basis, the SBA utilizes independent specialists and legal experts for special project work.

**External and Internal Auditors** - The Audit Committee, through the Chief Audit Executive who also heads the SBA's internal audit team and the Executive Director & CIO, engages and oversees audit activity. The law requires the SBA to obtain annual commercial audits of the FRS Pension Plan and the FRS Investment Plan financial statements. The Audit Committee appoints a pool of auditors to be used for special project audits. The SBA also is covered by Florida's Auditor General and the Office of Program Policy Analysis and Government Accountability.

## **Budget**

The SBA manages its budget conservatively while recognizing that the agency needs sufficient resources to be successful. By virtue of the size of its operations, the SBA has the potential to capture significant scale economies and aggressively seeks to do so. The management fee charged is 2.25 basis points on most funds under management for administrative overhead, which equates to less than 3/100 of one percent. Florida PRIME charges 1 basis point. The budget is set annually by the Trustees, SBA's all-in cost are consistently among the lowest of our peers.

The SBA provides a variety of investment services to state and local government entities in Florida and has a history of generating excellent returns relative to risk.

The SBA manages over 30 funds with an AUM of \$201,149,168,148 as of June 30, 2018, some established as direct requirements of Florida Law and others developed as client-initiated trust agreements. The primary funds managed by the SBA are:

- Florida Retirement System Pension Plan, accounting for approximately 80 percent of all assets under management, with an AUM of \$160,439,358,858.
- Florida Retirement System Investment Plan, one of the nation's largest defined contribution plans, with an AUM of \$10,830,238,256.
- Florida PRIME provides eligible participants a safe, liquid, cost effective investment vehicle for their surplus funds, with an AUM of \$10,512,868,079.
- Florida Hurricane Catastrophe Fund, with an AUM of \$14,462,339,318, and the associated State Board of Administration Finance Corporation with and AUM of \$2,784,793,984.
- Lawton Chiles Endowment Fund, with an AUM of \$763,131,860.

Additionally, the SBA has important responsibilities that do not directly involve pension asset management. These roles include:

- Providing personalized retirement planning and financial counseling support to members of the Florida Retirement System through the MyFRS Financial Guidance Program.
- Administering the Florida Hurricane Catastrophe Fund and its associated programs.
- Serving as an investment consultant to retirement programs administered by other state agencies, including the State of Florida Deferred Compensation Program and the State University System Optional Retirement Program.
- Managing the corporate affairs of the Inland Protection Financing Corp., a public-private entity created to raise funds to pay reimbursement claims for pollution cleanup.
- Managing the corporate affairs of the Florida Water Pollution Control Financing Corp., which is the state's revolving fund set up to finance clean water initiatives for local government water and wastewater systems.
- Administering debt service funds for bonds issued according to the State Bond Act, which allows the Division of Bond Finance to issue tax exempt bonds to provide capital financing for state and selected government agencies.
- Independently assess and opine on the adequacy of revenue and cash flows to cover principle and interest on Florida sovereign and agency debt.

The SBA also serves as escrow agent for state bonds.

- Providing administrative support for the Division of Bond Finance and the Florida Prepaid College Program

# *Public Plan Investment Performance, 2001-2016*

JP Aubry

Center for Retirement Research at Boston College

Director of State and Local Research

Public Pension Management and Asset Investment Review Commission

Harrisburg, PA

September 20, 2018



# CRR assesses plan performance in two ways.

1. A comparison of investment returns across plans:

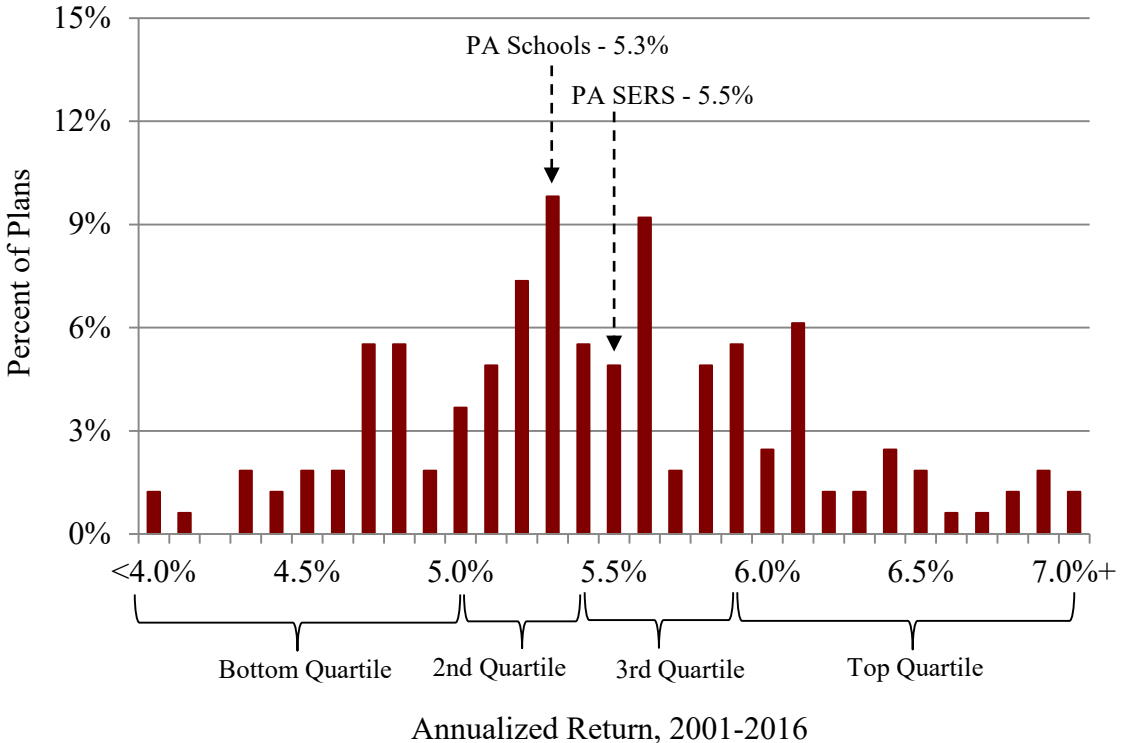
*Observed differences are the result of both differences in asset allocation and/or asset class performance.*

2. **A comparison of each plan's investment return to its own benchmark:**

*Performance relative to benchmark focuses on each plan's ability to execute its own strategy.*

# The long-term (2001-2016) investment return varies greatly among public plans.

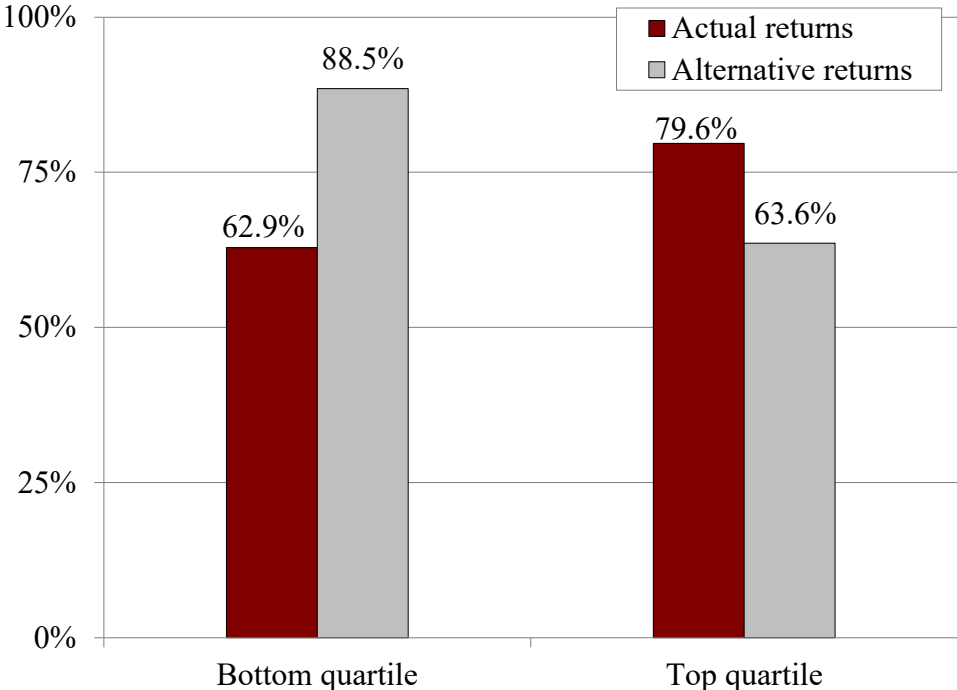
Distribution of Plans by Long-term (2001-2016) Annualized Return



Source: Author's calculations using the *Public Plans Database* (2001-2016).

# The difference in returns accounts for much of the variation in today's funded status.

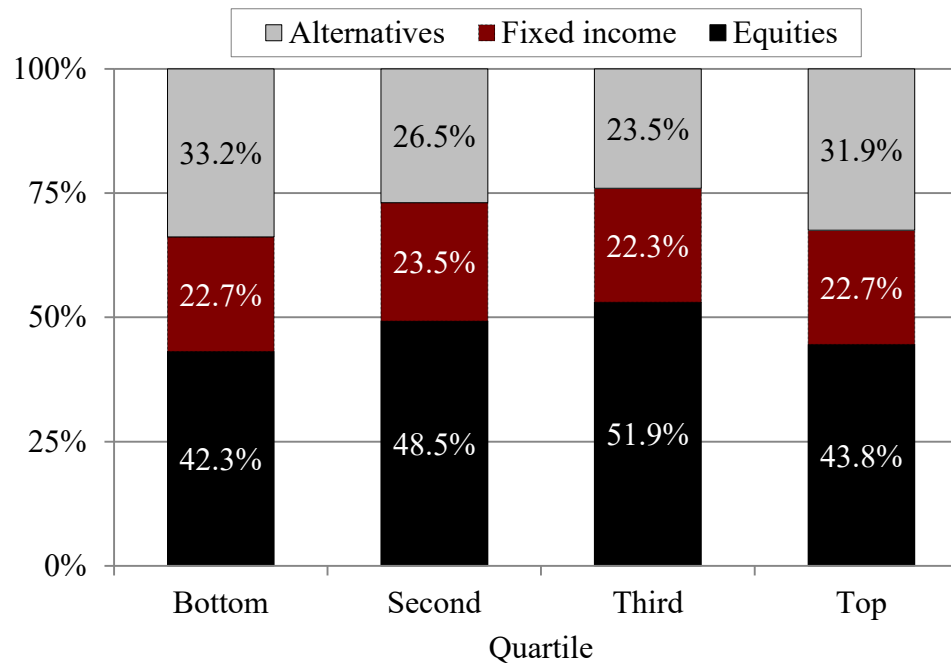
2016 Market Funded Ratios under Various Return Assumptions, by Quartile



Source: Jean-Pierre Aubry, Anqi Chen, Alicia H. Munnell, and Kevin Wandrei. 2018. "What Explains Differences in Public Pension Returns since 2001?" State and Local Plans Issue in Brief 60. Chestnut Hill, MA: Center for Retirement Research at Boston College.

# At a high level, the asset allocation of most public plans is quite similar.

Asset Allocation for State and Local Pension Plans, 2016



Source: Jean-Pierre Aubry, Anqi Chen, Alicia H. Munnell, and Kevin Wandrei. 2018. "What Explains Differences in Public Pension Returns since 2001?" State and Local Plans Issue in Brief 60. Chestnut Hill, MA: Center for Retirement Research at Boston College.

# But the top-quartile plans outperformed others in most asset classes.

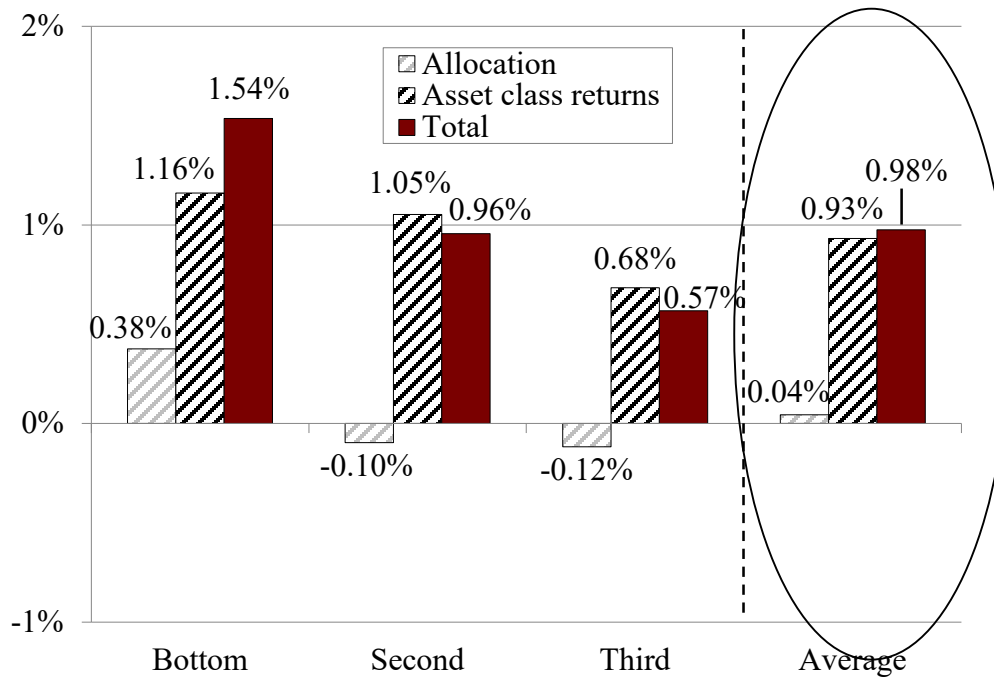
Annualized Asset Class Returns by Quartile, 2001-2016

Asset Class	Top	Third	Second	Bottom
Public Equities	6.7%	5.3%	5.4%	4.7%
Fixed Income	6.3%	6.3%	5.8%	5.8%
Alternatives				
Private Equity	9.7%	8.9%	7.1%	9.3%
Hedge Funds	4.1%	5.6%	7.5%	6.2%
Real Estate	10.1%	8.8%	8.4%	7.2%
Commodities	8.1%	3.1%	0.2%	3.9%

Source: Jean-Pierre Aubry, Anqi Chen, Alicia H. Munnell, and Kevin Wandrei. 2018. “What Explains Differences in Public Pension Returns since 2001?” State and Local Plans Issue in Brief 60. Chestnut Hill, MA: Center for Retirement Research at Boston College.

# So, for most plans, asset class returns - not allocation - explain the difference from the top quartile.

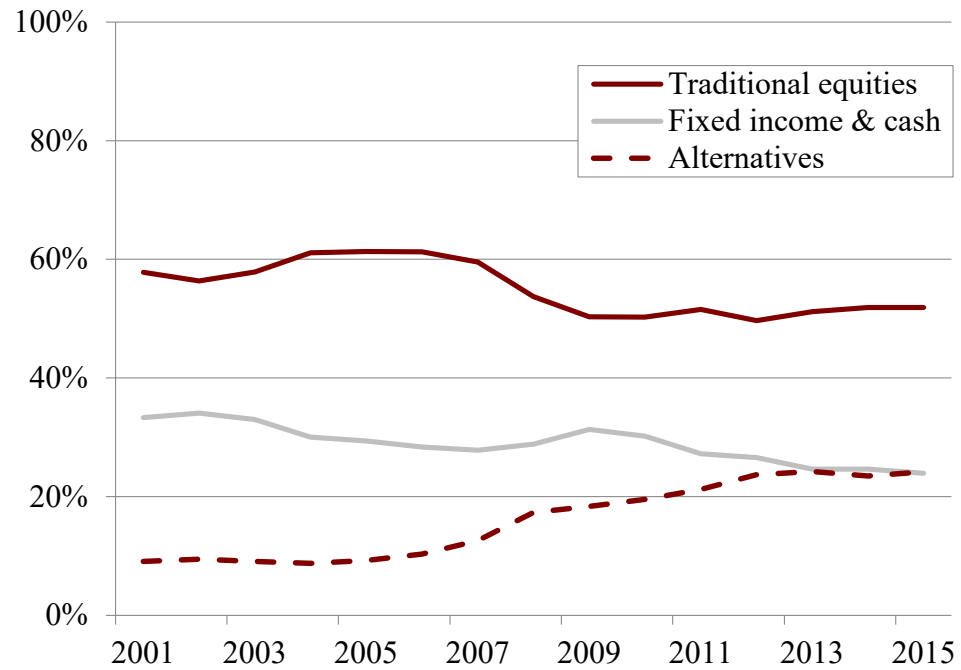
Role of Allocation and Returns on the Difference from Top Quartile



Source: Jean-Pierre Aubry, Anqi Chen, Alicia H. Munnell, and Kevin Wandrei. 2018. "What Explains Differences in Public Pension Returns since 2001?" State and Local Plans Issue in Brief 60. Chestnut Hill, MA: Center for Retirement Research at Boston College.

# In general, plans have shifted away from traditional stocks and bonds to alternatives.

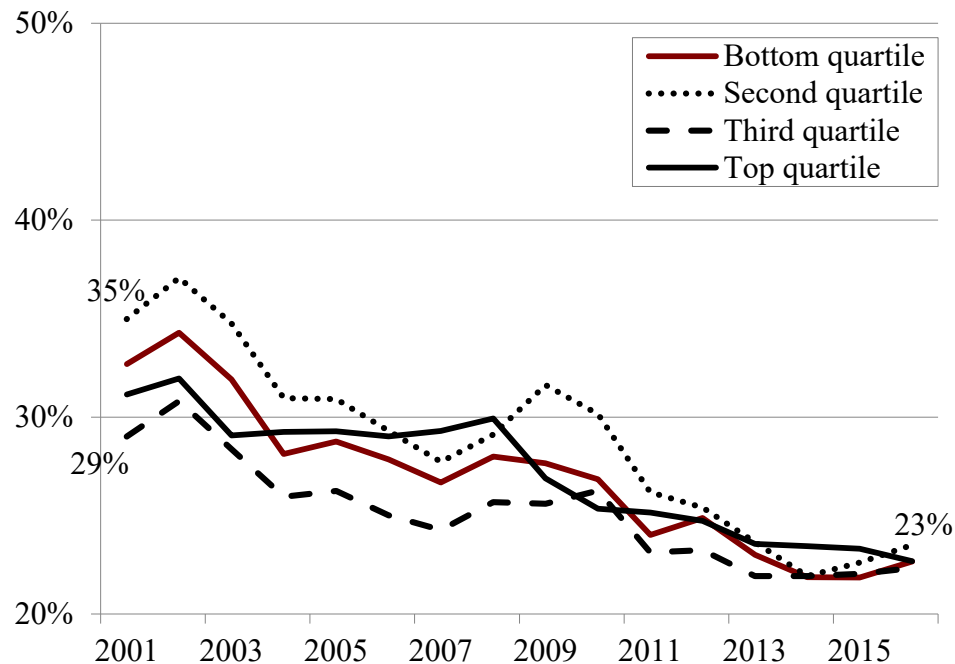
Asset Allocation for State and Local Pension Plans, 2001-2015



Source: Jean-Pierre Aubry, Anqi Chen, and Alicia H. Munnell. 2017. "A First Look at Alternative Investments and Public Pensions." State and Local Plans Issue in Brief 55. Chestnut Hill, MA: Center for Retirement Research at Boston College.

# All plans have made the shift away from traditional bonds in relatively similar fashion.

Allocation to Fixed Income by Quartile of Returns, 2001-2016

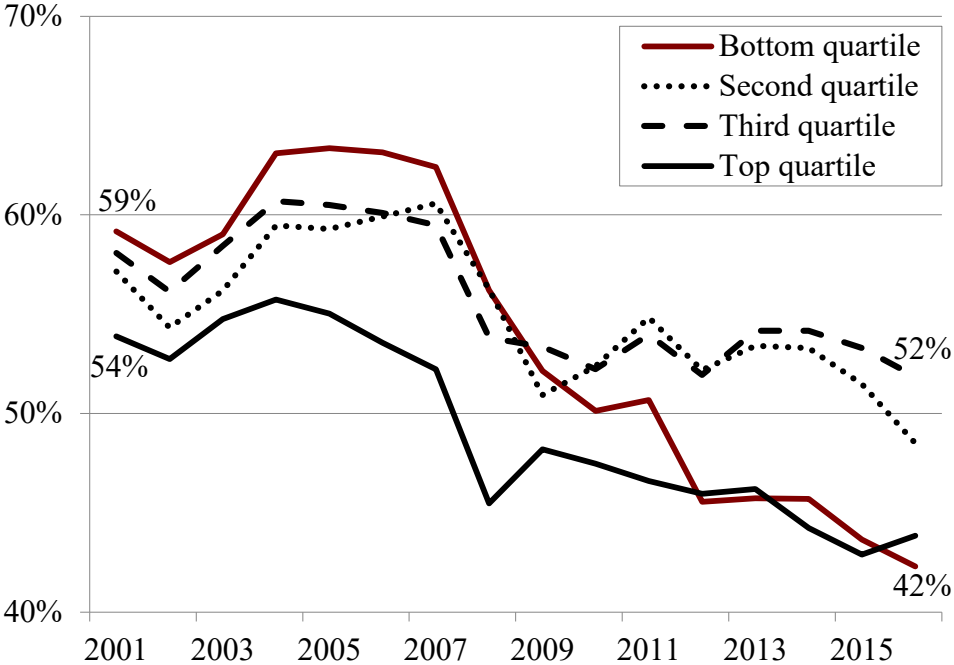


Source: Jean-Pierre Aubry, Anqi Chen, Alicia H. Munnell, and Kevin Wandrei. 2018. "What Explains Differences in Public Pension Returns since 2001?" State and Local Plans Issue in Brief 60. Chestnut Hill, MA: Center for Retirement Research at Boston College.



# However, after the crises, bottom quartile plans made the largest shift out of equities....

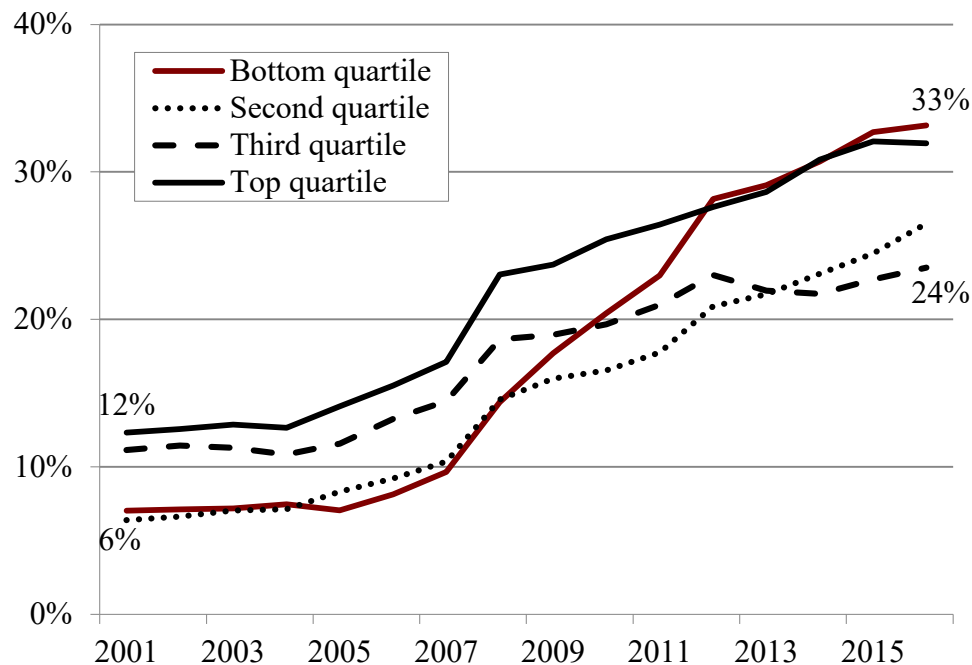
Allocation to Traditional Equities by Quartile of Returns, 2001-2016



Source: Jean-Pierre Aubry, Anqi Chen, Alicia H. Munnell, and Kevin Wandrei. 2018. "What Explains Differences in Public Pension Returns since 2001?" State and Local Plans Issue in Brief 60. Chestnut Hill, MA: Center for Retirement Research at Boston College.

# ...and into alternatives.

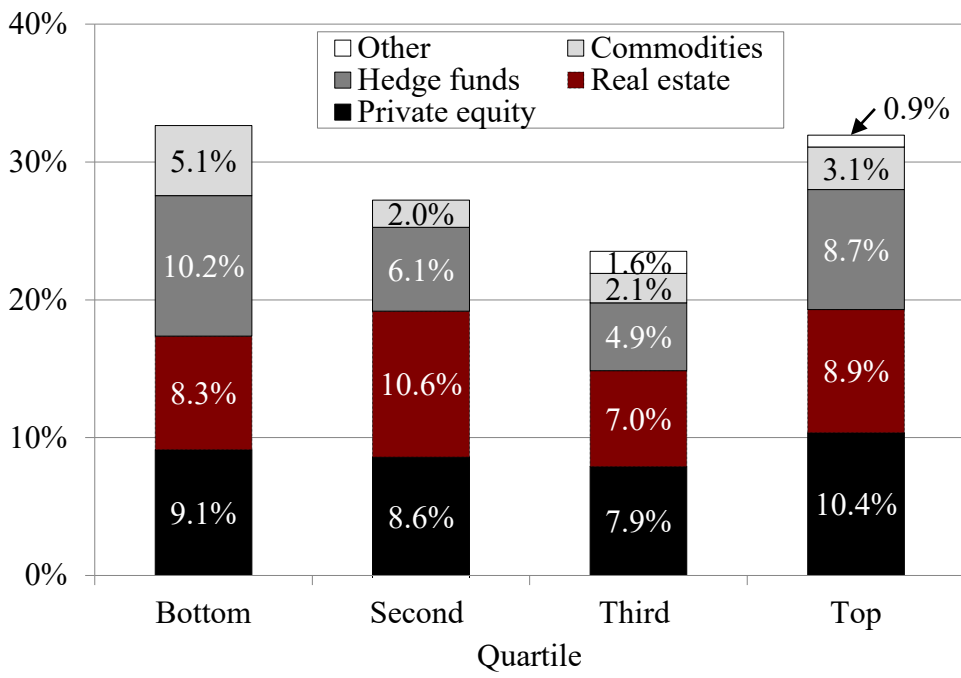
Allocation to Alternatives by Quartile of Returns, 2001-2016



Source: Jean-Pierre Aubry, Anqi Chen, Alicia H. Munnell, and Kevin Wandrei. 2018. "What Explains Differences in Public Pension Returns since 2001?" State and Local Plans Issue in Brief 60. Chestnut Hill, MA: Center for Retirement Research at Boston College.

# Specifically, they shifted more heavily into hedge funds and commodities...

Percentage of Plan Holdings in Selected Alternative Asset Classes by Quartile of Returns, 2016



Source: Jean-Pierre Aubry, Anqi Chen, Alicia H. Munnell, and Kevin Wandrei. 2018. "What Explains Differences in Public Pension Returns since 2001?" State and Local Plans Issue in Brief 60. Chestnut Hill, MA: Center for Retirement Research at Boston College.

..during a period when these asset classes dramatically underperformed others.

Returns from Alternative Asset Classes and Traditional Equities, FY 2001-2016

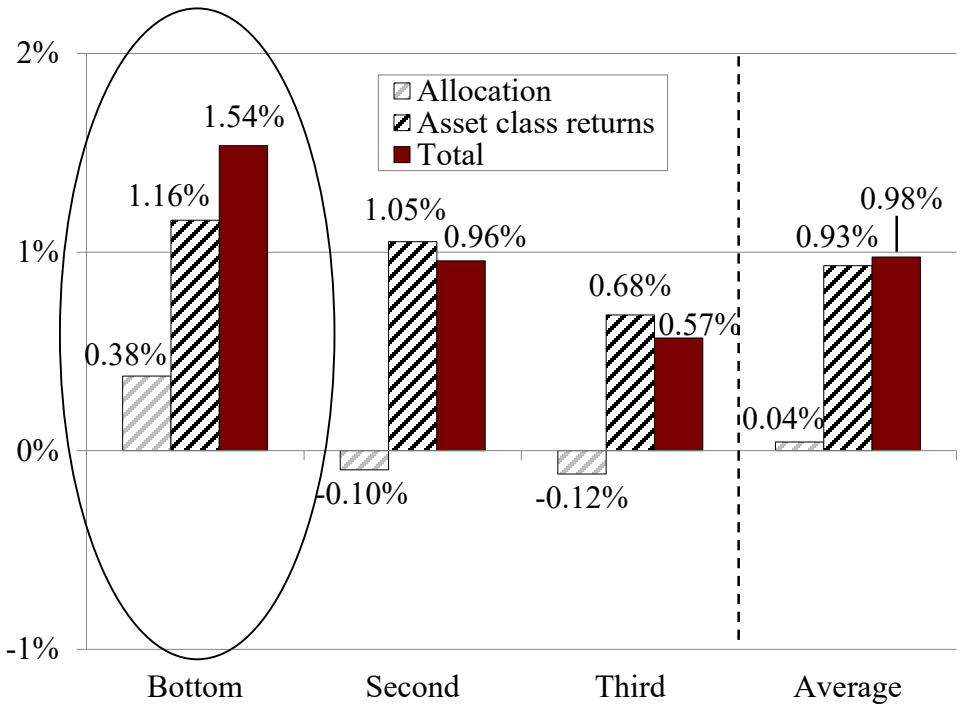
Asset class	2000-2007	2008-2009	2010-2016
Alternatives			
Private equity (before fees)	8.1%	-13.0%	25.0%
Hedge funds (after fees)	10.7%	-10.9%	1.3%
Real estate (before fees)	14.5%	-6.3%	12.1%
Commodities (after fees)	16.2%	-4.1%	-3.0%
Traditional equity	2.7%	-21.3%	14.9%

Note: Returns based on Thomson Reuters Private Equity Buyout Index, Hedge Fund Research Global Hedge Fund Index, NCREIF Property Index, S&P GSCI Index, and Wilshire 5000 Index (Total Return).

Source: Jean-Pierre Aubry, Anqi Chen, Alicia H. Munnell. 2017. "A First Look at Alternative Investments and Public Pensions." State and Local Plans Issue in Brief 55. Chestnut Hill, MA: Center for Retirement Research at Boston College.

# As a result, allocation played some role in the lower returns of the worst-performing plans

Role of Allocation and Returns on the Difference from Top Quartile



Source: Jean-Pierre Aubry, Anqi Chen, Alicia H. Munnell, and Kevin Wandrei. 2018. "What Explains Differences in Public Pension Returns since 2001?" State and Local Plans Issue in Brief 60. Chestnut Hill, MA: Center for Retirement Research at Boston College.

# CRR assesses plan performance in two ways.

1. A comparison of investment returns across plans:

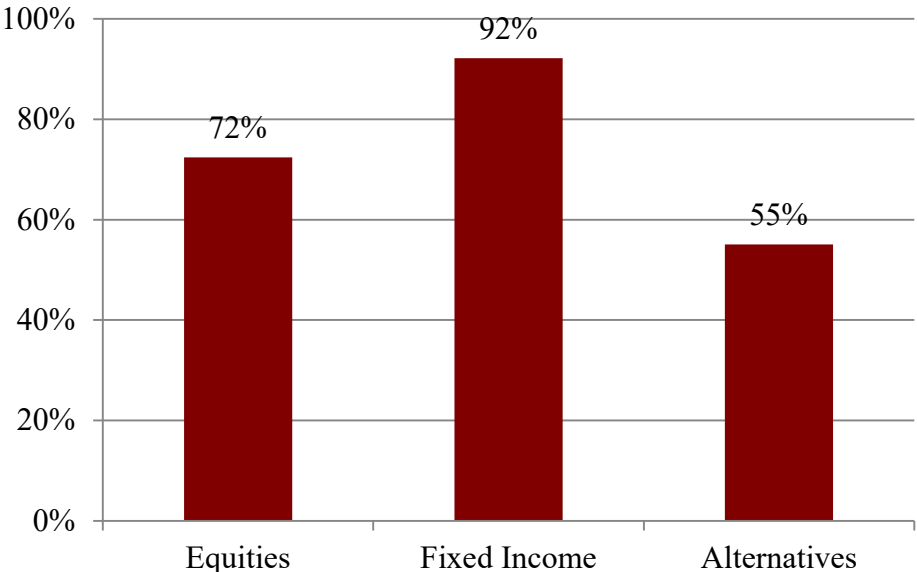
*Observed differences are the result of both differences in asset allocation and/or asset class performance.*

2. **A comparison of each plan's investment return to its own benchmark:**

*Performance relative to benchmark focuses on each plan's ability to execute its own strategy.*

# Most plans beat their benchmark for traditional investments, but only about half beat their benchmark for alternatives.

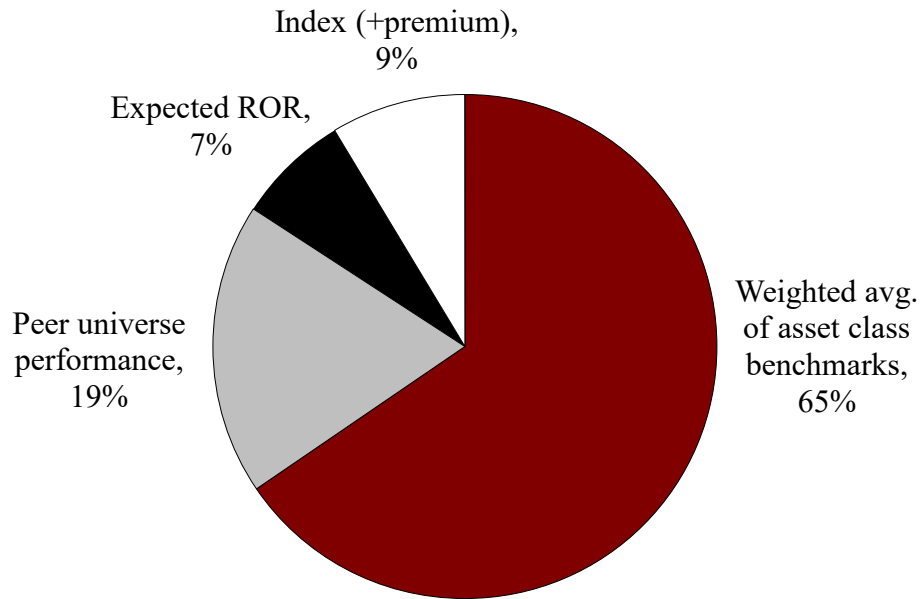
Percentage of Plans that Outperformed Their Asset-Class Benchmark from 2001-2016



Source: Author's calculations using the *Public Plans Database* (2001-2016).

# Currently, the portfolio benchmark for most plans reflects the plan's asset allocation.

Distribution of Plans, by Type of Portfolio Benchmark, 2016

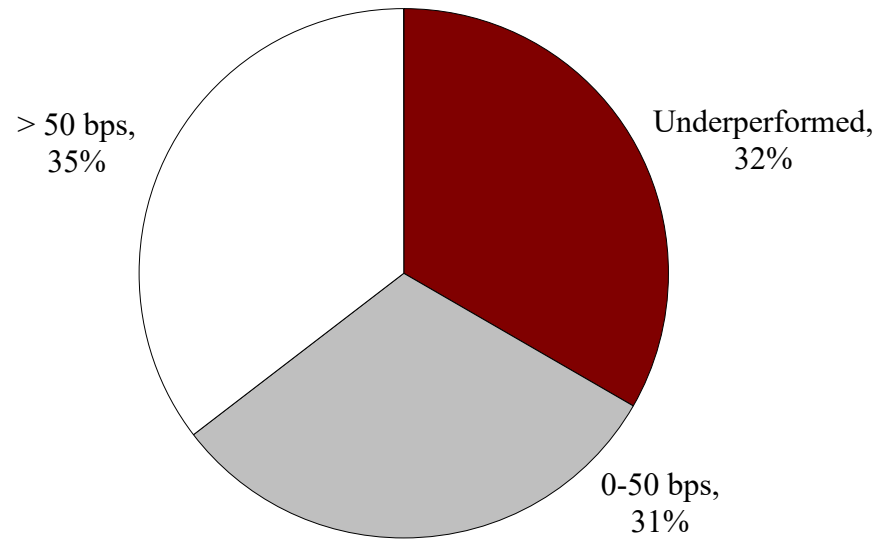


Source: Jean-Pierre Aubry and Caroline V. Crawford. "How Do Fees Affect Plans' Ability to Beat Their Benchmarks?" State and Local Plans Issue in Brief 61. Chestnut Hill, MA: Center for Retirement Research at Boston College.



# About a third of plans did not meet their portfolio benchmark over the long term.

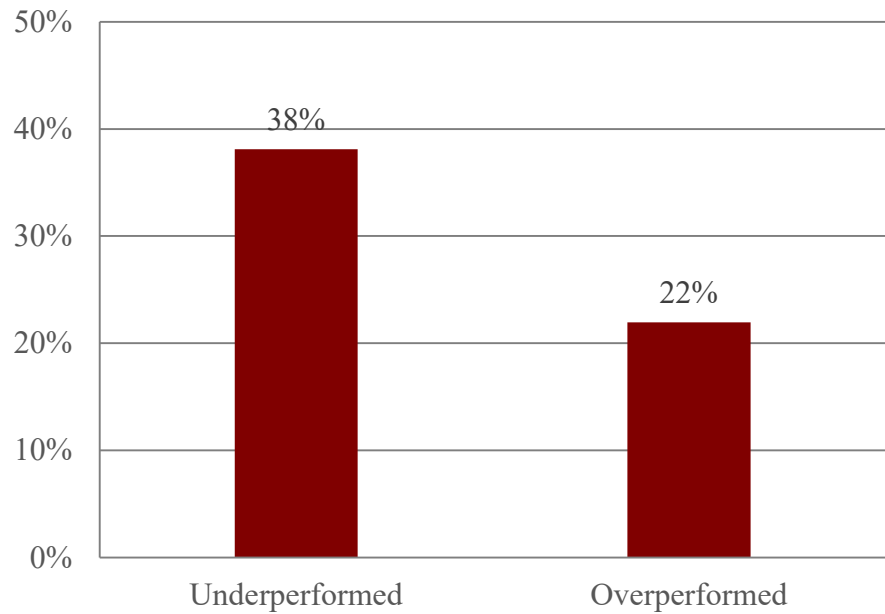
Distribution of the Gap between Portfolio Performance and Benchmark from 2002-2016



Source: Jean-Pierre Aubry and Caroline V. Crawford. "How Do Fees Affect Plans' Ability to Beat Their Benchmarks?" State and Local Plans Issue in Brief 61. Chestnut Hill, MA: Center for Retirement Research at Boston College.

# Plans that fell short of their benchmark were more likely to be bottom-quartile plans.

Percentage of Plans that Were in the Bottom Quartile, by Performance Relative to Benchmark

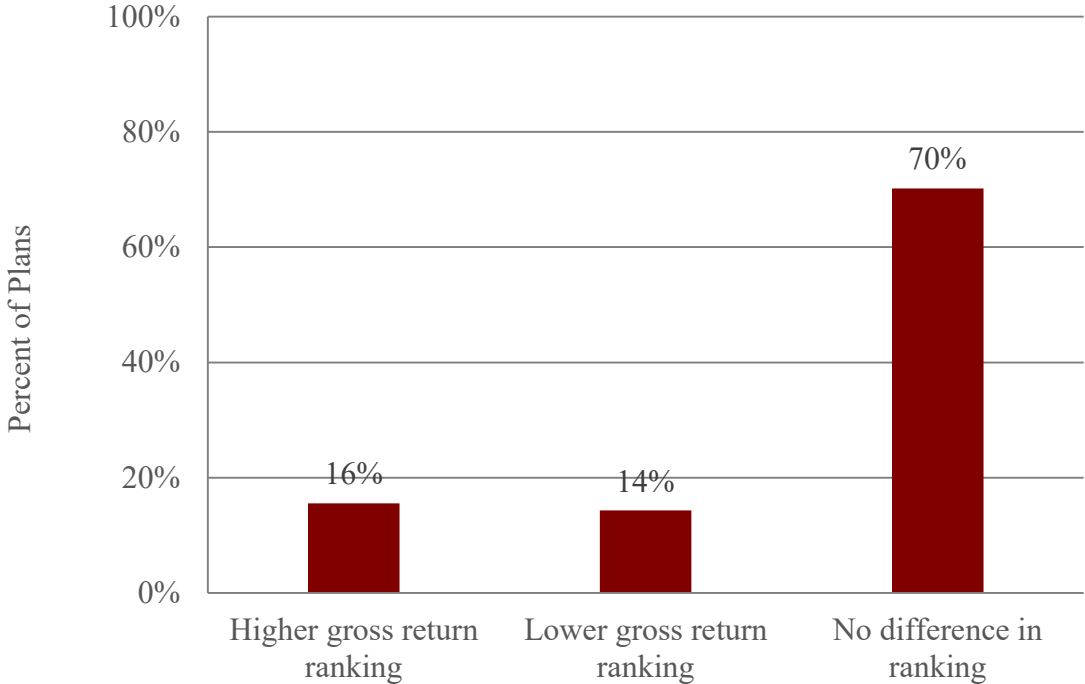


Source: Author's calculations using the *Public Plans Database* (2001-2016).

# What about fees?

# The data suggest that fees have a limited role in the relative performance of plans.

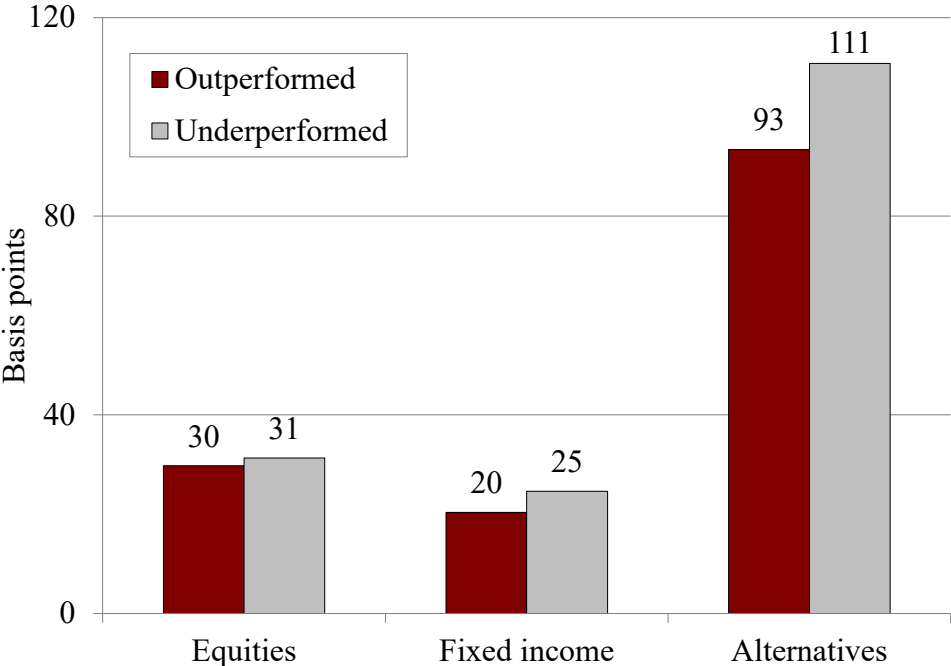
Quartile Ranking by Gross Returns Compared to Quartile Ranking by Net-of-fee Returns



Source: Author's calculations using the *Public Plans Database* (2001-2016).

# Plans that fell short of their benchmark did pay higher fees across all asset classes.

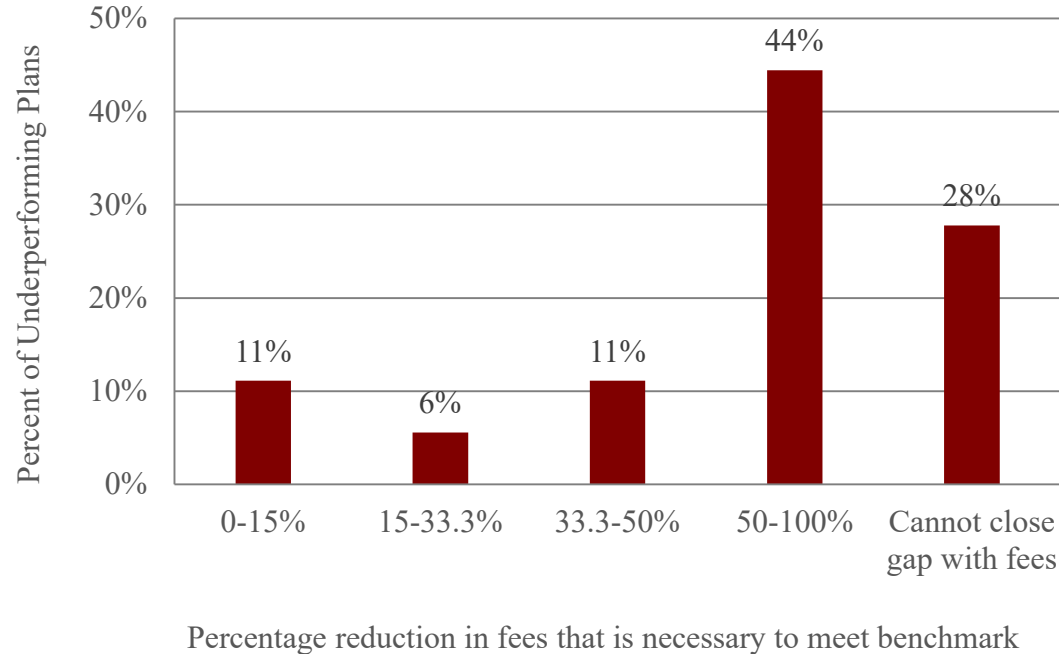
Average Expense Ratios from 2011-2016, by Plan Performance Relative to Benchmark



Source: Jean-Pierre Aubry and Caroline V. Crawford. “How Do Fees Affect Plans’ Ability to Beat Their Benchmarks?” State and Local Plans Issue in Brief 61. Chestnut Hill, MA: Center for Retirement Research at Boston College.

# But dramatic fee cuts would have been required to help most underperformers meet their benchmark.

Percentage Reduction in Fees Required to Achieve Benchmark Returns



Source: Author's calculations using the *Public Plans Database* (2001-2016).

# Conclusion

- The observed differences in long-term investment performance among plans are meaningful.
- For most, the difference is due to asset class returns. But, for the worst-performing plans, allocation to hedge funds and commodities has played a role.
- While most plans outperform their benchmarks, plans that underperformed were more likely to have bottom-quartile investment returns.
- Plans that underperformed their benchmark also paid higher fees (although, in many cases, moderate fee reduction would not have resulted in outperformance of their benchmark).

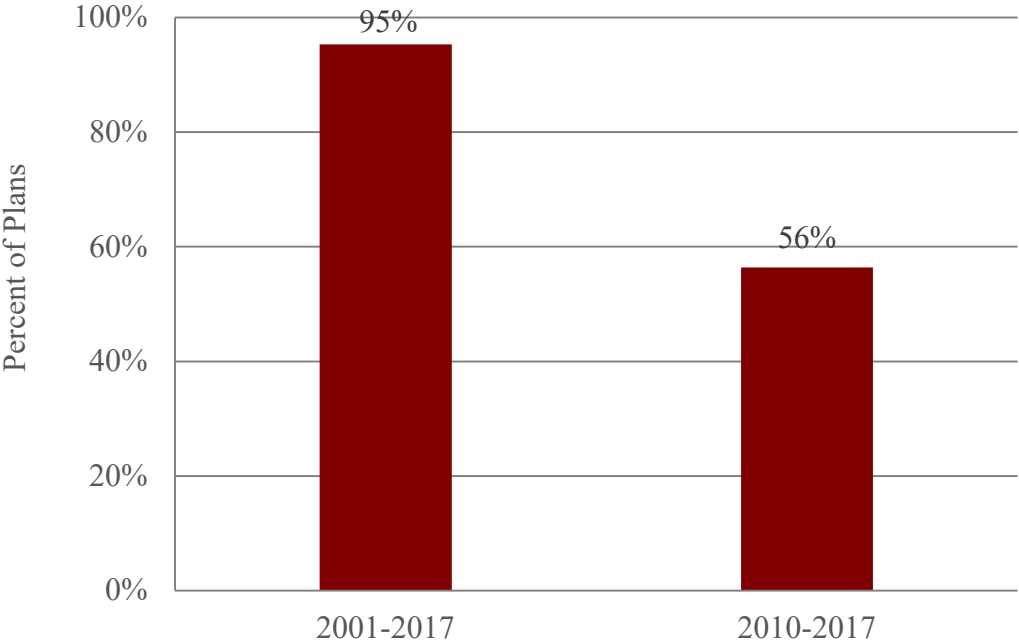
# Appendix

1. A simpler allocation: 60% Wilshire 5000 + 40% Barclay's
2. Use of leverage by public pension plans
3. Fair value of investments
4. Unfunded commitments to alternative investment funds



# The benefits of a simpler investment approach depend on the period in question.

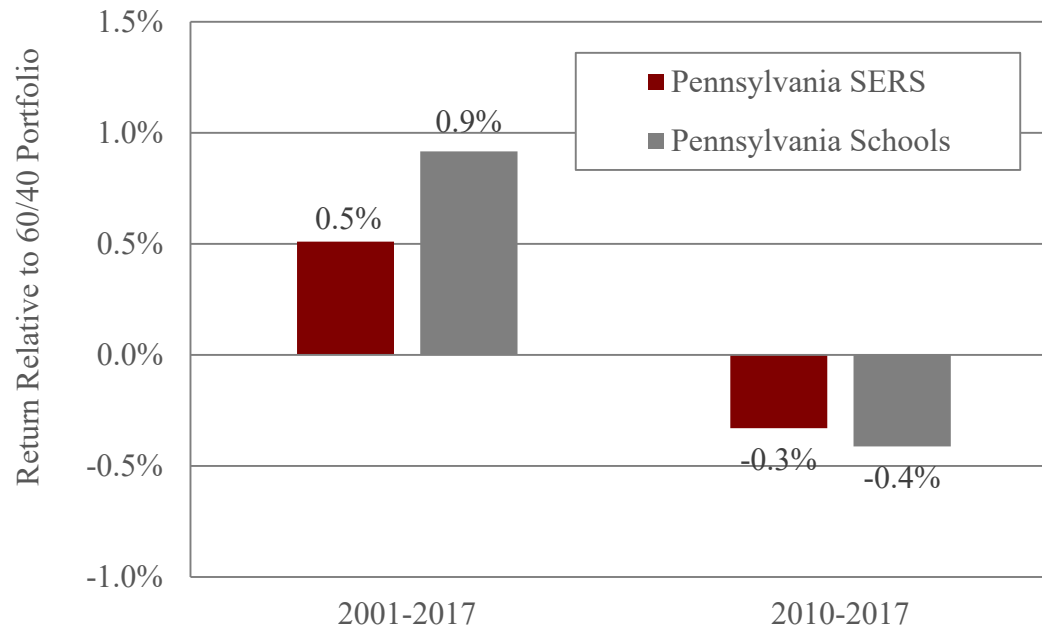
Percentage of Plans that Outperformed a Simple 60/40 Stock/Bond Portfolio



Source: Public Plans Database (2001-2016).

# SERS and PSERS have underperformed a simpler portfolio recently, but outperformed over the long-term.

Plan Returns Relative to a Simple 60/40 Stock/Bond Portfolio



Source: Author's calculations using the *Public Plans Database* (2001-2016), Dow Jones Wilshire 5000, and Barclays US Aggregate Bond Index.

# The explicit use of leverage is rare among public plans.

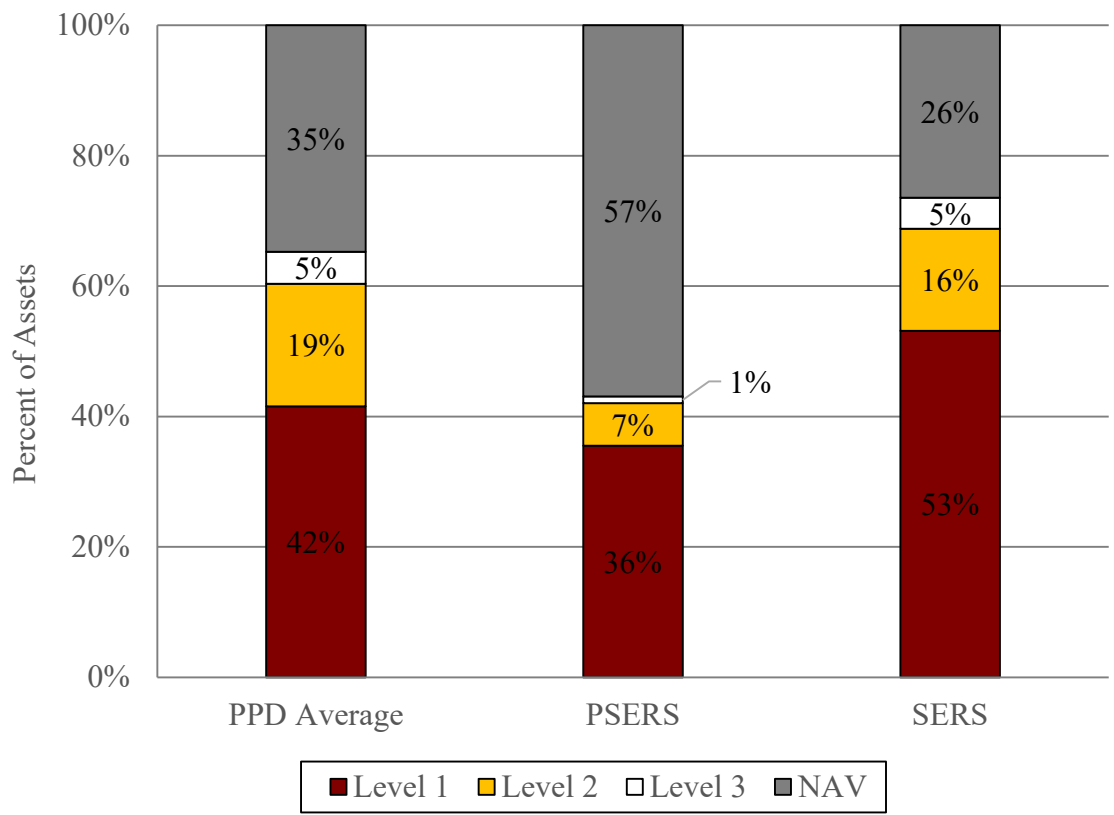
## Major State and Local Plans that Report an Explicit Use of Leverage, 2017

Plan Name	Type of Leverage	Percentage of Portfolio That is Levered
Massachusetts SRS	Uses leverage for real estate investments	1.7%
Massachusetts Teachers	Uses leverage for real estate investments	1.7%
Missouri State Employees	Uses leverage to achieve a beta balanced portfolio	52.1%
Ohio Police & Fire	Policy to leverage fixed income portfolio 2x	20.0%
San Francisco City & County	Uses leverage for real estate investments	0.0%
Virginia RS	Uses leverage in its real assets portfolio	3.6%
Wisconsin RS	Policy to leverage in fixed income portfolio	10.0%
Sacramento County ERS	Uses leverage for real assets portfolio	0.8%
San Diego City ERS	Uses leverage for real estate investments	1.8%
Pennsylvania PSERS	Uses leverage in fixed income portfolio	17.30%

Source: Author's calculations using the *Public Plans Database* (2001-2016).

# The majority of pension plan assets are classified as Level 1 and/or valued at NAV.

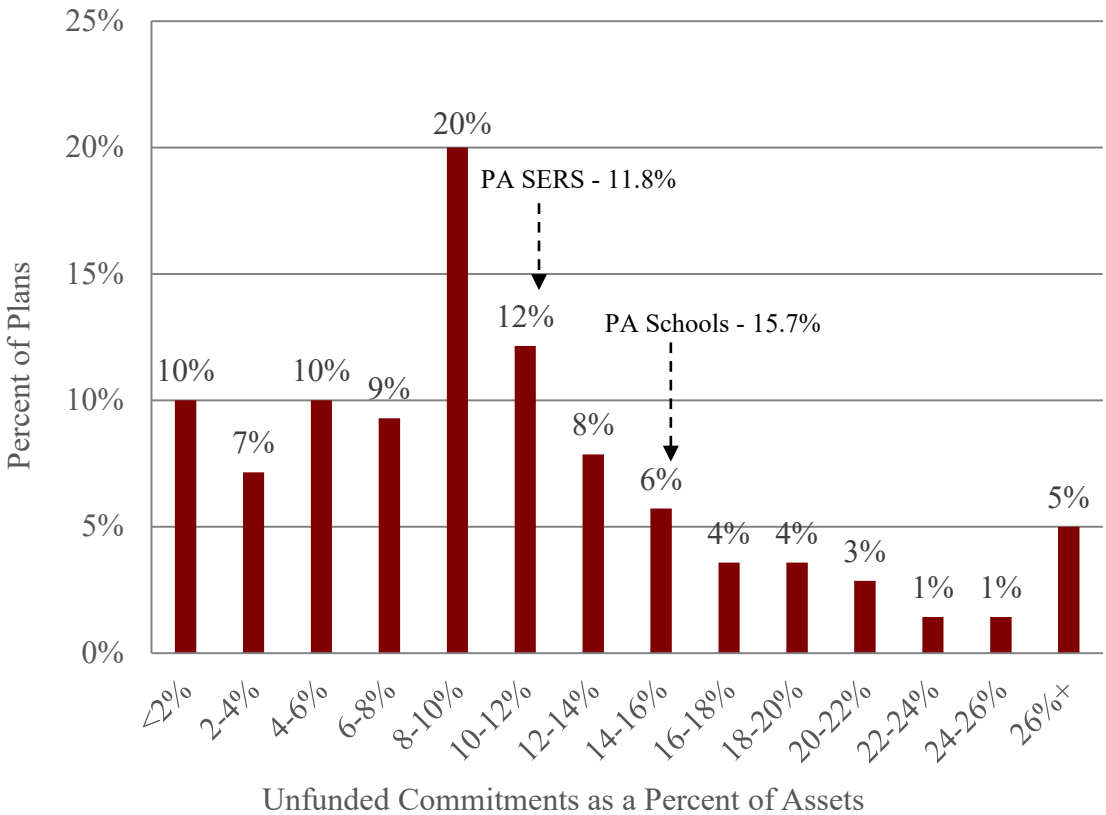
Percent of Assets, by Fair Value Measurement, 2017



Source: Author's calculations using the *Public Plans Database* (2001-2016).

# Future capital calls may limit the investment flexibility of plans.

Distribution of Plans by Unfunded Commitments as a Percent of Assets, 2017



Source: Author's calculations using the *Public Plans Database* (2001-2016).



**BOSTON COLLEGE**  
THE CENTER FOR RETIREMENT RESEARCH

Testimony of Jean-Pierre Aubry  
Director of State and Local Research  
Center for Retirement Research

Submitted for the Record

Hearing of the Public Pension Management & Asset Investment Review Commission  
“A Summary of CRR Research on Public Pension Investments”

September 20, 2018



## BOSTON COLLEGE

THE CENTER FOR RETIREMENT RESEARCH

Distinguished Members of the Commission,

Thank you for allowing me to speak today about the recent research completed by me and my colleagues at the Center for Retirement Research at Boston College (CRR). It is my sincere hope that the research will further inform the pension discourse in the Commonwealth.

My presentation today will summarize the results of two recent CRR briefs focused on public pension investment performance broadly. Assessments of Pennsylvania State Employees Retirement System (SERS) or Public School Employees Retirement System (PSERS) will be limited to high-level comparisons of SERS and PSERS to a broad universe of public pension plans. For those interested in making comparisons that are more detailed, the CRR has released a beta version of its [Public Pension Investment Comparison Tool](http://crr.bc.edu/special-projects/public-plans-investment-comparison-tool-beta/) (<http://crr.bc.edu/special-projects/public-plans-investment-comparison-tool-beta/>). Currently, the tool allows users to compare a single plan's asset allocation and performance (for the total portfolio and individual asset classes) to a broad universe of plans or a selected sub-group of plans.

Below are links to the two briefs that I will be discussing today, with bullets of the key takeaways. Broadly, the briefs assessed plan performance in two ways – by comparing the long-term returns across plans and by comparing the long-term returns of plans to their own benchmarks. Both approaches found that alternative investments have had a meaningful, and mostly negative, impact on performance.

### [What Explains Differences in Public Pension Returns Since 2001?](http://crr.bc.edu/briefs/what-explains-differences-in-public-pension-returns-since-2001/)

(<http://crr.bc.edu/briefs/what-explains-differences-in-public-pension-returns-since-2001/>)

- Average investment returns for state and local pension plans varied over 2001-2016 from 6.3 percent for the top quartile to 4.6 percent for the bottom.
- The observed variation in returns accounts for much of the difference in today's funded levels.
- The analysis found that asset allocation – in equities, fixed income, and alternatives – was broadly similar across plans, while asset class returns showed more variation.
- Therefore, asset class returns – not allocation – turned out to be the primary reason for the disparities in overall returns.
- However, allocation played some role for the worst performing plans: in the wake of the 2008-2009 financial, they made a dramatic shift out of equities and into alternatives – specifically, hedge funds and commodities – during a period when these asset classes underperformed others.



**BOSTON COLLEGE**  
THE CENTER FOR RETIREMENT RESEARCH

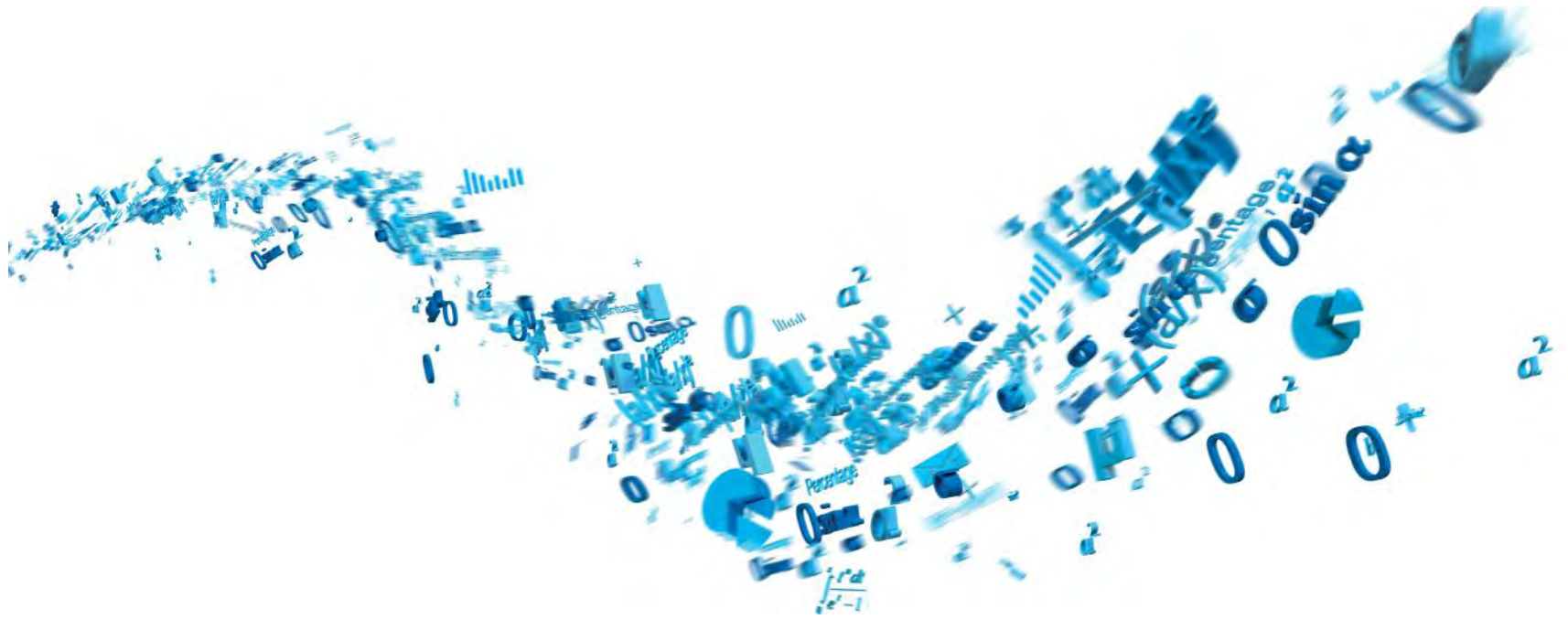
[How Do Fees Affect Plans' Ability to Beat Their Benchmarks?](http://crr.bc.edu/briefs/how-do-fees-affect-plans-ability-to-beat-their-benchmarks/)

(<http://crr.bc.edu/briefs/how-do-fees-affect-plans-ability-to-beat-their-benchmarks/>)

- One way that public pension plans assess their investment performance is to compare returns by asset class to selected benchmarks.
- Plans pay fees to external asset managers with the expectation that they will exceed the benchmarks.
- As these fees have come under greater scrutiny, the question is whether higher fees help plans outperform their benchmarks.
- The analysis, using new data for 2011-2016, found that plans that paid higher fees experienced worse performance relative to their benchmarks.
- This finding held across all major asset classes, but was particularly pronounced for alternative assets, such as private equity and hedge funds.

The research briefs described above rely on data from the [Public Plans Database \(PPD\)](http://publicplansdata.org/) (<http://publicplansdata.org/>). The PPD is a comprehensive database containing data from 2001 to 2017 on the actuarial funded levels, pension fund cash flows, investments, and membership of 180 major state and local pension plans – making up over 95 percent of all state and local pension assets and members. Importantly for members of this commission, the PPD contains detailed data – sourced mostly from plan CAFRs – on asset allocation, target allocation, returns by asset class, and benchmark returns for each asset class. I hope that Commission members will consider the PPD a resource as they continue their deliberations.





# Public Pension Management & Asset Investment Review Commission (PPMAIRC)

September 20, 2018

Investment advice and consulting services provided by Aon Hewitt Investment Consulting, Inc., an Aon Company.

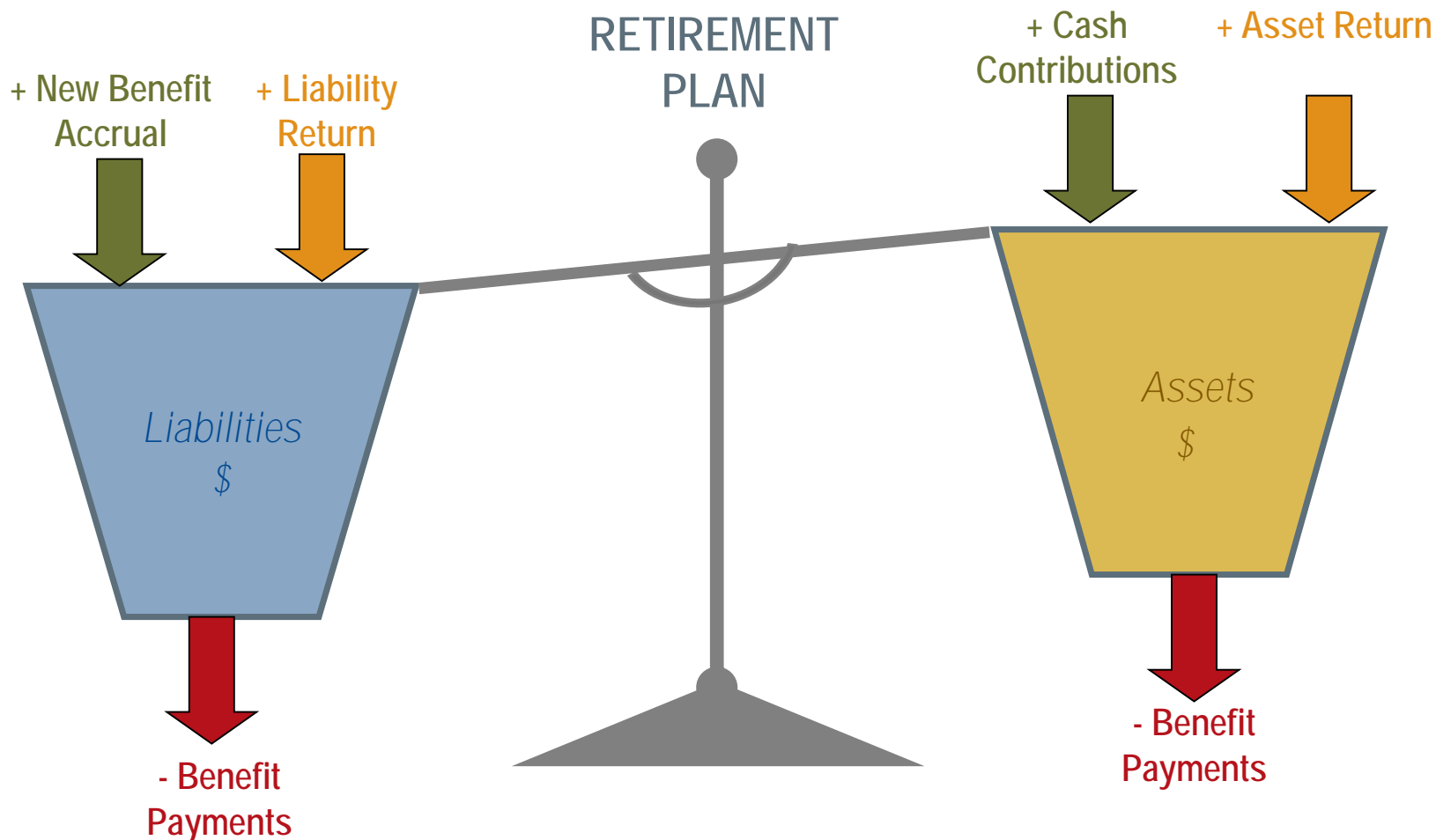
Nothing in this document should be construed as legal or investment advice. Please consult with your independent professional for any such advice.

To protect the proprietary information included in this material, it may not be disclosed or provided to any third parties without the approval of Aon.



# Pension Accounting

## Balance of Liabilities and Assets

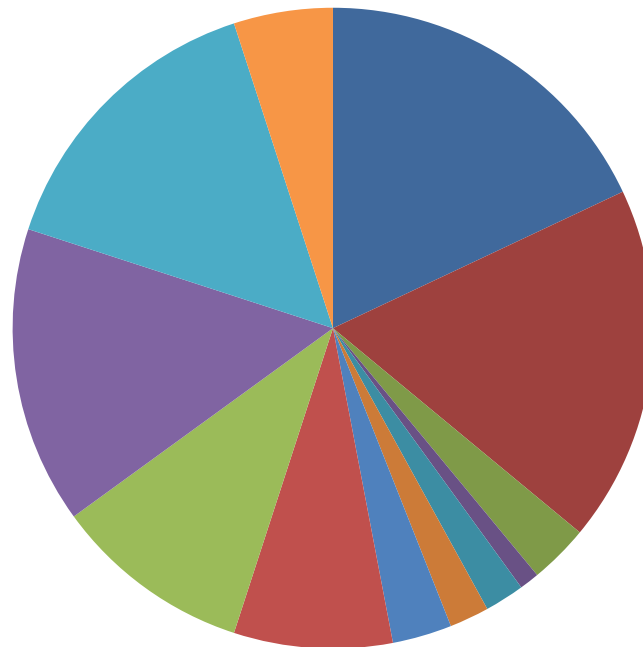


**Bottom Line: Benefit Payments = Contributions + Investment Return**

For illustrative purposes only

## What is Asset Allocation?

Asset allocation refers to the implementation of an investment strategy that seeks to balance reward (investment return) and risk (investment loss) by mixing various assets based on investor's risk profile and return goal

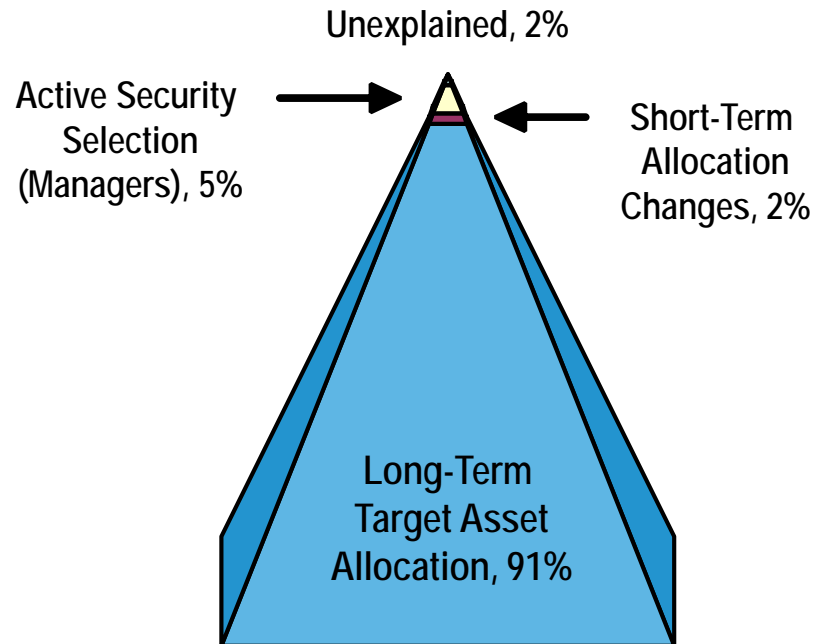


- U.S. Equity
- Int'l Equity
- High Yield Bonds / Bank Loans
- Non-US Developed Bonds
- Emerging Market Debt
- US Infrastructure
- Commodities
- Hedge Funds
- Real Estate
- Private Equity
- U.S. Fixed Income
- Inflation Protected

For illustrative purposes only

# Asset Allocation—The Most Important Decision

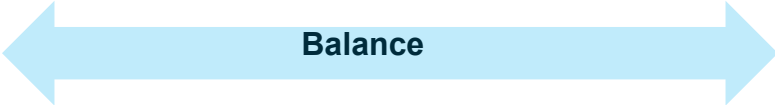
---



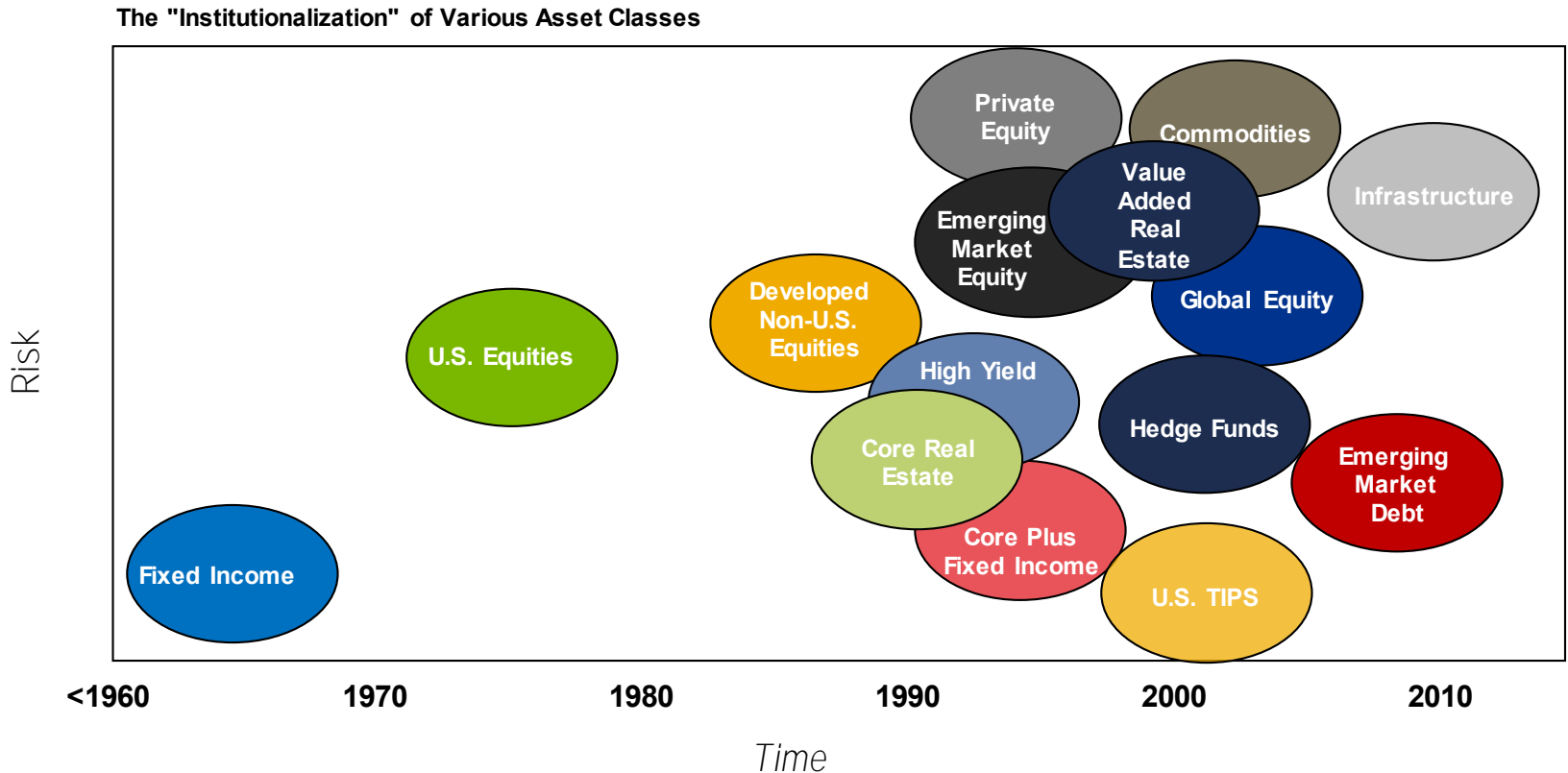
Asset allocation is the most important investment decision as it explains more than 90% of investment return

Source: Brinson, Singer and Beebower, "Determinants of Portfolio Performance II: An Update" 1991.

# Factors Driving Asset Allocation Implementation

Factor	Range of Investor Circumstances for Factor			
<p><b>Governance</b></p> <ul style="list-style-type: none"> <li>▪ Oversight resources</li> <li>▪ Speed of action</li> <li>▪ Tolerance for higher cost</li> </ul>	<b>Strategic</b>	<ul style="list-style-type: none"> <li>▪ More strategic investing</li> <li>▪ Greater reliance on market risk</li> <li>▪ Less alternatives</li> </ul>	<b>Flexible</b>	<ul style="list-style-type: none"> <li>▪ More opportunistic investing</li> <li>▪ Greater reliance on active risk</li> <li>▪ More alternatives</li> </ul>
<p><b>Time Horizon</b></p> <ul style="list-style-type: none"> <li>▪ Life span</li> <li>▪ Cash flow position</li> <li>▪ Tolerance for illiquidity</li> </ul>	<b>Short</b>	<ul style="list-style-type: none"> <li>▪ No illiquid alternatives</li> <li>▪ Diversification over return-seeking</li> </ul>	<b>Long</b>	<ul style="list-style-type: none"> <li>▪ Most illiquid alternatives</li> <li>▪ Return-seeking over diversification</li> </ul>
<p><b>Portfolio Size</b></p> <ul style="list-style-type: none"> <li>▪ Ability to diversify across strategies</li> <li>▪ Market impact of trades</li> <li>▪ Potential for closet indexing</li> </ul>	<b>Small</b>	<ul style="list-style-type: none"> <li>▪ Less alternatives</li> <li>▪ Greater reliance on market risk</li> </ul>	<b>Large</b>	<ul style="list-style-type: none"> <li>▪ More alternatives</li> <li>▪ Greater reliance on active risk</li> </ul>
<p><b>Investor Type</b></p>	<b>Efficiency</b>			<b>Opportunity</b>

# The Evolution of Institutional Investors' Asset Allocation



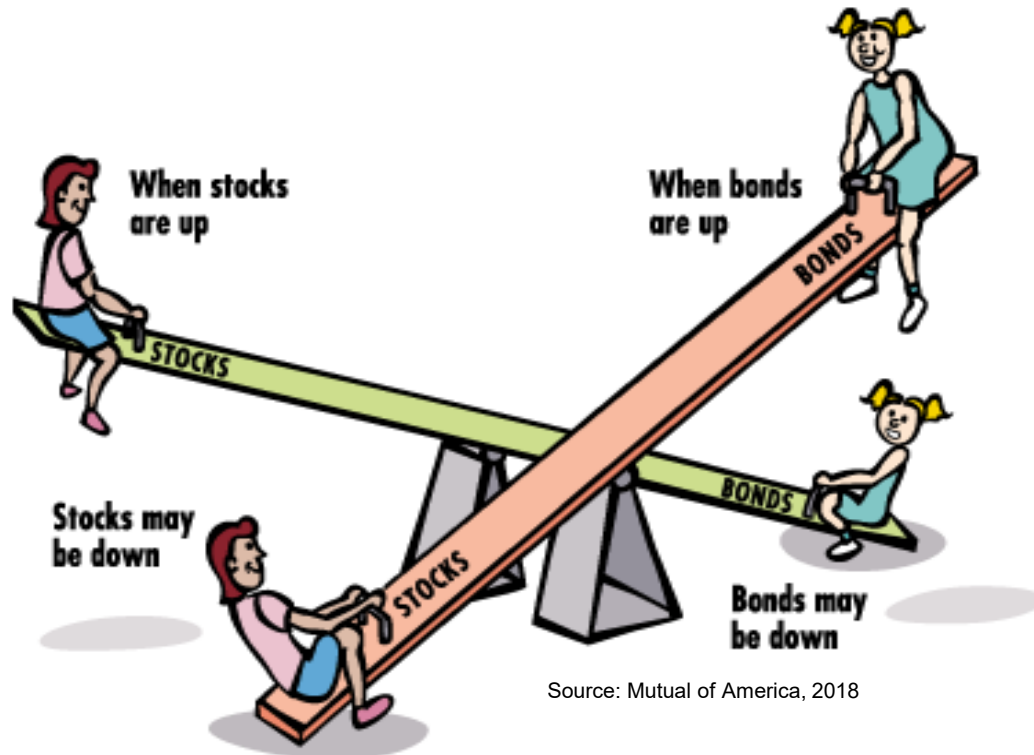
- The asset allocation of institutional investors has and likely will continue to evolve over time.

\*The chart provided above is for illustrative purposes based on AHIC's experience working with Institutional investors

# Diversification

*Diversification is a requirement in the definition of prudent fiduciary investing*

- Diversified portfolios are meant to reduce risk while maintaining an expected return
- All asset classes do not produce the same results in a particular economic environment
- An optimization analysis is used to determine optimal portfolios or mixes of assets depending on an investors' risk tolerance



Diversification does not ensure a profit nor does it protect against loss of principal. Diversification among investment options and asset classes may help to reduce overall volatility.

Investment advice and consulting services provided by Aon Hewitt Investment Consulting, Inc., an Aon Company.

## Diversification Example

*Diversification usually reduces volatility and, under certain conditions, can help increase returns*

### Example – Investor Starts with \$100

	Year 1 Return	Year 2 Return	Cumulative Return
Investment A: %	20.00%	-10.00%	8.00%
Investment A: \$	$\$100 \times 1.2 = \$120$	$\$120 \times 0.9 = \$108$	Final: \$108
Investment B: %	-10.00%	20.00%	8.00%
Investment B: \$	$\$100 \times 0.9 = \$90$	$\$90 \times 1.2 = \$108$	Final: \$108
50/50 Portfolio: %	5.00%	5.00%	10.25%
50/50 Portfolio: \$	$\$100 \times 1.05 = \$105$	$\$105 \times 1.05 = \$110.25$	Final: \$110.25

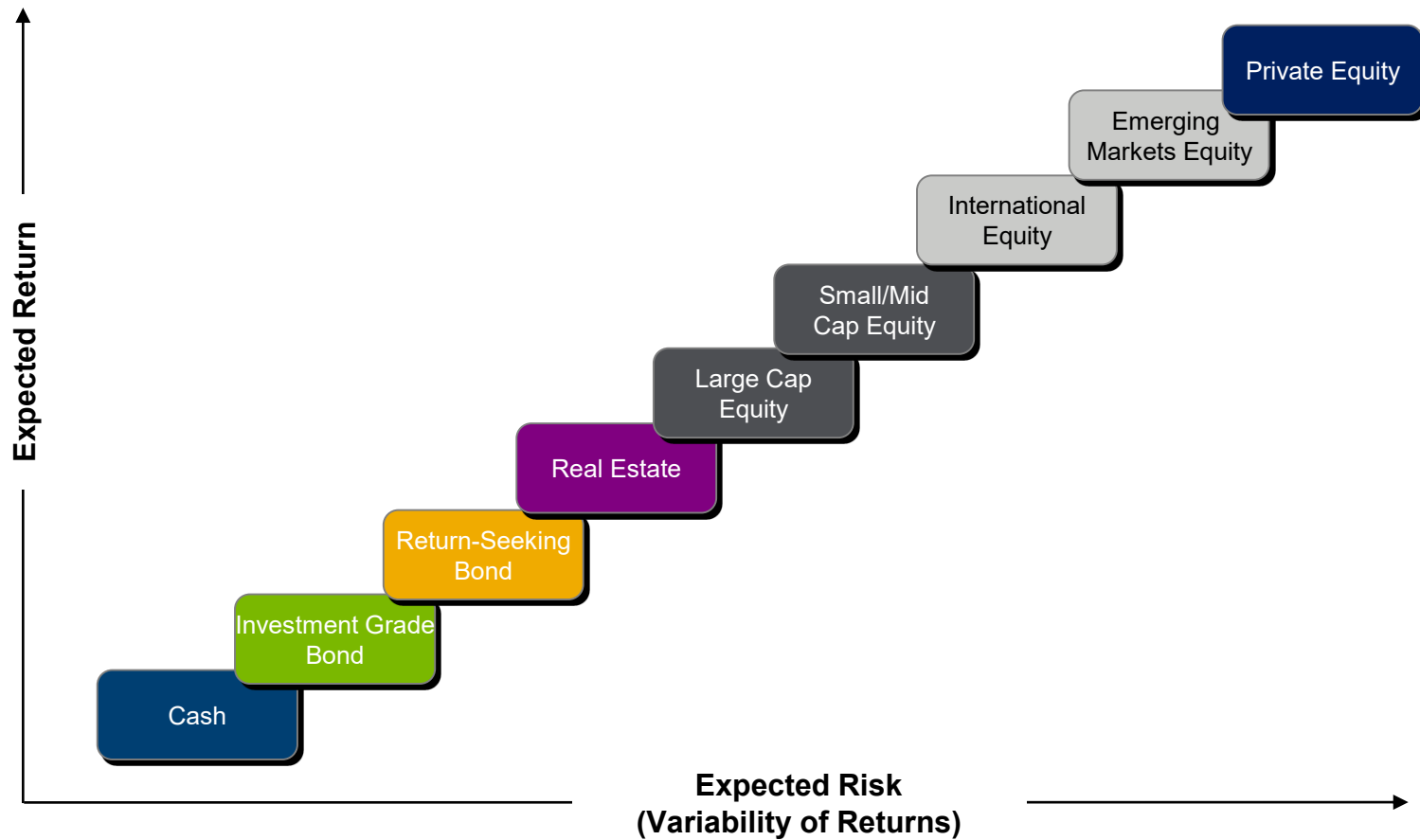
- This example makes the following assumptions to reach its conclusions:
  - Perfect negative correlation between stocks and bonds
  - Rebalancing at the end of Year 1
  - No cash inflows or outflows

Diversification does not ensure a profit nor does it protect against loss of principal. Diversification among investment options and asset classes may help to reduce overall volatility.

Investment advice and consulting services provided by Aon Hewitt Investment Consulting, Inc., an Aon Company.



# Risk-Return Spectrum (Illustrative)



For illustrative purposes only

## Benchmarking: Purposes & Types

---

- Benchmarks are used to measure the performance of the Total Fund, asset classes, and individual managers over various time periods and across methodologies to determine the effectiveness of implementation of an investment program
- We believe benchmarks are **essential to good governance**
- There are many types of benchmarks that can be used to analyze relative performance of an investment
  - Broad market (MSCI ACWI IMI Index)
  - Style-specific (S&P 500 Value Index)
  - Risk adjusted returns (vs. benchmark Sharpe ratio)
  - Absolute return metric (i.e. 7% return target)
  - Real return target (i.e. CPI + 3%)
  - Peer universe (i.e. Public Funds >\$1 billion)
- Careful attention should be paid to appropriateness when selecting the benchmark for a given asset class, manager, or strategy

## Characteristics of a Good Benchmark: SAMURAI<sup>1,2</sup>

---

- ***Specified in advance***: the benchmark is specified prior to the start of an evaluation period and known to all interested parties
- ***Appropriate***: the benchmark is consistent with the manager's investment style or area of expertise
- ***Measurable***: the benchmark's return is readily calculable on a reasonably frequent basis
- ***Unambiguous***: the identities and weights of securities constituting the benchmark are clearly defined
- ***Reflective*** of current investment opinions: the manager has current knowledge of the securities or factor exposures within the benchmark
- ***Accountable***: the manager is aware of and accepts accountability for the constituents and performance of the benchmark
- ***Investable***: it is possible to forgo active management and simply hold the benchmark

<sup>1</sup> As per CFA Institute's **SAMURAI** characteristics. The criteria commonly referenced as industry standard is based on research conducted by Jeffrey Bailey and others. Mr. Bailey published an initial paper titled "Are Manager Universes Acceptable Performance Benchmarks?" in the May-June, 1992, edition of the *Financial Analysts Journal*.

<sup>2</sup> The criteria listed above are more easily fulfilled for publicly traded, more liquid asset classes. Good benchmarks exist for private markets but they are more challenging to identify.

# Private Market Benchmarking

Asset Class	Most Commonly Used Benchmark	Alternative Benchmark
Private Equity	Broad Public Market Index <sup>1</sup> + Premium (Longer Time Periods) OR Peer Universe (Shorter Time Periods)	--
Core Real Estate	NCREIF ODCE	--
Non-Core Real Estate	NCREIF ODCE + Premium	Peer Universe
Hedge Funds	HFR Suite of Indices	CPI + Premium or Absolute Return

- Benchmarking private asset classes has challenges (timing, applicability, depth, tracking error, etc.)
- As peer benchmarks in private equity and private real estate become more robust, more plans are moving to adopt, for shorter time periods (~<10 years)

<sup>1</sup>Most plans use the Russell 3000 or MSCI ACWI as the Public Market Index when applying a premium

---

# Q & A

## Legal Disclosures and Disclaimers

---

Investment advice and consulting services provided by Aon Hewitt Investment Consulting, Inc. (“AHIC”). The information contained herein is given as of the date hereof and does not purport to give information as of any other date. The delivery at any time shall not, under any circumstances, create any implication that there has been a change in the information set forth herein since the date hereof or any obligation to update or provide amendments hereto.

This document is not intended to provide, and shall not be relied upon for, accounting, legal or tax advice or investment recommendations. Any accounting, legal, or taxation position described in this presentation is a general statement and shall only be used as a guide. It does not constitute accounting, legal, and tax advice and is based on AHIC’s understanding of current laws and interpretation.

This document is intended for general information purposes only and should not be construed as advice or opinions on any specific facts or circumstances. The comments in this summary are based upon AHIC’s preliminary analysis of publicly available information. The content of this document is made available on an “as is” basis, without warranty of any kind. AHIC disclaims any legal liability to any person or organization for loss or damage caused by or resulting from any reliance placed on that content. AHIC reserves all rights to the content of this document. No part of this document may be reproduced, stored, or transmitted by any means without the express written consent of AHIC.

Indices cannot be invested in directly. Unmanaged index returns do not reflect our fees or expenses.

Aon Hewitt Investment Consulting, Inc. is a federally registered investment advisor with the U.S. Securities and Exchange Commission. AHIC is also registered with the Commodity Futures Trading Commission as a commodity pool operator and a commodity trading advisor, and is a member of the National Futures Association. The AHIC ADV Form Part 2A disclosure statement is available upon written request to:

Aon Hewitt Investment Consulting, Inc.  
200 E. Randolph Street  
Suite 1500  
Chicago, IL 60601  
ATTN: AHIC Compliance Officer

© Aon plc 2018. All rights reserved.

# Index Definitions

---

Benchmark performance is:

- The relevant index for that asset class or sub asset class and is a standard market index, or
  - A custom benchmark representing the benchmarks of the underlying investment strategies equally weighted
  - The individual monthly benchmark returns are compounded to result in the corresponding annualized benchmark returns
  - Unmanaged index returns assume reinvestment of any and all distributions. Performance of the benchmark(s) is not an exact representation of any particular investment, as you cannot invest directly in an index or custom benchmark. All returns for investment advisor strategies and benchmarks are compiled from sources believed to be reliable and current, but accuracy cannot be guaranteed.
- **S&P 500 Value Index.** A capitalization-weighted index representing 500 publicly traded U.S. stocks with lower price-to-book ratios and lower forecasted growth values.
  - **MSCI All Country World Investable Markets Index.** A float-adjusted capitalization-weighted index of stocks across large, mid, and small cap size segments in approximately 46 developed and emerging countries, including the U.S. and Canadian markets.
  - **NCREIF Open End Diversified Core Equity (ODCE) Net Index.** An index of investment returns reporting on both a historical and current basis the results of 33 open-end commingled funds pursuing a core investment strategy, some of which have performance histories dating back to the 1970s. The NFI-ODCE Index is capitalization-weighted and is reported gross of fees. Measurement is time-weighted.
  - **Blended Benchmarks** – A weighted average of the underlying investment managers strategies' benchmarks.

## About Aon

---

Aon plc (NYSE:AON) is a leading global professional services firm providing a broad range of risk, retirement and health solutions. Our 50,000 colleagues in 120 countries empower results for clients by using proprietary data and analytics to deliver insights that reduce volatility and improve performance.

For more information, please visit [aon.com](http://aon.com).





# **Alternative Investment Asset Allocation**

**Prof. Greg Brown**

Kenan-Flagler Business School

UNC Chapel Hill

Presentation for:

Meeting and Hearing of the Pennsylvania Public Pension  
Management & Asset Investment Review Commission

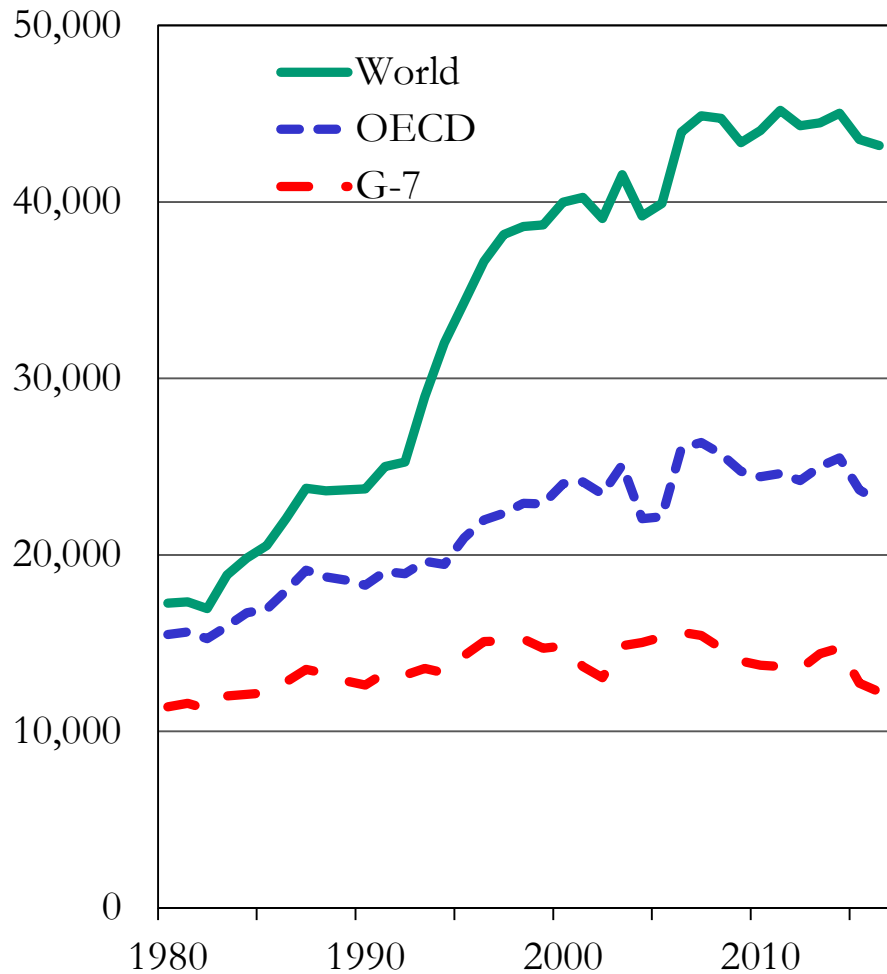
September 20, 2018

# 3 Eras of Modern Capital Market Growth

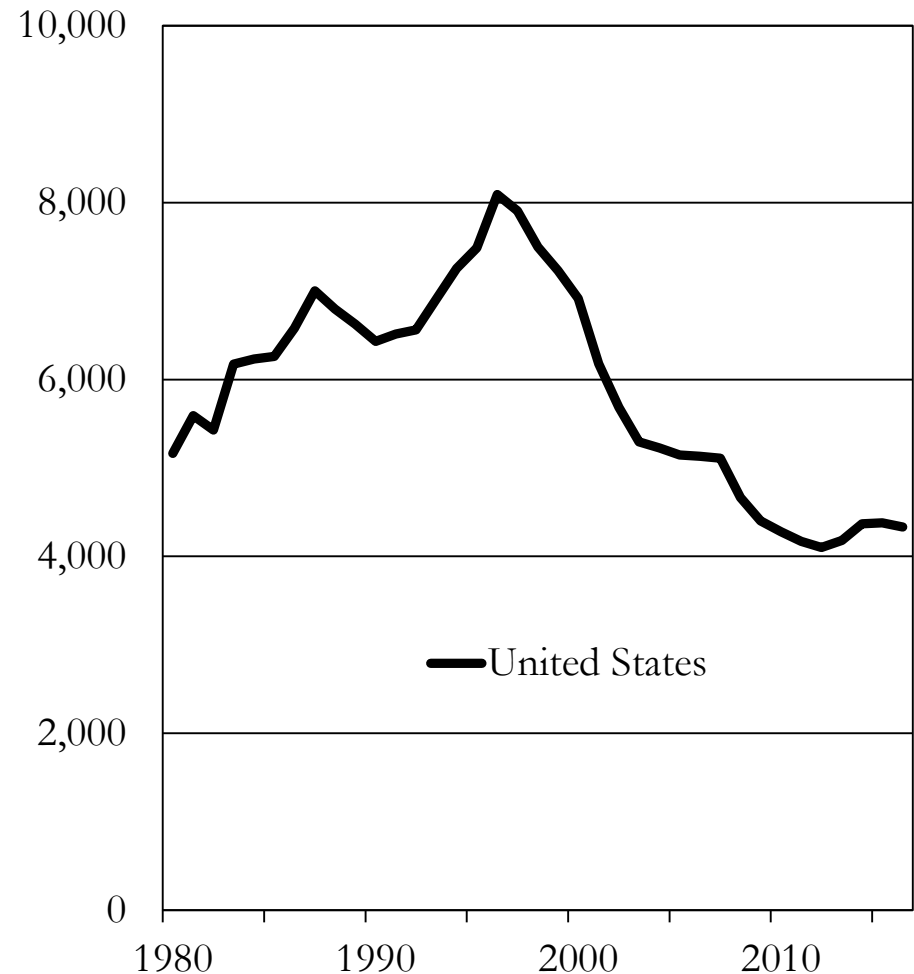
- The “Public Markets Era” (1950-1974)
  - Resurgence of public equity and debt markets after the dark ages of the depression and WW-II
  - Large growth in listings, market cap, and breadth of ownership
- The “Financial Engineering Era” (1975-1995)
  - Advances in derivative pricing theory and market structure lead to exponential growth in exchange-traded and OTC derivatives
  - Notional values of derivatives reach 100s of \$trillions, financial engineering invents technology for unfathomably complicated securities.
- The “Private Markets Era” (1996-present)
  - Institutionalization of private fund market and direct investments
  - Alternatives and the endowment model of investing

# Public Equity Markets

## # of Publicly-listed Companies

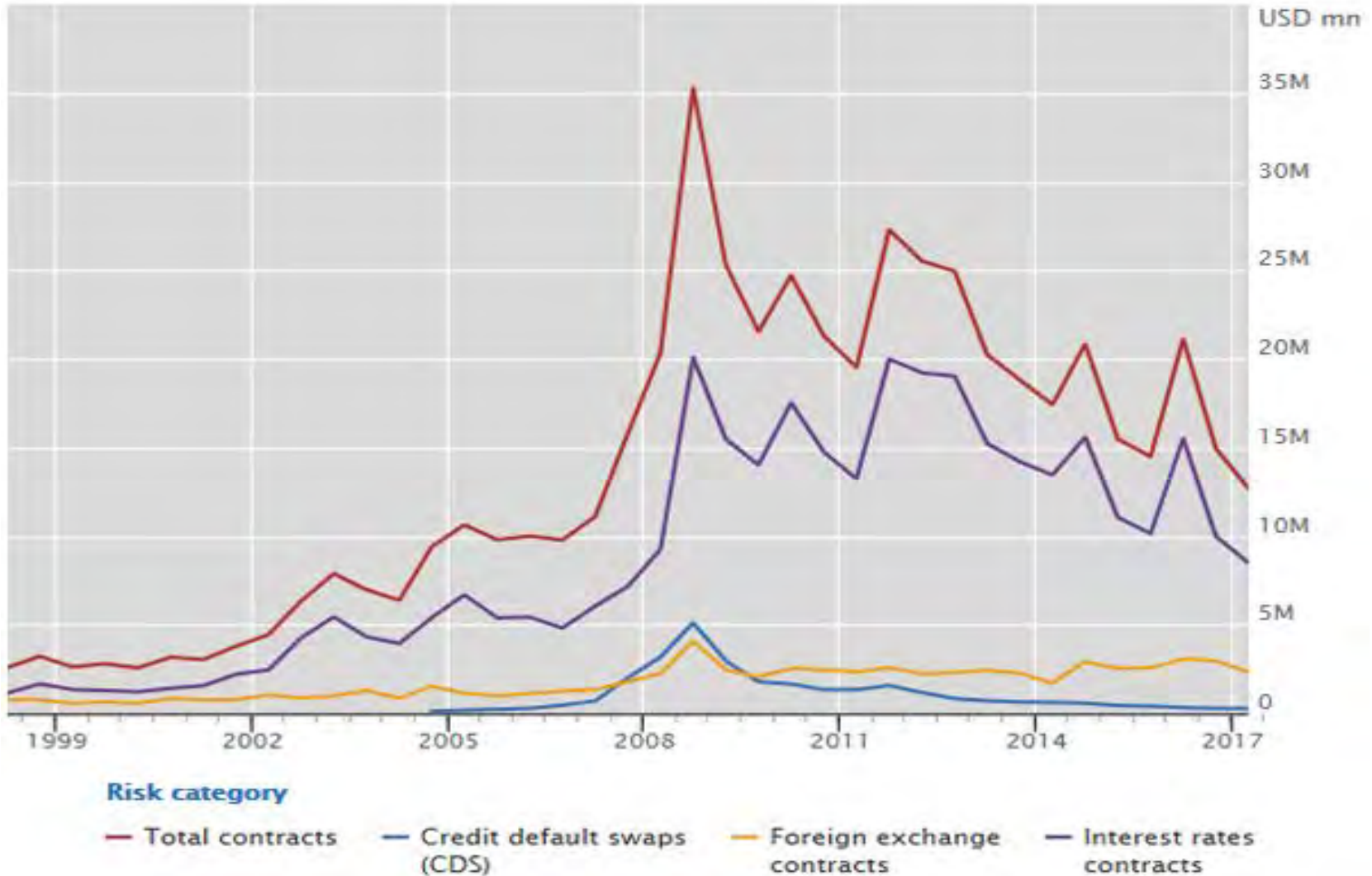


## U.S. Publicly-listed Companies



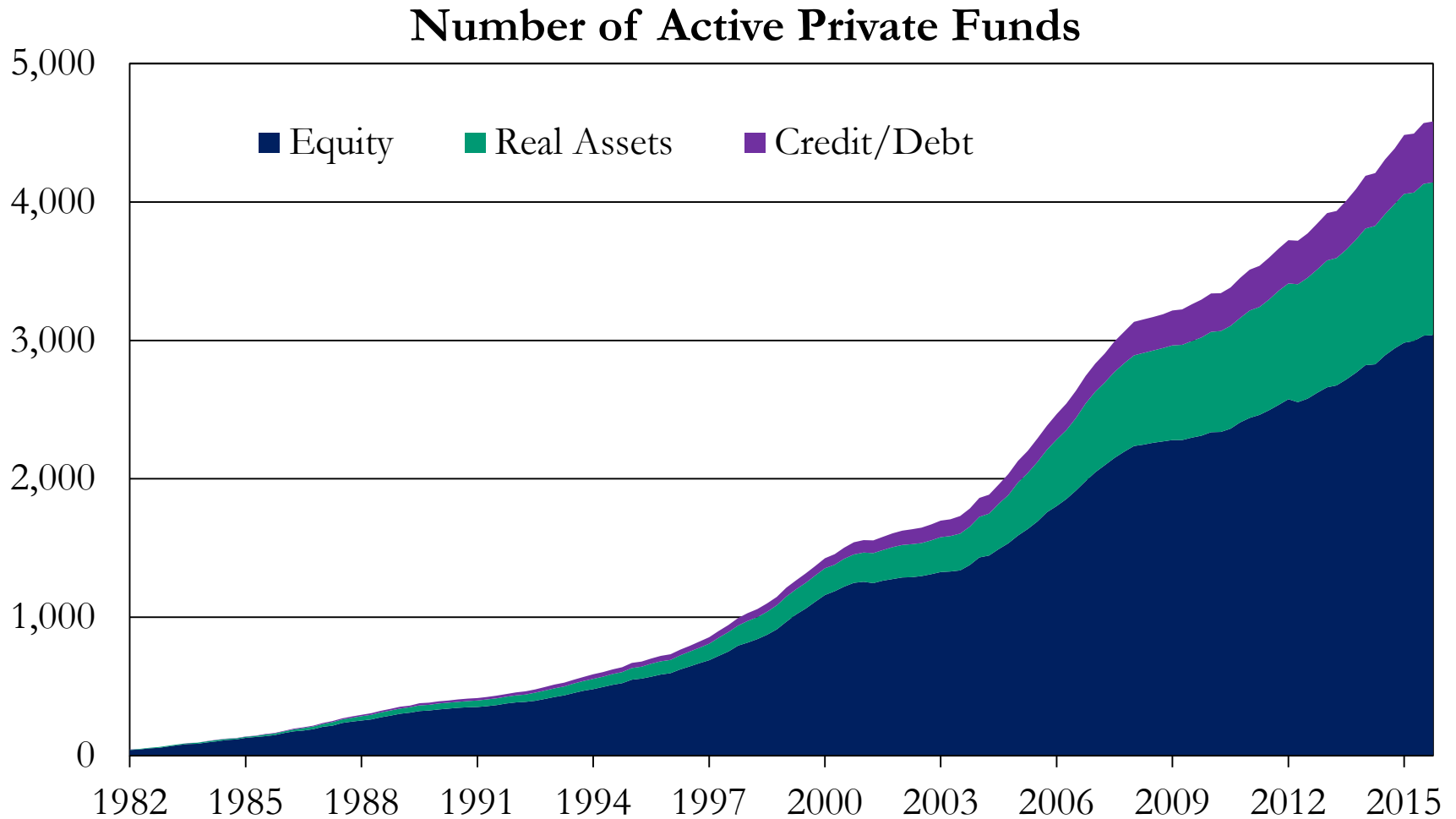
Source: WorldBank

# OTC Derivatives



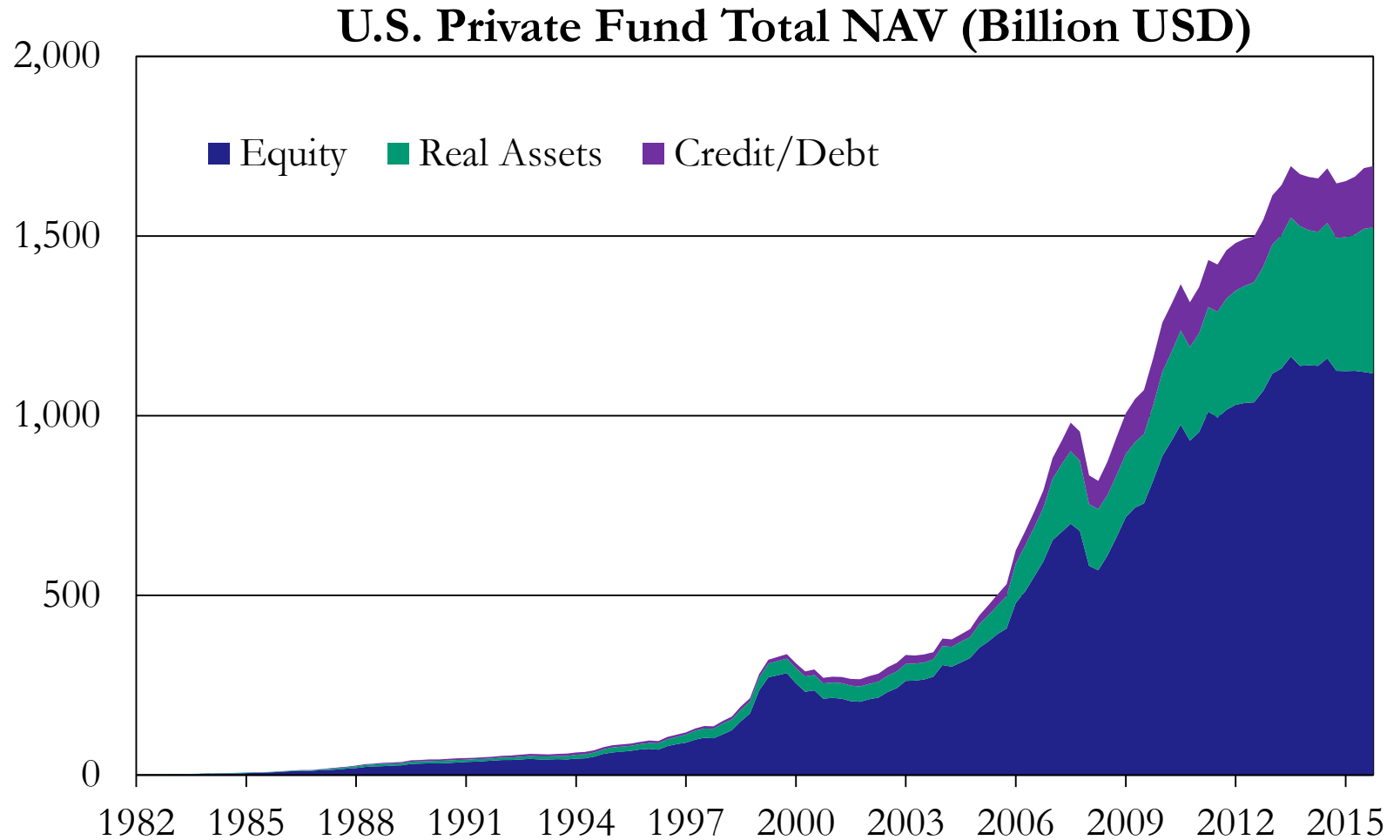
Source: BIS OTC derivatives statistics (Table D5.1).

# Emergence of Private Fund Industry



Source: Burgiss

# Emergence of Private Fund Industry

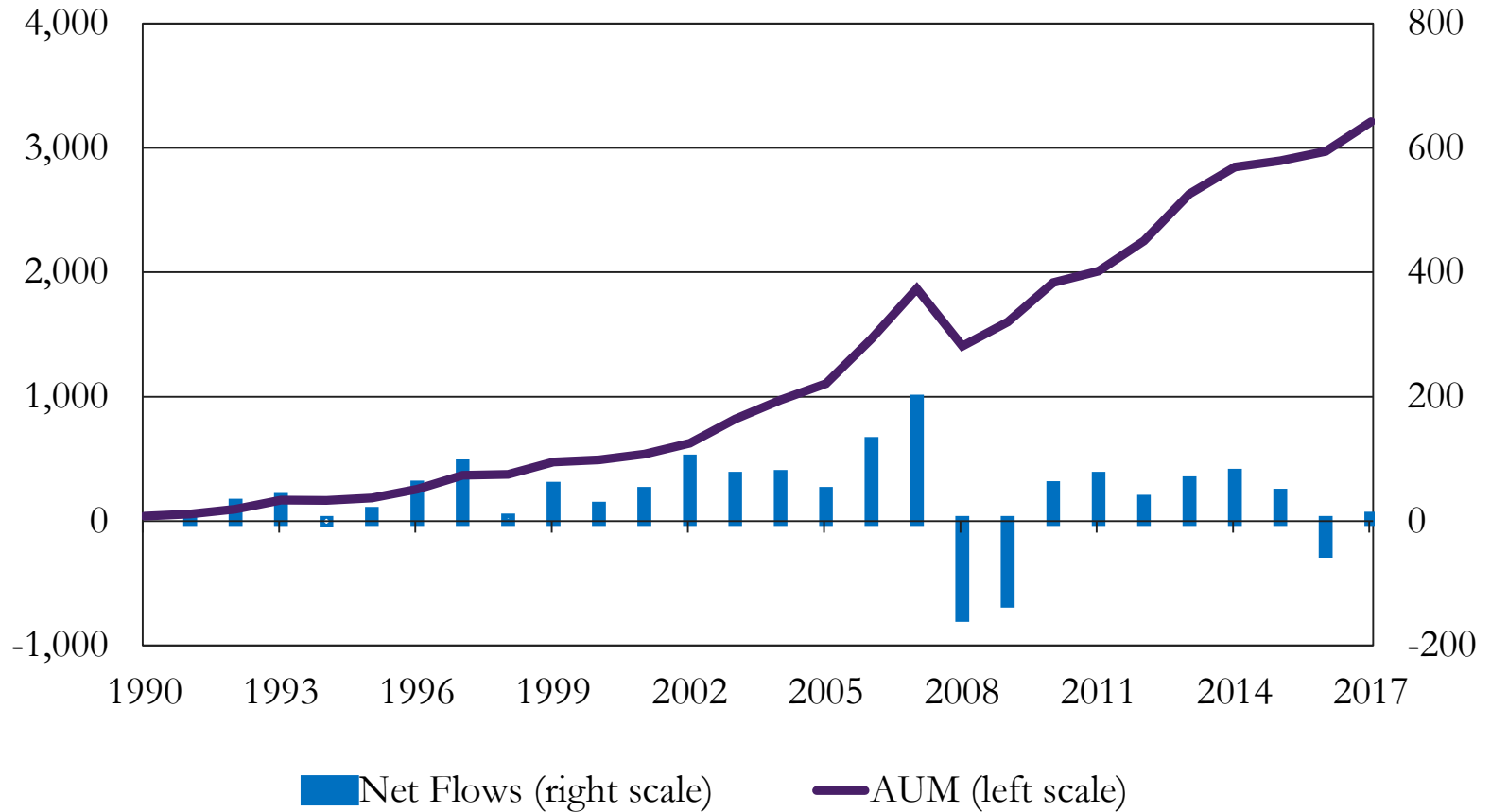


Source: Burgiss



# Hedge Funds

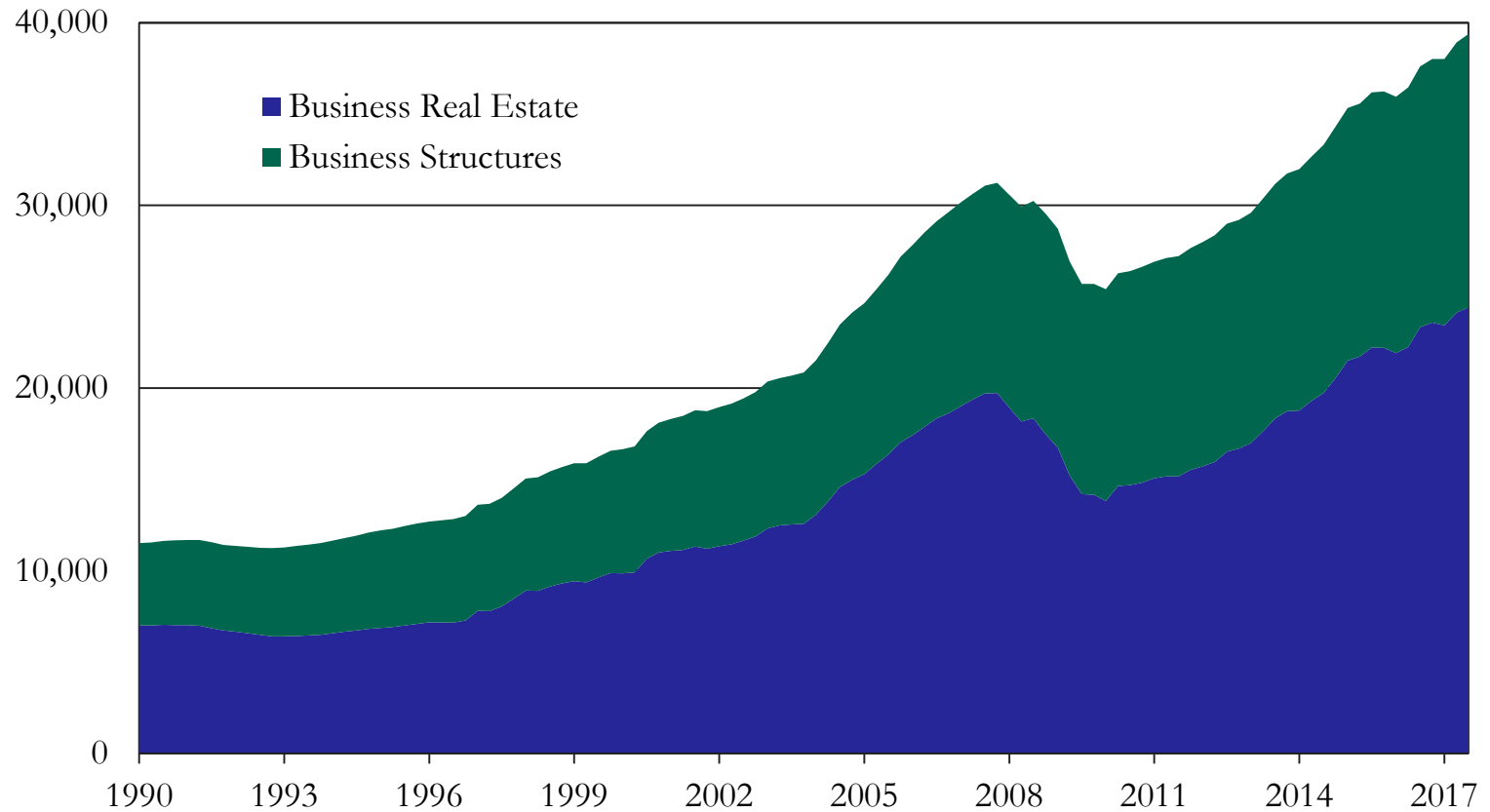
Hedge Fund AUM and Net Flows (USD billions)



Source: HFR 2017 Global Hedge Fund Industry Report

# Commercial Real Estate

Value of Business Real Estate & Structures (USD billions)

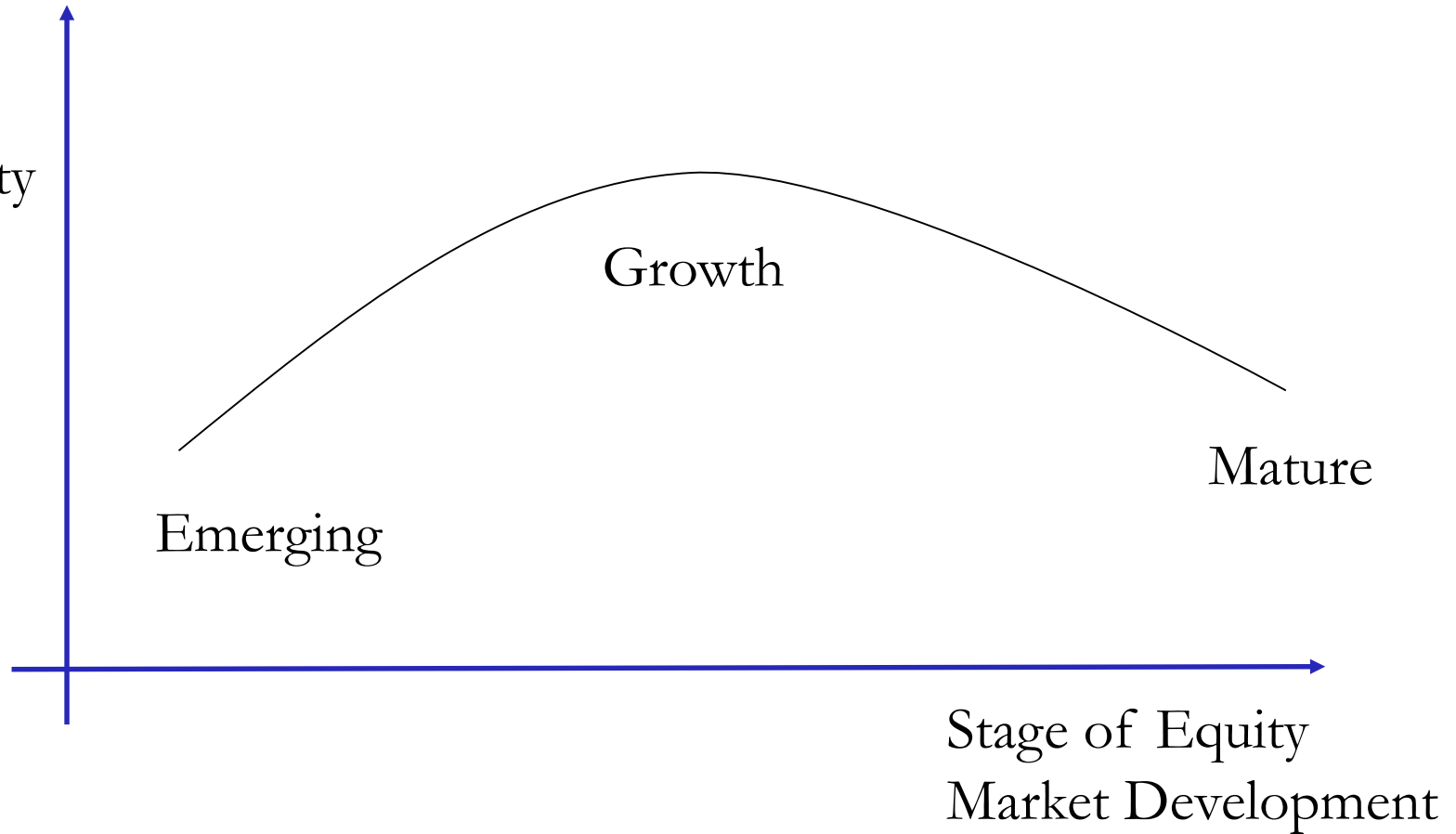


Source: FRB Flow of Funds Balance Sheet Tables B.100-B.103.

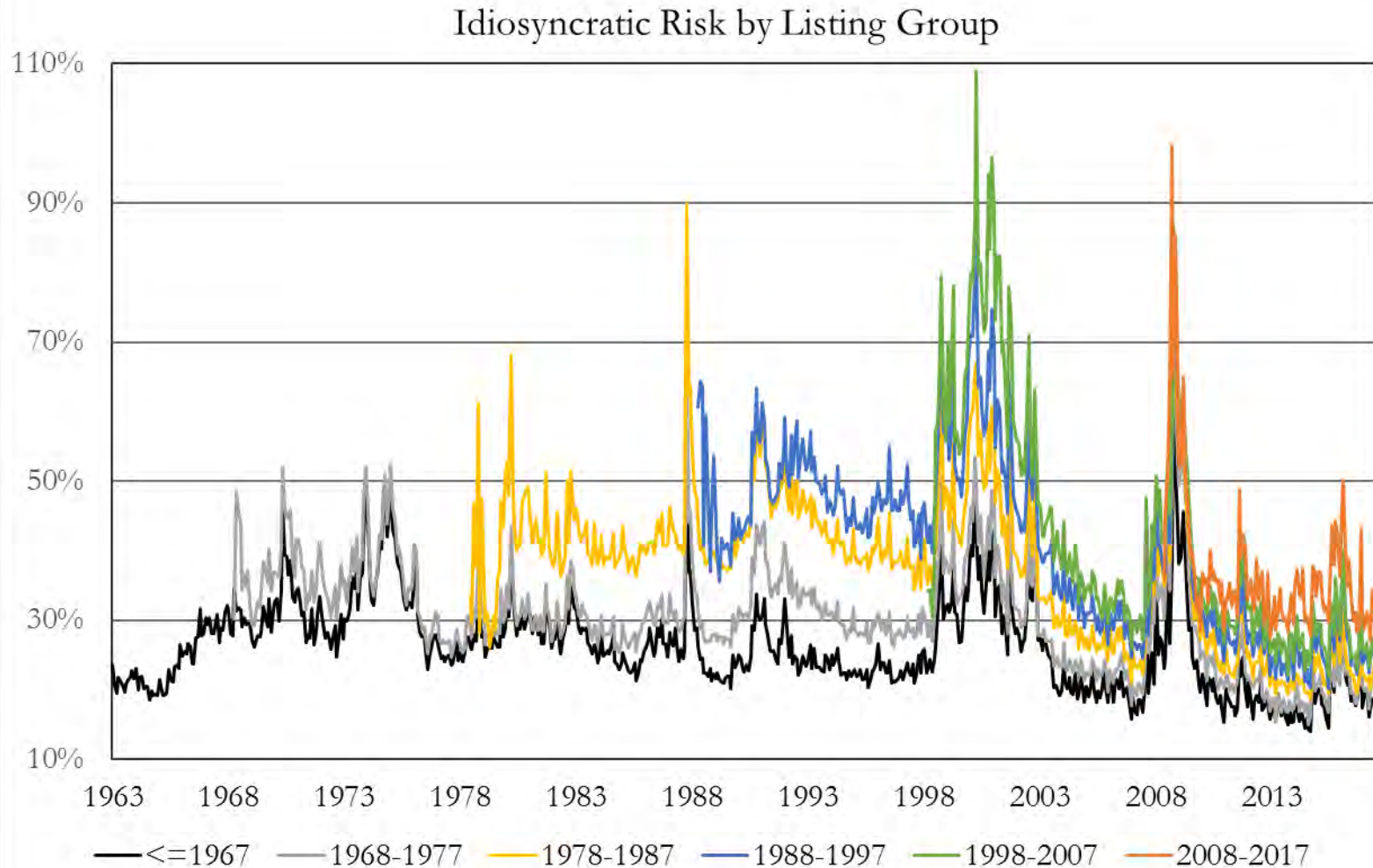


# Arc of Public Company Risk

Average  
Public  
Stock  
Volatility



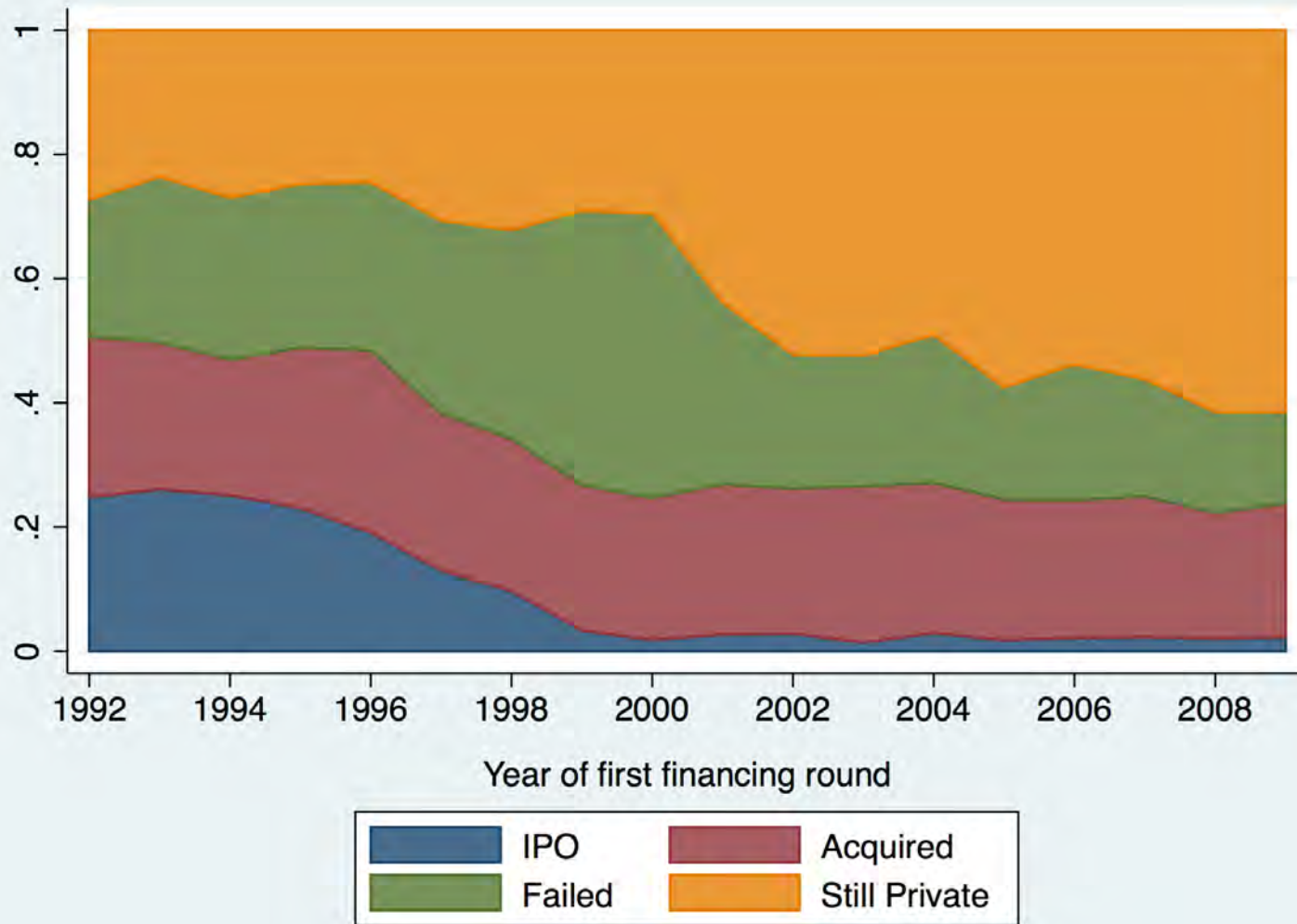
# U.S. Public Market Idiosyncratic Risk



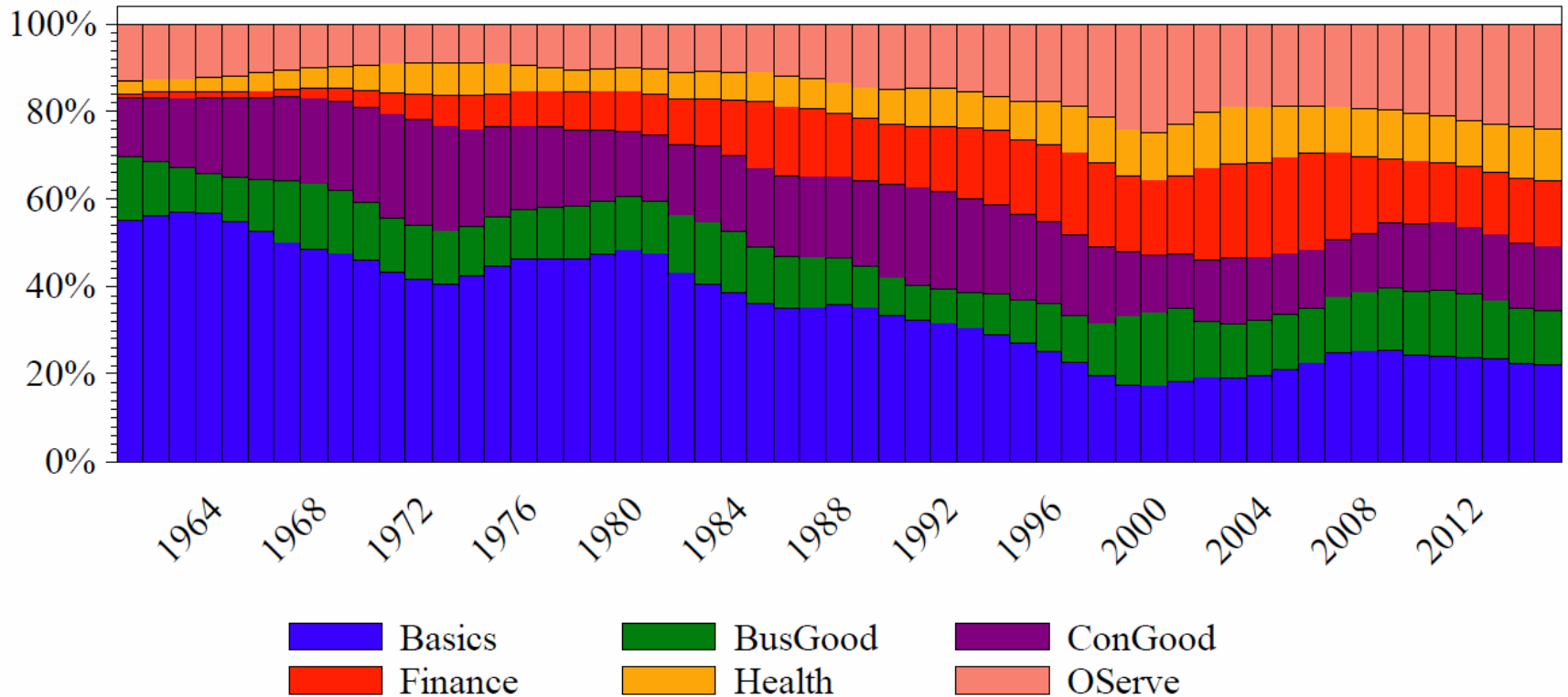
Brown and Kapadia, Firm-Specific Risk and Equity Market Development, *Journal of Financial Economics*, 2007, 84(2), 358-388.

Bartram, Brown, and Stulz, Why Has Idiosyncratic Risk Been Historically Low in Recent Years?, [ssrn.com/abstract=3107798](https://ssrn.com/abstract=3107798).

# IPO Decline is Driving Shift



# Changing Industry Composition of Public Companies



# What Does this Mean for Investors?

- The facts raise some important questions & issues:
  1. Where are we in the evolution of “alternatives”?
  2. What does this mean for value (returns) and portfolio management?
  3. How do we allocate in an environment that is not like anything we have experienced for alternatives recently (ever really)?
- Even if “alpha” is zero, still beneficial to invest in assets that provide additional diversification
  - Hedge Funds, Private Equity, Private Credit, Real Assets, etc.



# What Does this Mean for Investors?

Harder to do traditional portfolio allocation and optimization because market portfolio is unobservable and illiquid

1. Fully diversified portfolios require private component to access certain types of investments: size, growth, quality, etc.
  - Public market risk (especially industry and idiosyncratic volatility) driven by market development trends
  - Also other assets: especially real assets.
2. Likely requires a rethinking of allocation that is more focused on sectors (at a minimum) and factors including private market / illiquidity risk
3. Delegation of investment timing with closed-end drawdown funds introduces additional source of uncertainty

# The Case of Endowments

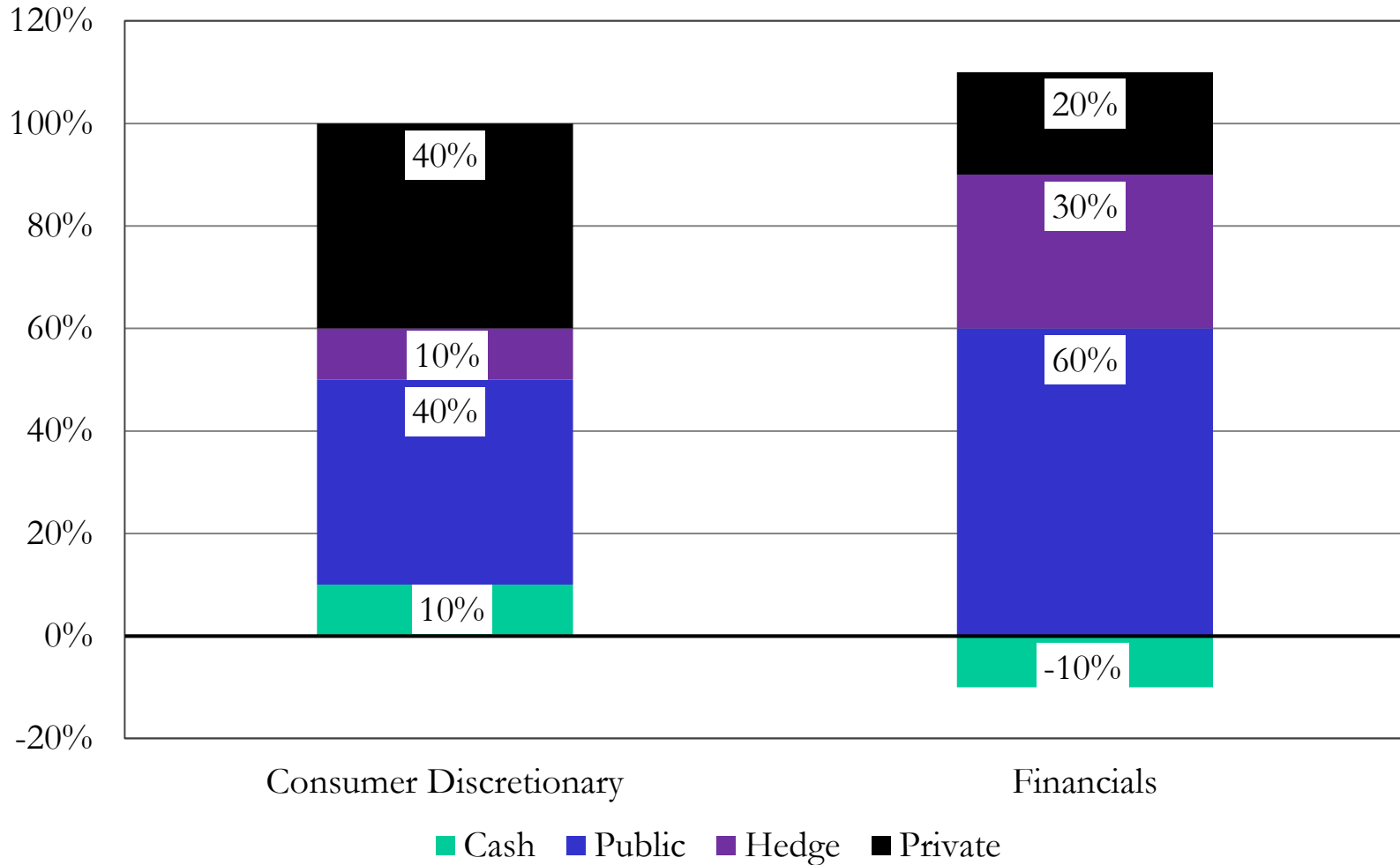
- University endowments were early adopters of alternatives
  - Many have high allocations: 50% for large endowments and 25% overall
- Evidence using data for 12 years ending 2015 suggests:
  - Higher returns from larger allocation to alternatives
    - 1-2% per year more, true for large and medium endowments
  - Portfolios with more alternatives have lower risk and higher Sharpe ratios
    - Even after adjusting for illiquidity
  - Expert staff and knowledgeable boards help returns and Sharpe ratios
  - Caveat: Much of the higher return is attributable to venture capital where access is limited and scale is hard.
    - Alternatives lower risk for all sub-groups

# What's Needed for Implementation?

- A model for expected returns
- Sector attribution of investments
- Risk measures for each sector-group:
  - Liquid – e.g., public equities
  - Semi-liquid – e.g., hedge funds
  - Illiquid – e.g., private equity funds, co-invests and directs
- This is a well-posed (solvable) optimization problem
  - Though making it dynamic and explicitly modeling liquidity risk complicates it.



# Revised Approach to Portfolio Optimization & Asset Allocation



For example, L'Her et al., A Bottom-Up Approach to the Risk-Adjusted Performance of the Buyout Fund Market, Financial Analysts Journal 72(4) discusses public and private sector allocations in buyouts.

# Conclusions

- Evolution of financial intermediation mandates a rethinking of the portfolio management process
  - ➔ Good reasons to be in private markets
    - And this doesn't rely on superior returns
- Feasible (but potentially complicated) implementation

PENNSYLVANIA STATE EMPLOYEES' RETIREMENT SYSTEM

TESTIMONY TO THE

PUBLIC PENSION MANAGEMENT & ASSET INVESTMENT REVIEW COMMISSION

THURSDAY, OCTOBER 25, 2018

Thank you, Mr. Chairman, and members of the Commission for inviting the State Employees' Retirement System here to provide testimony today.

My name is Terri Sanchez, and I am the Executive Director of the State Employees' Retirement System. Joining me today to testify is Mr. Bryan Lewis, Chief Investment Officer for the State Employees' Retirement System. Bryan has been with SERS since 2016. I have been with SERS since May of this year, and I can't think of a better time to be with this organization. For SERS, it's a time of tremendous change on many fronts. Change, that as one who stands as a fiduciary to the 240,000 members of this system, I am proud to be a part of.

The State Employees' Retirement Board is in the process of enhancing board governance by adopting leading governance policies and practices that improve the effectiveness of the Board to better serve the needs of the

Retirement System's members and employers, with corresponding benefits for the taxpayers of Pennsylvania.

We also are implementing one of the most comprehensive pieces of pension legislation in the 95-year history of this organization – Act 5 of 2017 – and evaluating how we can capitalize on this opportunity to better serve all members. In addition, we have stepped up our efforts to pursue quality investments at reasonable costs.

We stand strongly behind our steadfast dedication to honesty and integrity, and we are working hard to further advance our strong commitment towards providing as much transparency as possible, without breaching our standard of care and fiduciary duties.

I hope you will come to realize that the goals of this commission and those of the State Employees' Retirement Board are more alike than different.

We are here today to respond to the Commission's request to receive the benefit of our perspective on specific workable actions that can be taken to reduce investment expenses and improve investment and investment-related

operations, and generate actuarial savings of \$1.5 billion over 30 years from the effective date of the legislation that created this Commission, Act 5 of 2017.

SERS has been committed to finding and implementing positive, practical approaches to strengthen the operational efficiencies and oversight processes of the system – with the ultimate goal of maximizing results for its members and paying promised benefits – benefits that were earned.

These are responsibilities we do not take lightly. Last year, the system paid approximately \$3.3 billion in benefits to its members. Of that, more than 90 percent, about \$3 billion, was paid to members who live right here in Pennsylvania.

These three-plus billion dollars represent actual lifelines – providing important means of support and even survival, not only for SERS members, but for the thousands of small businesses across Pennsylvania that rely on them as valued customers.

To put this in a long-term perspective, over the past 25 years, the SERS fund has earned over \$50 billion and paid \$48 billion in retirement benefits. The SERS Board and team of investment professionals made difficult investment decisions

in the best interest of its members through multiple market environments, cycles of suppressed employer contributions, unfunded benefit enhancements, legislative changes, and challenging political headwinds. In spite of these challenges, SERS returned 8.4% and outperformed a 60/40 index portfolio, net of fees, over the same time period.<sup>1</sup>

**Returns as of Dec. 31, 2017, net of fees, annualized<sup>1</sup>**

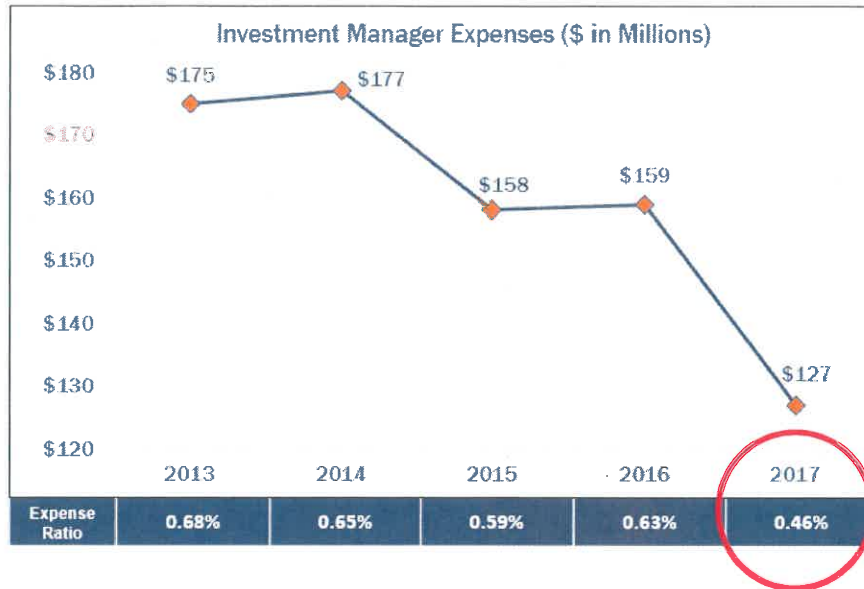
	25-YRS
SERS' Total Fund	8.4%
60/40 Index	7.3%

In short, we take our responsibilities as legal and fiduciary protectors of our members' retirement funds very seriously. And I think that will become evident through our testimony.

The fact is, seeking relief from investment fees is a way of life at SERS. The system has been reducing investment manager expenses over the past several years, and in the past year has reduced annual investment manager expenses by \$32 million to 46 basis points (0.46%).

---

<sup>1</sup> Source: RVK, Inc. Performance is shown net of fees, annualized. The 60/40 Index consists of 60% MSCI ACWI (USD) (Net) and 40% Bloomberg Barclays US Aggregate TR Value Unhedged Index (USD). Prior to 12/31/1998, the 60/40 Index consisted of 60% MSCI World TR (Net) and 40% Bloomberg Barclays US Aggregate TR Value Unhedged Index (USD). The fee used for the 60/40 index is 6 basis points.



We are happy to have the opportunity to share our plans and perspectives, and even some of the accomplishments that have been realized since the beginning of 2016.

Before we get to those cost-saving items, however, I would like to take just a moment to assure the Commission, our members, and the public, that the State Employees' Retirement Board has an ongoing commitment to demonstrate transparency in its reporting of fees and investment expenses, while working within our legal and fiduciary framework.

Each year, SERS reports investment and investment-related expenses, including ongoing management fees and performance/incentive fees, to the

general public in two reports, our ***Supplemental Budget Book*** and our ***Comprehensive Annual Financial Report***.

Although SERS reports management fees and expenses paid to private partnerships, these amounts are typically returned to SERS later in the investment life cycle. These returned amounts, however, are not retroactively adjusted in SERS' fee reporting. So, if anything, these management fees and expenses are **overstated**.

In an effort to ensure that all management fees and expenses are calculated and audited in a consistent ongoing manner, SERS' Office of Finance and Administration (OFA) has created and implemented internal controls that comprise very detailed processes and methodologies.

It is a multi-step process designed to ensure that all relevant financial data reconciles and that management fees are calculated accurately and reported properly, so we don't pay more than the contractually negotiated amount.

Where the confusion comes in is with the term **"Profit Sharing" – (what the industry refers to as "Carried Interest")**. It is our opinion and the opinion of some



of the previous testifiers, as well as others in the industry, that carried interest is not a fee.

In exchange for providing the capital for an investment, SERS is entitled to the majority (typically 80%) of the partnership profits. The General partner then receives its share of the profits (typically 20% of profits, minus fees and expenses, as noted). These General partner profits are determined only after: 1) all prior management fees and expenses paid by SERS are returned to SERS; and 2) capital contributed by SERS also is returned to SERS.

While we understand that the General partner's 20% share of the profits of a successful investment could be a significant amount, this type of compensation structure works very well to align the interests of the General partner with those of SERS. When the General partner succeeds, SERS succeeds; typically, for every dollar of profit the General partner receives, SERS receives four dollars. ←

That being said, because SERS and others in the industry do not consider carried interest as a "fee," it isn't something that historically has been reported or tracked by SERS. It was never "hidden" and there is nothing shady going on here. It simply wasn't something that was reported or tracked – and there is a very big difference between one and the other.

We are working in the midst of a maturing industry where new standards are emerging, and SERS is open to these standards.

In fact, State Employees' Retirement Board Motion 2018-15, passed in April, specifically directed SERS' staff to request general partners of new investment opportunities in private markets to begin adopting and completing the Institutional Limited Partners Association (ILPA) fee disclosure template, effective immediately. Similar requests are being made of general partners of existing investments in private markets, effective January 1, 2019.

So, we are well underway in our efforts. Thank you for your indulgence in letting me "shine some light" on this important matter.

I will now turn the microphone over to Bryan to discuss our ideas for cost savings.

Bryan Lewis

Let me first say that SERS believes the established benchmark of \$1.5 billion in actuarial savings is an achievable goal. To arrive at this conclusion, we worked closely with our actuarial partners at Korn Ferry to perform projections as to what it would take to reach that \$1.5 billion mark.

Based upon the projected assets for each of the 30 years, we estimate that, if the fund were to reduce investment costs by 4.5 basis points, and sustain that reduction in each of those 30 years, it will be sufficient to create an estimated actuarial savings of \$1.5 billion, as of June 2047.

For the record, we were working diligently on ways to trim investment manager expenses even before Act 5 became law. Since the beginning of 2016, SERS implemented a number of measures to reduce costs:

- Transferred \$2.5 billion of active public stock strategies into low-cost index strategies. Nearly 80% of SERS' public stock portfolio is invested in index strategies.
- Negotiated lower fee structures with public stock and fixed income managers.
- Liquidated eight hedge fund strategies and transferred nearly \$900 million from these hedge fund strategies into low cost index strategies.
- Consolidated fixed income portfolios to take advantage of more favorable fee structures.

- Negotiated a private equity fund with a supplemental component (side car) that charges no fees, thereby reducing the management fee of that total investment.
- Invested in a private equity co-investment vehicle with no fees charged on committed capital, a 35% reduction on invested capital management fee, and a 50% reduction in the General partner's profit sharing.
- Reduced the number of private equity managers in which SERS has invested, while increasing the size of SERS' commitment amount – thereby hitting certain investment size thresholds to reduce management fees.
- Worked closely with PSERS, so that the two agencies invested in the same investment opportunity can benefit from reduced fees as a result of the combined investment size in the strategy.

*and the  
pacing model*

Naturally we're proud of what we've accomplished thus far, but we're not finished yet. At the direction of SERS' board, we continue to work with our

consultants to pursue cost savings wherever feasible and beneficial to fund investment risk/return outcomes.

One key cost reduction tactic is to participate in no fee/no carry or reduced fee/reduced carry co-investments alongside General partners with whom SERS has made primary fund commitments. These co-investments help reduce the aggregate fee burden on dollars deployed with General partners. As noted, we already are working with several General partners who offer co-investments to SERS and have expressed further interest in completing co-investments.

Another key cost reduction SERS has begun implementing is negotiating management fee reductions with an eye to founder's and/or first close terms. Private Equity and Real Estate funds sometimes offer incentives to first (or early) closers by offering management fee discounts. Where possible, SERS can achieve these discounts by committing to General partners in a first close. The resulting management fee discounts can range from five to 25 basis points.

Another way we continue to reduce investment expenses related to management fees is through building strategic partnerships with managers that invest across various fund products. The formation of strategic partnerships typically involves large commitments to managers that are divided, at an agreed-

on ratio, among various strategies in which the manager actively invests. Such partnerships are often diversified across sub-strategies, geographies, and investment types, thereby creating diversification with the broader portfolio.

SERS is also researching internal asset management opportunities for public and private markets that are designed to reduce the amount of fees paid to external managers.

To ensure that SERS is implementing a best-in-class framework, we plan to contract with a consultant to assess SERS' existing systems and processes; identify operational risk, gaps in current infrastructure, and human resources requirements; and then present a viable solution that details the pros and cons of various options, systems, portfolio management, trading, middle and back office functions, and compliance and risk management. We also will ask the consultant to help evaluate costs to successfully implement internal asset management objectives.

Now I'll turn this back to Terri.

Terri Sanchez


Thank you, Bryan, and thank you to the Commission for asking us for our perspective on what the General Assembly can do to help us improve efficiencies and reduce costs.

The State Employees' Retirement Board and staff stand in direct fiduciary status to the fund. All of the requests that follow are absolutely consistent with the fiduciary duties and responsibilities of the Board and staff in administering the fund for the exclusive benefit of the members, and with the skill and care that a person familiar with such matters would exercise.

Specifically, we ask that:

- The board be given the decision-making authority for organization, position complement, and compensation for management employees in place of the Commonwealth's Executive Board.
  - Having maximum flexibility in the ability to increase our staffing complement will allow us to continue with the cost-saving improvements that are already underway. The addition of high quality, specialized staff in the investment and investment accounting areas will help us to improve our investment and financial operations and audit capabilities, and to reduce costs.

- Increasing our staffing complement will also enhance our ongoing effort to implement and grow our internal asset management capabilities. We've seen the promise that this effort holds – from our own experience, and in learning about the actions taken by some elite public pension funds.
- Having control over the ability to set compensation levels allows the board to attract high quality expertise.

- 
- The board be given greater flexibility to more efficiently procure goods and services.
  - The board be given the ability to determine its budget, without having the Office of the Budget approve, or alter the board's budget requests.

There is no entity better positioned to make the necessary fiduciary decisions regarding the investments and disbursement of any of the monies of the fund, than the board. In addition to the specific items listed above, I ask the General Assembly to remember that administrative limitations imposed upon the ability of the board to efficiently administer the fund and manage SERS operations, and substantive restrictions on how the board can invest the assets of the fund have consequences. Administrative burdens or substantive restrictions can, to a



greater or lesser degree, increase costs or reduce the ability of the board to achieve desired investment returns. This applies to both current statutory regimes or future statutory changes. The board must be given maximum administrative flexibility and investment authority in its ability to satisfy its fiduciary duties and obligations.

The items just stated are all important and achievable goals. But there is one more area that holds even greater promise and would go a long way toward demonstrating that Pennsylvania is serious about its commitment to public pension fund reform. This is by far our biggest “ask” if you will.

I would ask the Commission to consider the benefits to the fund, the members, and to the Commonwealth of consistently paying the actuarially required contributions to the fund year after year, as this administration and the General Assembly have done for what is now the third year in a row. An amount, that when combined with investment earnings, would be sufficient to pay promised benefits in full, in a cost-effective manner.

We have seen, first-hand, how persistent underfunding can jeopardize a plan’s sustainability, eating away at the asset base, forcing decisions to liquidate investments at the most inopportune times, and pushing a retirement board to

reach for returns that it otherwise may not need to. Returns that are often reached through expensive investment alternatives.

At a previous hearing we heard testimony from other systems who had more passive, less expensive investment strategies than SERS. It is important to note that these systems acknowledged that had they not been in the healthy financial position that they were, their investment approach would **not** be possible.

After years of suppressed contribution rates, SERS is not in that position. And, given our position, alternative types of investments are critical to meeting the assumed rate of return so that we can continue to pay promised benefits in perpetuity. None of us want to take unnecessary risk. And, quite frankly, as fiduciaries, we cannot and should not take unnecessary risk.

But perhaps this commission can help position us so that we can, in good conscience, move towards an asset allocation where we not only look to get the best return for the risk we take, but where we also take less risk overall, and pay promised benefits cost-effectively.

So how might you do that? One way would be to recommend consideration of an amendment to the constitution that requires the legislature to incorporate into the State Employees' Retirement Code, a dedicated funding source and a contribution payment amount that is based on sound actuarial methods and assumptions consistent with generally accepted actuarial standards of practice. Ensuring funding at an amount that cannot be impaired by the changing priorities of elected officials, insulating it from the unpredictability of the appropriations process, and preventing the manipulation of amortization methods and other funding deferral mechanisms that have cost the system approximately \$8 billion through 2017. Those assets could have offset the unfunded liability and provided more investment flexibility to the Retirement Board – flexibility that may well have included an asset allocation with more lower cost investments.

What has been suggested here is a heavy lift, no doubt, but it is a lift that several states have already made; some in reaction to situations much more dire than ours. But Pennsylvania has an opportunity to be *proactive* and attempt to implement elements of the Government Finance Officers Association (*GFOA*) funding policy best practices and of the Conference of Consulting Actuaries

funding policies and practices guidance now. Preserving the good that this administration and General Assembly have accomplished and ensuring that future administrations and General Assemblies do the same.

Thank you for your time and attention to this critical issue. We are happy to take your questions.

**Public School Employees' Retirement System (PSERS)**  
**Testimony From**  
**Glen R. Grell, Executive Director**  
**James H. Grossman Jr., Chief Investment Officer**  
**October 25, 2018**

Good Morning Chairman Tobash, Vice Chairman Torsella, and members of the Public Pension Management and Asset Investment Review Commission.

I am Glen Grell, Executive Director of the Public School Employees' Retirement System (PSERS). With me today is Jim Grossman, PSERS' Chief Investment Officer.

I would like to thank those Commission members who attended PSERS August Board and Committee meetings which included our Asset Liability Study and Asset Allocation process. We hope your attendance gave you a clearer understanding of how PSERS approaches these important processes.

Also thanks to Commissioner Bloom for attending PSERS' recent October Committee and Board meetings, as well as having a one-on-one meeting with Jim Grossman.

Before we present PSERS' ongoing fee savings and efficiency recommendations, I would like to take a few brief moments to address the false narrative that has been circulated and unfortunately continues to be circulated surrounding these hearings about PSERS.

To date PSERS has taken the high road and not engaged in a negative public debate. We prefer to engage on issues in a thoughtful, professional, factual, and principled manner. Having said that, we believe the right time to address some of the most outrageous allegations is at today's hearing when we finally have an opportunity to address the entire Commission in person.

PSERS has a duty and a responsibility to address these allegations and politically-motivated hyperbole of "hiding fees" or "wasting" the System's assets. I have two specific points regarding the public commentary to date.

1. **PSERS does not waste System assets.** This is a fact and it is not up-for-debate. Saying PSERS wasted funds is irresponsible and insulting to every PSERS employee who works hard each and every day on behalf of our members with **only** the best interests of our members in mind. This false narrative also disparages our Board members who volunteer and devote a significant amount of their time and expertise to serve on PSERS Board. As those of you who have attended PSERS Committee and Board meetings know, these meetings are very long and the Board packet contains thorough and extensive due diligence write-ups on investment opportunities as well as detailed materials on the often overlooked benefits administration side of the Agency. The ensuing discussion at Board Meetings can result in questions, dialogue, and vigorous debate on potential investments and other administrative agenda items.

The specific assertion is that PSERS “wasted” \$3.9 billion in fees to Wall Street managers.

The fact is that PSERS engages and compensates money managers in areas where we can’t internally manage the investment and only after due diligence of the manager. We carefully track the manager and the investment to make sure we are getting value for these fees, and we report asset class and manager performance to our Board of Trustees.

While not every investment is productive—and we frequently terminate underperforming managers—the value of these external managers fully justifies the fees paid.

Over the past 20 fiscal years, PSERS has outperformed a global 60/40 portfolio by 84 basis point. In dollars, PSERS generated \$10 billion in performance above a global 60/40 passive portfolio at a cost of \$6.9 billion. Net investment income during the past 20 years was approximately \$62 billion and would have been only \$52 billion if we followed a passive, no cost global 60/40 index portfolio.

2. **PSERS does not hide fees.** Another charge of this Commission is that the Funds have hidden billions of dollars in fees. PSERS has long been a leader in fee transparency. While the Government Accounting Standards Board (GASB) only requires the reporting of “readily separable fees,” PSERS professionals have gone above and beyond the reporting requirements of the GASB, releasing both readily separable as well as not readily separable fees. PSERS discloses them annually in our Comprehensive Annual Financial Report, our annual budget requests to the General Assembly, and in an annual presentation to the Board of Trustees. At PSERS we pay strict adherence to reporting standards and take great pride in having been recognized for 34 straight years for excellence in public financial reporting.

With few exceptions, standard practice for public pension plans across the country has been to disclose those fees that are readily separable. PSERS additional reporting of many not readily separable fees has led to frequent criticism of PSERS since our reported fees look much higher than many peers who have chosen not to expend the resources to capture and report not readily separable fees. We regularly hear “why are your fees so high” when various lists and surveys are published. In fact, we are actually criticized because we report fees that other funds cover in footnotes or not at all.

We take great offense to the accusations that we are “hiding” billions of dollars in fees. While this false allegation creates sensational headlines, it is incorrect and irresponsible. This accusation relates to testimony regarding the capture and reporting of “carried interest.” Carried interest received by our investment general partners is not being “hidden.” Carried interest is the General Partner’s (GP’s) ownership interest in the venture and is a share of profits distributed from a limited partnership to the general

partner. It is only earned and paid if the investment is successful and exceeds a certain predetermined “hurdle” or preferred return rate, generally 8%.

Additionally, there is no industry standard as whether carried interest is even a fee. Federal tax law views it as a capital gain while base management fees are reported as ordinary income. Income distributed from limited partnerships is net of carried interest earned and is reported accordingly in our financial statements. If we were to detail it as a “fee” in our financial statements, it would only gross up income and gross up investment expenses with no impact on the bottom line. However, given the current focus of some on this subject, we have spent significant staff time over the past year and have broken out, to the best of our ability to gather historical data, the total amount of carried interest received by our GPs in calendar years 2016, 2017, as well as since inception of our investments in private equity, private real estate, and private credit. The total amount of GP carried interest distributions since inception (**from the 1980s**) through December 31, 2017 was \$5.2 billion. Clearly a large number, but to put this in perspective, the System received \$24.2 billion in income net of the carried interest and all other costs. This carried interest presentation is posted on our web site and has already been provided to the Commission.

The fact is however, PSERS and its members, benefit when we incur carried interest to our GPs because it means our investments have been very profitable. I’d pay \$5 billion to get \$24 billion for our members any time.

Before moving to the next portion of our testimony – dealing with management fees and efforts to control and reduce them – I want to offer some research and analysis we have compiled while awaiting our opportunity to address the Commission. Chairman Tobash’s invitation made it clear not to dwell on our views on your prior witnesses or any explanations of how we operate and manage PSERS. However, we offer these materials for your consideration.

Moving to the subject of manager fees and efforts to reduce them, I want to take you back three years ago, shortly after I became the Executive Director of PSERS. Governor Wolf expressed an interest in the investment operations at both pension funds. We were asked to meet with Governor Wolf to review our investment policies and strategies. In an effort to be professional and thorough, PSERS prepared a slide deck of 50+ pages and provided this briefing material to the Governor’s Office. We are providing the Commission with a copy of the slide deck we presented to Governor Wolf in June 2015. The point is that PSERS has been focused on monitoring, measuring, and controlling external fees every day since I have been Executive Director.

It was very clear during the presentation that Governor Wolf had personally reviewed the lengthy presentation in detail and had a complete grasp of the information provided. The Governor asked astute questions regarding why and when PSERS manages funds internally versus externally; how we select and monitor managers; and when we use active versus passive management. The Governor expressed an interest in keeping external managers and external

manager fees as low as possible, but we quickly moved on to other topics, having satisfied his concerns about our approach to the use of external managers.

In the ensuing year we reduced our reliance on external managers and requested additional complement positions to further support PSERS internal investment operations. This move to expand internal management significantly lowered external manager fees even while we awaited the additional complement. The Governor issued a press statement in March 2016 noting this accomplishment. Unfortunately further reduction efforts stalled when it took PSERS approximately 18 months to receive approval for seven of the 15 additional internal investment office positions we had requested. The seven positions, once approved, were filled and we have continued to add significant talent to our investment office which now includes 13 Chartered Financial Analyst Charterholders and 16 MBAs.

Like many other large public pension funds with best in class internal investment operations, we believe a part of the solution to large external management fees is to build a strong internal investment platform with the skills and tools to engage in the kind of sophisticated pension asset management that other comparable public pension funds do. PSERS investment professionals currently manage 19 portfolios in-house with a net asset value of over \$23 billion in-house saving approximately \$39 million a year in external manager fees. The amount managed internally increased \$6 billion from just three years ago from 30% of the Fund's asset to 36% today.

I would like to turn over the next portion of our testimony to our CIO Jim Grossman, to present PSERS Fee Savings Plan. This plan was created in response to Act 5 and to Treasurer Torsella's sponsored Board resolution challenging PSERS Investment Professionals to work with our consultants to create a Fee Savings Plan. The plan was presented and adopted by PSERS Board at the August 2018 Board meeting. This plan is a fluid and flexible plan of action that will adapt and change as necessary.

### **Fee Savings Plan – (Jim Grossman)**

Section 8538 of Act 5 established a goal for PSERS to develop a plan to save \$1.5 billion in management fees over 30 years. PSERS Retirement Board Resolution 2017-41, passed December 8, 2017, was developed by the Treasurer and our Executive Director. It directed PSERS Investment Professionals and the Board's investment consultants to come up with a fee savings plan to present to the Board. PSERS Investment Professionals presented such a plan at its August 2018 Board Meeting.

The plan focused on investment manager cost efficiency, assumed no changes to the strategic asset allocation, included those portions of the asset allocation where we expected fees to increase in the future, and was to be implemented over three years. Annual savings were converted to cumulative compounded savings over a 30-year period.

PSERS Investment Professionals took a two-pronged approach to generate fee savings.

The first was to establish a plan to renegotiate management fee arrangements to create a better alignment of interest between PSERS and each investment manager. The goal was to



decrease the guaranteed fees, or base fees, in exchange for a profit-sharing arrangement on returns above a negotiated benchmark. Estimated savings from these reduced guaranteed fees amounted to over \$1.5 billion compounded over 30 years.

The second was to expand internal management and bring additional assets in-house at a lower cost than external management. Net of the cost of the additional 9 investment professionals needed, we estimated savings of over \$900 million compounded over 30 years.

Together, the cumulative fee savings are \$2.4 billion compounded over 30 years, which represent a 9.6% annual reduction in base management fees. The detailed presentation is posted on our website and has been provided to the Commission.

The fee savings plan crafted is by no means an end to our efforts to reduce management fees and better align the interests of the investment managers with PSERS. Since the plan was prepared, we've identified over \$350 million in additional cumulative base fee savings compounded over 30 years. The cumulative fee savings have now increased to \$2.8 billion compounded over 30 years, a 10.4% annual reduction in base management fees.

In addition, we've aggressively negotiated management fee deals with new managers and mandates. In two cases recently, we entered into agreements with zero base management fees and the investment manager only gets a share of the profits generated, plus we are currently negotiating two other similar deals. In other cases, we have continued our longstanding practice of obtaining fee discounts for our large commitments and for being in the first closing of a fund.

We also aggressively negotiate the less obvious management fee terms as well, including hurdle rates and catch-up provisions. It is important to recognize that the long-term nature of our pension plan positions us to drive fees down even further because managers are generally willing to accept lower fees in exchange for stable, patient capital. Whenever possible, we attempt to make the most of this natural advantage.

One criticism of the fee savings plan we'd like to address relates to the profit-sharing fees. We've received questions about the possibility that total management fees – base fees plus profit-shares -- may increase under this plan. To be clear, the plan has at least a 9.6% reduction in base management fees. Base management fees are guaranteed no matter the performance. So, overall base management fees are going down. If we are so fortunate as to have very strong performance by the investment managers, then the profit-sharing component of total fees will go up. If the profit-share goes up, so does our investment income. For example, if a manager has a 20% profit share and earns \$10 million above its benchmark, then PSERS is better off by \$8 million while the manager collects an additional \$2 million. Our interests are aligned. Higher investment income means lower required contributions and, by extension, lower taxes for the Commonwealth and school employers. In government, increased costs are generally frowned upon since increased taxes are required to fund them. In investment management, increased profit-sharing fees are funded by increased performance which has the opposite effect: decreased costs to the government as well as less taxes needed to fund the pension benefit. It's a win-win-win. It's a win for PSERS members, the taxpayer,

and the investment manager. And importantly, a profit-share focuses the manager's efforts on performance rather than simply growing assets under management to collect more base fees, an activity that often reduces the likelihood of outperformance.

Another item to note is that we have not included in our fee savings plan any savings from not having to pay carried interest in our private equity co-investment program or reduced carried interest in our real estate co-investment program. The private equity co-investment program allows us to invest in private companies at no cost: no fee and no carry. The real estate co-investment program allows us to invest in private real estate at reduced fee and reduced carry. Based on the size and success of our private equity co-investment program alone, which has an internal rate of return of over 23%, the savings would be significant.

Also not included in our fee savings plan are other areas of consideration recommended by our investment consultants, including an increased pursuit of strategic partnerships; direct investing in private markets; secondary sales of non-core, fee-paying private markets funds; side-car co-investment vehicles; and non-management fee reductions for new investments such as 100% fee offsets.

Additionally, our size, longevity and reputation position us as the perfect partner for new managers who require an anchor investor. Such "seed investors" in new investment managers commonly negotiate a perpetual share of the revenue generated by the new manager, effectively transforming manager fees into a new profit center for PSERS. These are all areas that merit further exploration.

We are open to considering any fee savings recommendations that 1, enhance PSERS net-of-fee return; and 2, do not increase the risk of the investment program. The investment professionals at PSERS are always looking to negotiate the fairest fee deal possible. To that end, we've recently implemented a formal External Manager Fee Policy to document our objectives in fee negotiations. In addition, we've instituted a formal internal policy of reviewing all fee arrangements at least once every two and a half years to ensure that each fee arrangement is still appropriate. All fee negotiations are now formally documented and saved in our document management system in accordance with recommendations from the Auditor General.

### **Additional Recommendations – (GLEN GRELL)**

You have asked us to come here today with ideas on how the General Assembly can help ensure the availability of PSERS pension benefits into the future.

We will present seven or so specific recommendations, however, we urge caution in any legislation to restrict the management of either fund by its respective Board. Frankly, when the General Assembly has acted on pension matters in the past, the results have ranged from modestly helpful to disastrous.

To illustrate, let me share 2 charts, which when considered in tandem tell a troublesome story.

On the top chart the blue line shows the average public fund percentage of Employer Contributions versus the ARC/ADC. The green line is the comparable rate of contributions to PSERS during the well-documented extended period of underfunding. It bottomed out at 27% in the year Act 120 was passed.

The good news is Act 120 put the Commonwealth on the climb to 100% annual funding – painful to school districts and the General Fund but essential to the health of the Fund.

The bottom chart shows how poor policy decisions (in this case mostly via legislation) can take a public pension fund from robust 128% funded in 2001 to 56% funded in FY 2016/2017. What happened?

- First, Act 9 granted benefit enhancements which were not only unfunded but also were made retroactive.
- Second, investment markets fell sharply after September 11 and the so-called Dot.com bubble.
- Third, in response, the Administration and General Assembly artificially suppressed the Employer Contribution Rate, thereby underfunding the plan for 10-12 years.

This sequence of events has strapped PSERS with a \$44 billion unfunded liability which eats 75 cents of every employer contribution dollar we receive. And none of this had anything to do with manager fees.

With that backdrop, I offer these ideas for what the General Assembly should do- and several things they should not do – to support the System and its members.

1. **Require 100% annual funding of the ARC** so the last three years become the rule and not the exception.
2. Toward that end, **a constitutional amendment** requiring full actuarial funding of PSERS and SERS should be recommended and pursued.
3. **Require prefunding for any benefit enhancements/COLAs** that may be offered in the future to avoid adding any more debt to the system. These enhancements are not currently prefunded. When an enhancement is granted it immediately adds a debt (millions or billions) to the fund on top of existing pension debt. Prefunding will make the true costs of any enhancements transparent to all constituencies and prevent any unfunded mandates.
4. **Pass governance reforms which enable the PSERS Board to exercise greater autonomy and agility in its operations.** PSERS has a short list of such governance reforms but a prime and illustrative example is the ability of the PSERS Board to set the Agency complement and organizational structure. Currently, we have to go through the Office of Administration hiring process and receive approval from the Budget Office to increase staff complement. PSERS currently manages over \$23 billion internally, making PSERS one of the largest money managers in Pennsylvania. Significant additional fee savings may be gained from bringing more assets internally to be managed. In fact, greater internal management is an essential element of any fee reduction plan. That, however, will require PSERS to get an approval to increase complement. We currently have 10

positions pending with the Budget Office. We appreciate the assistance we have eventually received from the Governor and the Budget Office but 18 months is too long to wait.

5. **Perhaps a missed opportunity, but both PSERS and SERS felt there was no reason to require each system to establish a Defined Contribution (DC) plan structure under Act 5.** When Act 5 was passed, two separate defined contribution plans needed to be created, which limited the ability to leverage the bargaining power of the Commonwealth in negotiating with third party service providers. Additionally, it required duplicative efforts by PSERS and SERS in management oversight of the DC plans. PSERS recommends making one organization responsible for the administration and oversight of the two DC plans. PSERS would support enabling legislation that would allow the two Funds to consolidate the DC plans at an opportune time once they are established.
6. **Consider establishing a Rate Stabilization Fund** or other form of reserve fund along the lines of a current proposal from Representative Frank Ryan. Similar, and perhaps in concert with a Rainy Day Fund, but dedicated to PSERS as a future cushion for school districts against increases in the employer contribution rate.
7. **Authorize PSERS to engage its own custodian bank.** – It is rare today for a State Treasurer to act as the statutory custodian for a public pension where the state’s legislature has created an independent pension Board, but in Pennsylvania that’s the case. The Treasurer, not PSERS’ Board, has sole authority to select a custodian bank on behalf of PSERS’ defined benefit plan. The custodian bank’s client is Treasury, not PSERS. Treasury assesses PSERS approximately \$2.5 million annually in fees attributable to Treasury’s custodian bank contract, yet PSERS lacks any authority to require the custodian bank to meet service level standards. This situation creates not only operational risks and conflicts of interest but also real economic costs. PSERS has encountered and continues to encounter a profusion of errors and omissions by the custodian bank. For example, we regularly see the custodian bank not crediting us income it has received on our behalf in a complete and timely manner and charging us fees for account overdrafts actually caused by the bank’s own actions. PSERS has had to assign a number of investment professionals to overcome the custodian bank’s lax quality controls in order to safeguard the Fund’s assets. These investment professionals could have been and should have been deployed in more productive activities. Unfortunately, Treasury staff, under several Treasurers, have been ineffectual in addressing our concerns or holding the custodian bank accountable. We recommend that the PSERS Board be given the statutory authority to directly hire and manage its own custodian bank relationship.

**Finally, what not to do:**

I ask you to remember the period prior to the mid-1990s, PSERS' universe of investment options was limited by statute. In 1994, Pennsylvania policymakers wisely chose to move PSERS away from these legal lists by statutorily providing the Board of Trustees with prudent person investment authority, broadening the Board's powers to invest the Fund's assets for benefit of the system's members. As noted in this testimony, the results of empowering the Board to invest in this manner have been overwhelmingly positive. Limiting the Board's authority again at this time would amount to a form of unnecessary and onerous regulation that would turn the clock back toward the days of legal lists, limiting the investment return potential of the fund, imposing arbitrary caps on fee arrangements, thereby increasing employer contributions and unnecessarily burdening the taxpayers of the Commonwealth with the resulting bill.

In closing, I urge you again to proceed with caution.

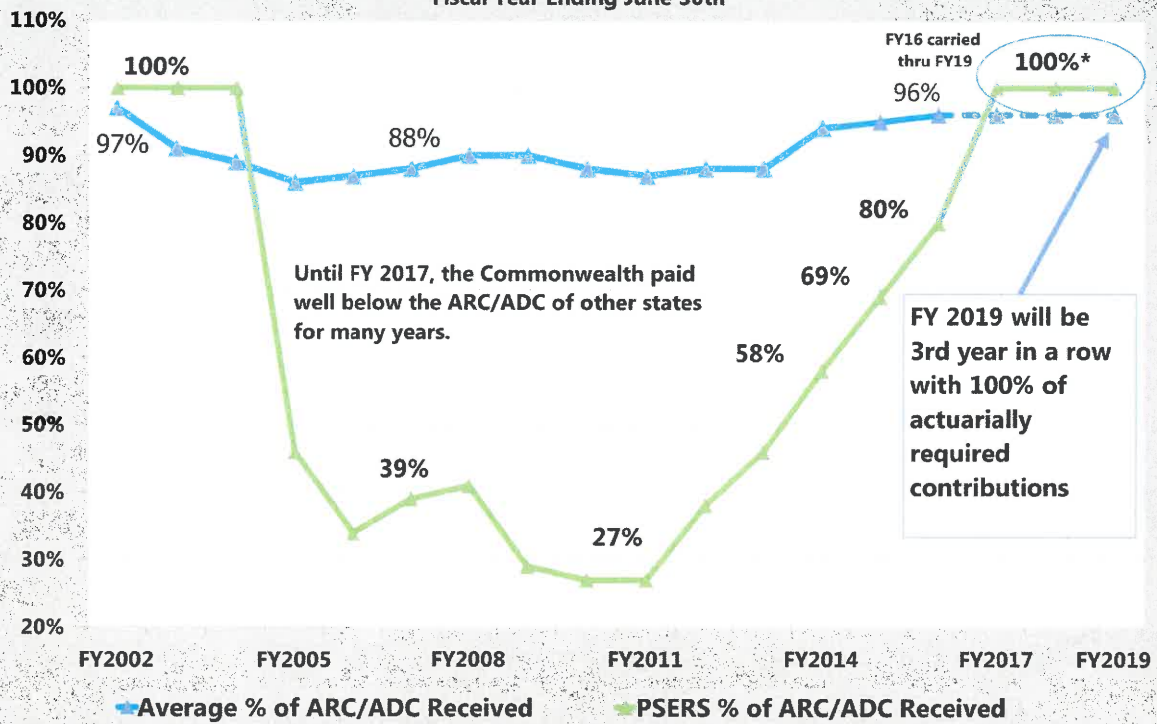
- Please avoid the knee-jerk approach to legislation.
- Avoid the "sounds good"/"looks good" reaction.
- Avoid legislating trendy concepts that tend to fall from favor faster than legislative bodies can react.
- Be deliberative in the approach to legislative proposals.
- Consult with the Systems and our consultants on the merits and risks associated with a proposal.

PSERS is a large complex system, and should any future recommendations from the Commission impact investment risk or returns; including changing the asset allocation or the actuarial assumption; there could be a significant negative impact on taxpayers and the General Fund. This is a rapidly changing investment industry, with new products and strategies emerging regularly. Don't tie the hands of our Trustees and Investment Office to participate and lead. Remember, just as there is in the commercial sector there are real costs associated with regulation and with a public pension fund those costs are reflected in the employer contribution rate.

Thank you for the opportunity to appear before you today. We will be happy to answer any questions you may have.

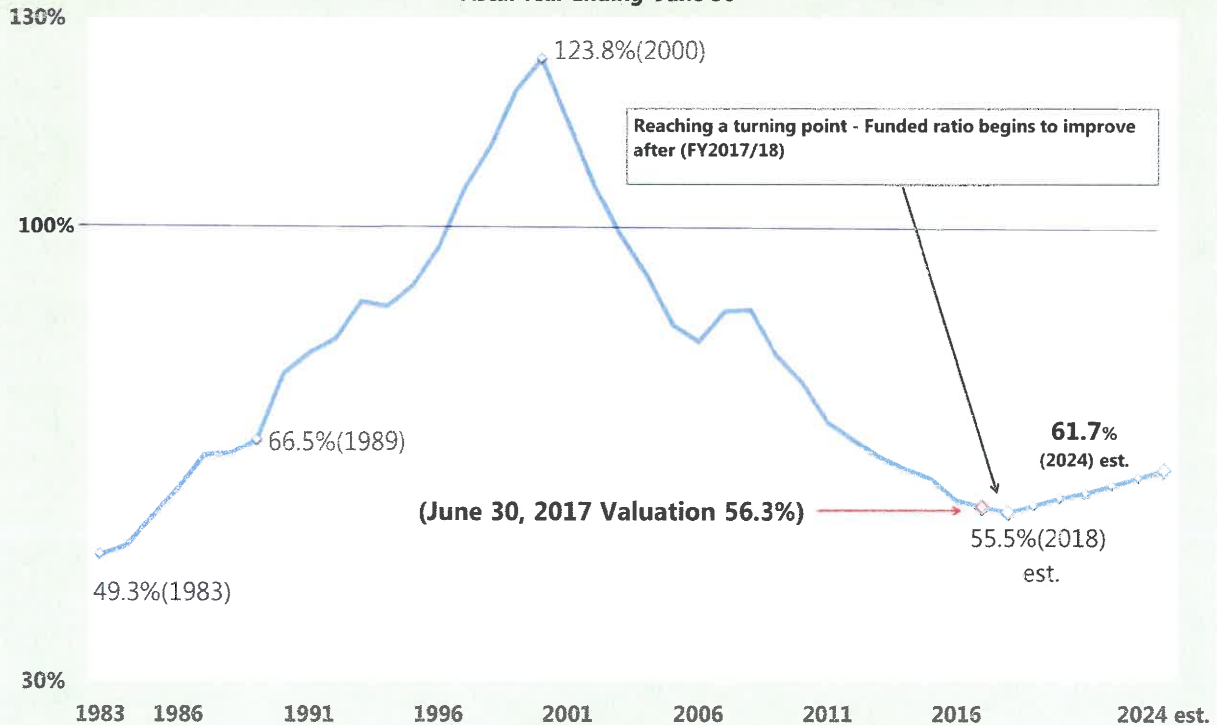
# Proper Funding is Key!

**Average % of Annual Required Contribution (ARC)/Actuarially Determined Contribution (ADC) Received - Other Public Plans vs. PSERS % of ARC/ADC Received**  
Fiscal Year Ending June 30th



\*FY2018 and FY2019 are based on the actuarially required rate calculated by PSERS Actuary.

**History of PSERS Funded Ratio Beginning 1983**  
Funded Ratio = Actuarial Value of Assets/Actuarial Accrued Liabilities  
Fiscal Year Ending June 30



# **Pennsylvania Public Pension Management and Asset Investment Review Commission (PPMAIRC)**

Summary of Analysis and Recommendations

Third Hearing, October 25<sup>th</sup>, 2018

Dr. Ashby Monk

Harrisburg, PA

# PPMAIRC Third Hearing

---

## Agenda

- The Drivers of Cost Saving Strategies
- The Menu of Options (The Toolkit)
- Governance Considerations
- Risk-Adjusted Performance and Context Considerations
- Cost Saving Recommendations



# The Drivers of Cost Saving Strategies

---

- 1) **Investment Innovation:** Changing the supply and demand of capital by doing things that others are not. But innovation is hard and often against the nature of pension funds.
- 2) **Strategy Simplification:** Complexity generally comes with new costs, which means you can seek to remove complexity to cut fees. Note, however, that this can imply a change in exposures and different risk levels for the fund.
- 3) **Cost Arbitrage:** Looking for similar risk factors in different markets at lower cost or looking for new, cheaper ways to access the same risk factors (e.g., products or assets).
- 4) **Monitoring and Revisiting :** Taking what you have in the portfolio and getting a better deal.

# Menu of Cost Saving Options

---

## Investment Innovation

Amongst the best performing funds, innovation is a key ingredient for the adoption of certain cost saving investment strategies.

Innovation starts with understanding the comparative advantages of a fund.

Instead of joining the pack (being subjected to herding behavior), investors can innovate to alter the supply and demand of capital by:

- Seeding new managers
- Entering into new forms of collaboration with peers and partners
- Using different corporate structures, such as platform companies (e.g. REOCs)
- Utilizing new technologies

# Menu of Cost Saving Options

---

## Investment Innovation

Seeding new managers:

- Forming new Investment funds (de novo firms) with an exclusive relationship that enables better cost economics for the investor.
- Investors either alone or with other peer investors have launched new firms made up of individuals that have a proven track record in their space.

Illustrative Example – PE portfolio (\$10+ billion) for a Pension Fund:

	<b>Management Fees</b>	<b>Carried Interest</b>
Seeded Funds (70% of portfolio)	0.875%	11.81%
Traditional Funds (30% of funds portfolio)	1.74%	20%
Weighted average funds portfolio	1.13%	14.22%
Co-investments and Direct Investments (44% of portfolio)	0%	0%
Weighted average total PE Portfolio	0.63%	7.93%

# Menu of Cost Saving Options

---

## Strategy Simplification (Active to Passive, Private to Public)

- It can be challenging to breakdown the amount of complexity associated with the expanding array of financial products and services on offer.
- Complexity does not necessarily bring better returns and there may be risks that are not apparent, or easy to understand.
- Investing in simpler products tends to be a lot less expensive than investing in more complex strategies.
- The most noticeable example of the shift towards cheaper, simpler strategies has been a movement away from active into passive management in public equity

# Menu of Cost Saving Options

---

## Strategy Simplification

- Active to Passive
- Private to Public
  - Private – high specific risk, dependency on security selection
  - Public – relatively cheaper to manage and trade, more transparent, more liquid (less cash drag)

## Key Considerations:

- Active Risk Exposures
- Increased short-term volatility in public markets
- Time-Horizon
- Liquidity needs of the plan

# Menu of Cost Saving Options

---

## Cost Arbitrage - Risk Factor Approach

- The Financial Crisis taught us that financial product and asset class labels are often misleading. Supposedly uncorrelated investments in a portfolio moved in sync, raising fundamental questions about whether diversified portfolios based on asset class categories actually were diversified.
- We have observed a shift in a Total Portfolio Risk Budgeting Approach as opposed to Asset Allocation approach to Investment Strategy. The approach essentially diversifies the portfolio at the level of risk and return streams, rather than at the level of specific asset classes such as real estate or infrastructure.
- Cost Arbitrage occurs by Investing in products with similar risk exposures but at lower cost.
- Expensive active management strategies are being re-developed with technological advancements so that they can be offered in a lower cost product that achieves the same risk-adjusted performance (Smart Beta).

# Menu of Cost Saving Options

---

## Cost Arbitrage – Re-intermediation and Internal Management

- As Thomas Philippon shows, the unit cost of financial intermediation is higher today than it was a century ago.
- We use the term re-intermediation to define how investors should re-think the ways in which they use intermediaries to access markets and opportunities. The idea is to change the intermediary make-up to drive more alignment and to reduce the agency costs of investment management. Evergreen funds or platform companies are examples of this re-intermediation.
- You can also completely dis-intermediate, which refers to replacing external managers with an in-house team.
- In-sourcing can be more resource intensive in private markets compared with public markets but cost savings can be greatest.

# Menu of Cost Saving Options

---

## Cost Arbitrage – Internal Management

Illustrative Example – Simplified Infrastructure Investment Portfolio (\$10bn):

- Conservative estimate for external manager fees: 1% mgt. fee and 10% carried interest, 10% return (Total: \$200m/year)
- Building an internal team (expensive assumptions using CPPIB as a proxy): Total cost per internal member (including back office) on average \$1m/year – 40 member team

External Manager	Internal Management
1% management fee	40 member team
10% carried interest	Average \$1m/team member
10% return	10% return
\$200m /annum	\$40m /annum



# Menu of Cost Saving Options

---

## Cost Arbitrage – Internal Management

Crucial Considerations:

### Comparative Advantages (or lack thereof) of the Fund

#### Nature (Categorical):

- Do you have scale?
- What is your time horizon (for private market assets) What are your liabilities? Can you take advantage of a long time horizon? Can you pick up a liquidity premium? When do you need the money back? Can you focus on Total Return or Income?
- Are your liabilities pooled or individual?
- Do you have certainty of assets? What is the net cash flow situation? Positive, negative, predictable?
- In a financial crisis, will your assets be called? Or can you be a liquidity provider?

#### Nurtured (Cultivated):

- Can you attract talent? Are there constraints to Government Pay Scales?
- Can you be a partner with asset managers and other investors as non-competitors for capital?

# Menu of Cost Saving Options

---

## Monitoring and Renegotiation

- At times, the easiest and most practical method of reducing costs is to better monitor and renegotiate what is already contained in a portfolio.
- Investment managers deploy resources into improving their negotiating skills with clients.
- Public market negotiations are more immediate than Private markets.
- Private markets are more expensive and therefore could be a source for greater savings.
- Access to information is crucial for a full analysis.

# Menu of Cost Saving Options

---

## Monitoring and Renegotiation

- **Key guidelines to save costs:**
  - Direct/indirect compensation should be credited back to investor
  - Expenses should be borne by manager, brokerage should be 'unbundled'
  - Investors need to establish appropriate benchmarks to evaluate Managers' performance
  - Managers should be incentivized to take appropriate risks by limiting fees through use of tools such as hurdles, caps, high watermarks; and avoiding use of catch-up clauses
  - Investors should invest through the vehicles, structures, and share classes that minimize total costs over the lifetime of the investment and it should receive benefits from both the economies of scale and the status that its investment brings
  - By consolidating certain SERS and PSERS investments together, there could be significant scale savings from mandates with external managers and also in other areas – operations, benefits etc.

# Governance Considerations

---

- Before embarking on any of these cost-saving pathways, investors need to assess their governance capabilities to determine whether a given investment strategy is commensurate with its organizational capabilities and oversight.
- Central to this is the ongoing tension between having a Board that is representative and one that has financial and investment expertise.
- In particular cost saving pathways that stem from innovation and certain cost arbitrage strategies (internal management, seeding, re-intermediation) require an appropriate 'Governance Budget'.
- Governance Budget - resources and assets that drive sustainable returns including talent and skills, processes and protocols of decision-making.
- While some cost saving strategies demand greater governance requirements, other strategies do not and in fact certain pathways can ease the governance burden while saving cost.

# Governance Considerations

---

- Our research has shown that one of the most important factors driving the success or failure of an institutional investor over the long run are the procedures used to nominate Board members.
- In the ideal, these procedures should prioritize commercial, financial and entrepreneurial expertise over political or stakeholder affiliations.
- To adopt innovation and certain cost arbitrage strategies, investors need to ensure that their governance budget aligns with the new strategy and risk budget.
- Lower governance budgets are consistent with less complicated or unsophisticated arrangements.

# Governance Considerations

---

- Good governance forms the foundation of the pyramid (and Pre-requisite) for innovating successfully in institutional investor organizations:



# Governance Considerations

---

- This analysis was carried out as preliminary. We were not given access to do a full governance analysis. Our assertions are subject to doing a full governance analysis.
- **PSERS:**
- 15 member “representative” board appropriate for administrative purpose but not as an Investment Board
- Best Practice – 7-9 members for an investment board.
- PSERS is running a complex (innovative) investment strategy – lots of illiquids, use of derivatives, internal management, seeding new managers, looking to open foreign offices.
- PSERS Board does not appear to have the expertise to be able to adequately oversee the current complex strategies employed by the Investment Office.
- Board has an over-reliance on Investment Staff and Consultants – information asymmetry, agency costs.
- Delegation needs to be accompanied by adequate oversight.
- PSERS Board does not appear to have the ability to oversee adequately the Investment Policy Statement implemented by the Investment Staff.

# Governance Considerations

---

- This analysis was carried out as preliminary. We were not given access to do a full governance analysis. Our assertions are subject to doing a full governance analysis.
- **SERS:**
- 11 member “representative” board appropriate for administrative purpose but not as an Investment Board.
- Best Practice – 7-9 members.
- SERS has undergone a governance upheaval following certain events (alleged misconduct by former CIO, staff turnover, departure of long-time chairman).
- *“In order to administer the System and carry out its investment obligations, the Board relies heavily on both staff and external contractors.”* - SERS Statement of Investment Policy.
- Value-add by investment consultants for manager selection has been found to be questionable (Jenkinson et al 2014, 2018, Clark and Monk 2015).
- If the gap in expertise is too large between the Board and investment staff, this could suggest the governance budget is not equipped to take on too much risk.
- As at December 31<sup>st</sup> 2017, SERS had commitments in over 350 PE funds and over 50 RE funds.
- Extremely large undertaking for Board and staff to accurately monitor and scrutinize the performance of these managers.



# Governance Considerations

---

## Investment Boards vs Administrative (Representative) Boards

- It is interesting to note that the US public sector plans that have been able to carry out innovative strategies like internal management successfully, have a separate Investment Board compared with their administrative (representative) Board. E.g. South Dakota, State of Wisconsin, Florida State.
- Investment Boards are appointed based on the finance experience requirement.
- Business-like environment is encouraged by the selection of successful business executives.
- Investment Boards hire and monitor the position of the CIO.
- Investment Boards help to maintain a non-political environment and to focus the fund on long-term performance.

# Governance Considerations

---

- This analysis was carried out as preliminary. We were not given access to do a full governance analysis. Our assertions are subject to doing a full governance analysis.

## Summary

- The capacity, resourcing and expertise of the respective Boards of the two PA plans does not seem to be aligned with the complexity of the two plans.
- The Governance budget does not seem to match the risk budget, which means the complexities and risks in the portfolios of the two plans are likely not fully appreciated by the Board. This is problematic.
- Lower Governance Budgets are suited to lower levels of complexity and sophistication.

# Risk-Adjusted Performance and Context Considerations

---

## Risk-Adjusted Performance:

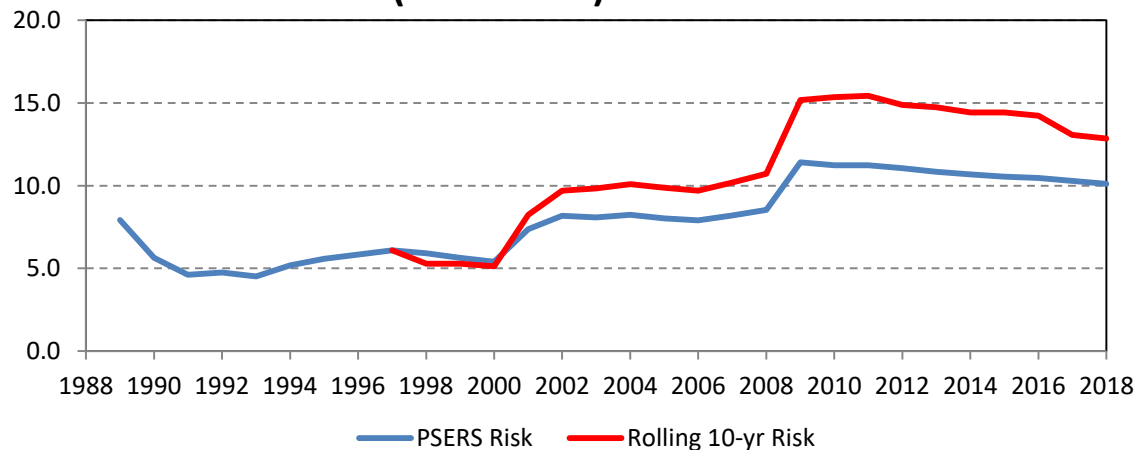
- Risk-adjusted investment performance provides an effective comparison of total and active management performance specific and general to each fund's portfolio.
- Two common performance statistics in the industry are the Sharpe ratio (risk adjusted performance vs. risk free rate) and the Information Ratio (risk-adjusted performance vs. a similar passive benchmark).
- We calculated Sharpe Ratios and Information Ratios for PSERS and SERS from publicly available data, beginning in 1988 (approx. 30 years), adjusted for differing reporting fiscal year-end.
- We constructed multi-asset benchmark portfolios using total return indices for comparison to the pension plan returns and to evaluate information ratios.
- Benchmarks compounded monthly data to provide annual returns consistent with annual plan returns. Global multi-asset benchmarks represent index returns. These do not include management fees which might cost 10-15 bps to manage and administer.
- Available public fund information was limited to published annual returns, but recognize that strategic policies have varied significantly over the last decade. We suggest sufficient sample size requires focus on at least 10 year statistics. Trends of longer horizon data are informative, nonetheless.

# Risk-Adjusted Performance and Context Considerations

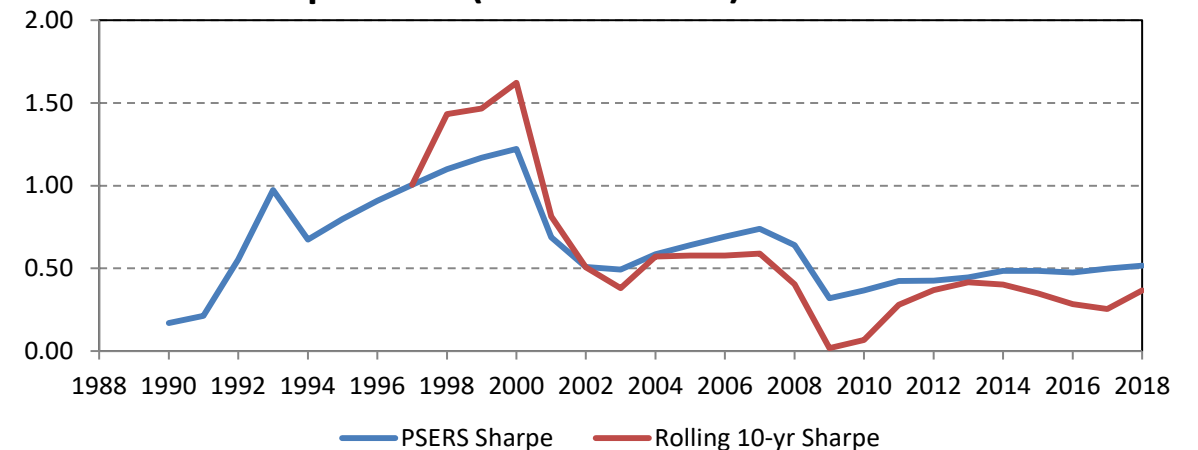
## PSERS:

	PSERS	Retn %	Balanced Benchmarks				
			US 60/30/5/5	Global Bal	PSERS Global	Quasi-LDI	T-Bill
30yr Return		8.23%	8.16%	7.92%	7.41%	7.39%	3.01%
Risk		10.11	9.51	8.97	7.93	7.07	2.60
Sharpe Ratio		0.52	0.54	0.55	0.55	0.62	
Information Ratio vs.			0.01	0.08	0.19	0.14	
10yr Return		5.03%	7.76%	6.88%	5.78%	5.90%	0.31%
Risk		12.86	10.20	11.27	11.54	10.46	0.42
Sharpe Ratio		0.37	0.73	0.58	0.47	0.53	
Information Ratio vs.			-0.81	-0.54	-0.20	-0.16	
5yr Return		9.28%	11.93%	10.44%	7.80%	6.66%	0.43%
Risk		5.55	4.72	6.28	5.60	5.35	0.56
Sharpe Ratio		1.59					

### PSERS Fund Risk (1988-2018)



### PSERS Sharpe Ratio (FY 1988-2018)

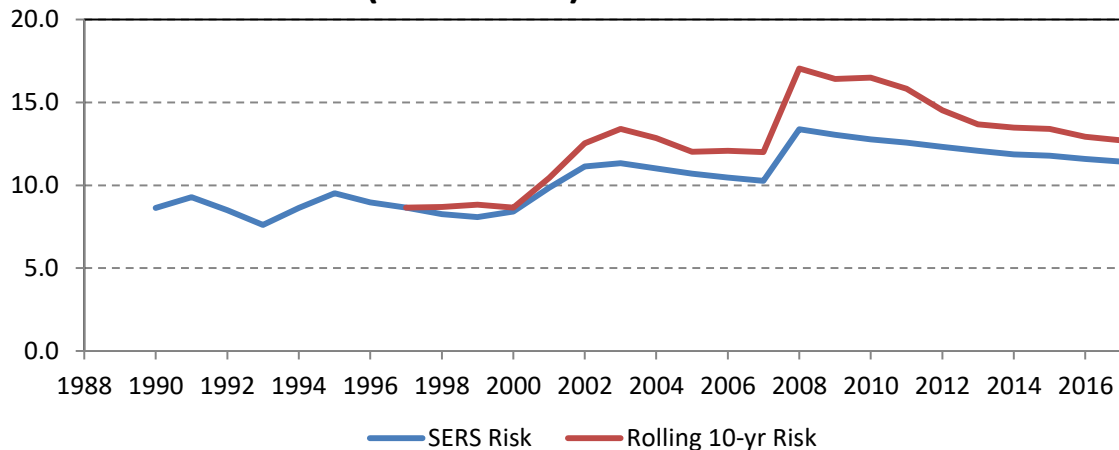


# Risk-Adjusted Performance and Context Considerations

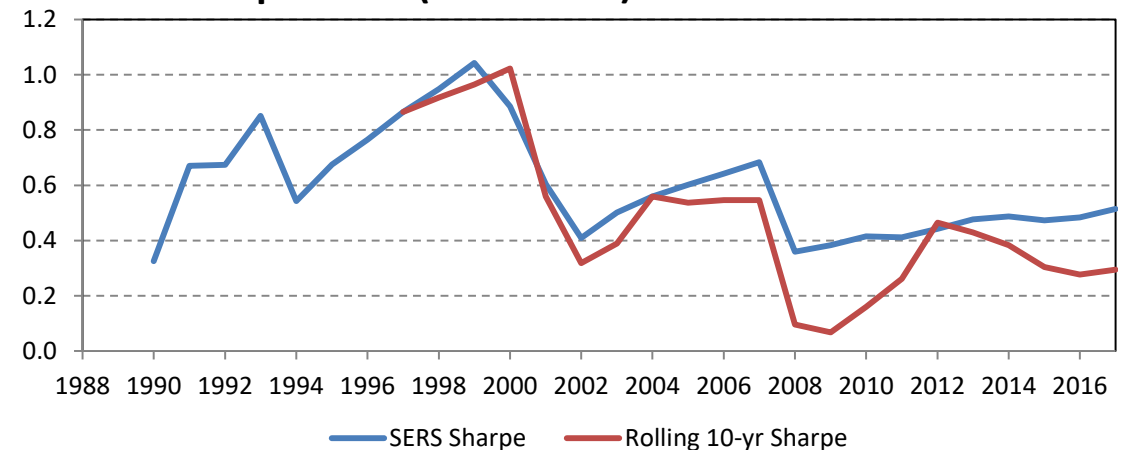
SERS:

	SERS	Retn %	Balanced Benchmarks				T-Bill
			US 60/30/5/5	Global Bal	SERS Global	Quasi-LDI	
<b>30yr</b>	Return	8.98%	9.38%	9.33%	9.32%	7.89%	3.09%
	Risk	11.44	11.12	11.83	12.02	9.01	2.56
	Sharpe Ratio	0.51	0.57	0.53	0.52	0.53	
	Information Ratio vs.		-0.08	-0.07	-0.06	0.16	
<b>10yr</b>	Return	4.06%	7.08%	6.56%	6.46%	6.01%	0.33%
	Risk	12.72	12.19	14.23	14.54	11.11	0.49
	Sharpe Ratio	0.29	0.55	0.44	0.42	0.51	
	Information Ratio vs.		-0.62	-0.38	-0.38	-0.07	
<b>5yr</b>	Return	8.27%	10.75%	9.46%	9.40%	6.48%	0.26%
	Risk	5.99	6.72	7.34	7.56	4.96	0.36
	Sharpe Ratio	1.34					

SERS Fund Risk (1988-2017)



SERS Sharpe Ratio (1988-2017)



# Risk-Adjusted Performance and Context Considerations

---

## Key Takeaways:

- Risk-Adjusted Performance of both plans against very simple US balanced or global balanced allocations of public indices has been poor.
- Overall fund risk of the two plans increased over longer horizons and remains at high levels, despite recent market volatility decreasing across equities, bonds, and currencies.
- Sharpe Ratios for both plans decreased over the 10 and 30 year periods, although 5 year Sharpe Ratio did increase due to significantly lower market volatility.
- Negative 10 year information ratios suggest inferior strategic policy allocation of public funds has underperformed simpler US and global balanced strategies of risk-adjusted public market indices.

## Contributing Risk Factors and Areas of Concern to Address:

- PSERS allocations to high cost illiquid asset classes, inefficiency of incorporating commodities, and leverage to fund extended fixed income duration as interest rates climb and Federal Reserve's Government bond holdings are reduced.
- SERS allocation to private equity although allocation to global equity is better placed.

# Cost Saving Recommendations

---

## Summary

- Based on our abbreviated analysis, we believe that there are certain cost saving strategies that are not appropriate for the PA plans because they do not appear to have the governance required to adequately monitor them.
- We do not think that increasing internal management is advisable.
- The risk-adjusted performance of the plans would indicate that allocations to illiquid and costly asset classes such as private equity need to be addressed.

# Cost Saving Recommendations

---

In terms of the cost saving options available to the plans:

## **1. Renegotiation and Monitoring of Current Mandates**

- Without changing the asset allocation and risk levels of the current portfolio, renegotiations should take place along best practice guidelines. Our colleague Marcel will provide details for the plans on their current public equity mandates.

## **2. Strategy Simplification**

- A move to simpler strategies such as from Active to Passive and from Private to Public could be considered and investigated further. This may not only reduce costs but help bring the Governance Budget of the plans in line with the level of complexity contained within it. Consideration would need to be given to the active risk associated with these changes as well as the extra short-term volatility that might come with moving to passive indexes for example.



---

**THANK YOU**

# NOVARCA

PA Treasury  
Investment Cost Transparency & Optimization  
for SERS and PSERS  
Oct, 2018



# Contents

1.	Executive Summary	3
2.	Overview	6
3.	SERS Mandates	7
4.	PSERS Mandates	11
5.	Private Equity Savings	17
6.	Summary of Savings Potential	18
7.	Disclaimer	10



# Executive Summary

**We were asked to find savings opportunities to achieve actuarial savings of \$1.5 billion for each System** compounded over 30 years under the assumption of a 7.25% annual return.

**Our analysis is purely limited to best-practice procurement in order to achieve cost reductions while keeping the existing risk/return exposure.** None of our recommendations should be interpreted as investment advice, as our analyses and recommendations are done under the assumption that asset allocation and manager selection remain unchanged.

**We believe that both plans are able to meet the target,** although due to the different size of the plans, achieving the target proves to be more difficult for the smaller of the two plans, SERS.

Over a 30-year time horizon, taking into account 7.25% interest for both SERS and PSERS; the plans' current investment strategy carries the potential to achieve the following actuarial savings:

Plan	Identified Savings Potential
SERS	\$ 1.51 B
PSERS	\$ 4.96 B

We have not been granted full access to the information needed in order to perform an in-depth analysis across the entire portfolios of SERS/PSERS. In order to produce a report in time for this hearing we have, thus, focused our analysis on Public Equity mandates, where we have been given more, albeit still not sufficient, information in the case of SERS.



# Executive Summary

## **SERS Public Equity Mandates:**

Many passive mandates, which seem generally to be priced fairly.

There are four primary candidates for in-depth review and potential renegotiation:

- SERS Active Mandate 1: Agreement almost 9 years old; returns (3y ending June 2017) are poor.
- SERS Active Mandate 3: Very expensive for Developed World Small Cap.
- SERS Active Mandate 4: Agreement 8 years old.
- SERS Active Mandate 6: Agreement 5 years old.

**Most Favored Nation (MFN) clauses don't guarantee best terms!** And in fact; over time, they tend to serve the asset manager more than the asset owner.

## **PSERS Public Equity Mandates**

**More expensive mandates don't guarantee better returns.**

The cheapest out of five mandates in “International All Cap Equities,” has enjoyed the best returns. This cheapest mandate is priced at 44 bps, the average of the other four is 81.75 bps.

There are several primary candidates for potential renegotiation:

- All of the five International Equities Small Cap mandates.
- PSERS Passive Mandate 1, as SERS pays lower fees for the same.
- PSERS Active Mandate 3: Absence of tiers above \$200M is not in line with best practice.
- PSERS Active Mandate 4: Worst performer in its category, despite highest fixed fee.



# Executive Summary

## Lack of Transparency

Despite having asked for unredacted contracts and limiting our request to Public Equity, **to date, we have not received these contracts for SERS**. Our analysis, specifically on SERS, is thus based on assumptions and average rates that we found in consultant reports.

Due to **the lack of data provided by the plans, it is difficult to make a statement about the potential overcharges, which the SEC found in 2014 to be likely in more than 50% out of all Private Equity General Partners**. For most investors, Private Equity is the most expensive asset class; therefore, potential cost savings can be substantial. However, they need to be captured over a longer time horizon than with other asset classes, as fees can only be renegotiated upon new investments, after a typical holding period of 10 years.

## Performance Data

The data on performance used at the time of producing this report is as per end of June 2018.



# Self-Assessment of the Plans

As part of our review, we have asked the plans to participate in a self-assessment on their investment cost. Here is a shortened version and excerpt of the answers provided.

## 1. On a scale from 1-10, where do you think your management fees are placed in the market (1 being least competitive, 10 being most competitive)?

PSERS	SERS
10	10

Both plans justify this (self-assessed) ranking, by the fact they have Most Favored Nation (MFN) clauses in place.

Novarca Comment: **We do not believe the plans merit a 10. Although there are many things that the Plans are doing very well, there are gaps that can and should be closed.** Most Favored Nation (MFN) clauses are not a guarantee of best terms.

## 2. What is the average age of the fee schedules in your portfolio?

PSERS	SERS
Not tracked.	Not tracked.

Novarca Comment: It is essential to review contractual terms on a regular basis; at the very least every 2-3 years. **We, therefore, believe the plans should actively track the age of the agreements.**



# Self-Assessment of the Plans

## 4. What percentage of your asset managers have confirmed in writing that they don't receive commissions, rebates, retrocessions and the like; associated with your investment?

PSERS	SERS
<i>"PSERS does not maintain this information."</i>	SERS has not directly answered the question, however indicates that this is addressed as part of their Due Diligence.

Novarca Comment: **This is an area of potentially big conflicts of interest and should be monitored with great discipline.** Most pension funds we work with have all asset managers confirm in writing whether or not they have received such benefits.

## 5. What percentage of your asset managers have confirmed in writing that they don't pay and have not paid any commissions, introduction fees or the likes associated with your investments?

PSERS	SERS
<i>"PSERS does not maintain this information."</i>	SERS has not directly answered the question; however, SERS indicates that this is addressed as part of their Due Diligence process. SERS also mentions that they do not directly work with placement agents and requires the fund sponsors to attest that no placement agent fees have been paid to attract SERS' investment.

Novarca Comment: **We believe it is crucial to have full transparency on where your fees are ending up.** There have been many situations in the past where parties were inappropriately compensated for capital introduction; not being fully made aware of such potential payments carries enormous reputational risk for the plan and the state.





# Self-Assessment of the Plans

## 8. Do your brokers, or those of your managers, make use of bundled brokerage?

PSERS

SERS

*"Yes, in some cases."*

*"Yes, several of them."*

Novarca Comment: Bundled brokerage incentivizes the managers to churn the portfolio more than necessary, in order to generate soft dollars, such as, with Research. It is never clear if such soft dollars are then used for the benefit of the client who created such budgets or not. For example, **in Europe**, with MiFID II regulation coming into force, **bundled brokerage has been banned and has been considered illegal since the beginning of 2018.**

## 9. Are you conducting regular transaction cost analyses on equities, fixed income and FX?

PSERS

SERS

No

*"Yes, on a quarterly basis."*

Novarca Comment: **It is important to regularly perform transaction cost analysis**, as it would highlight potential **shortcomings** in the implementation of a mandate, **such as closet indexing**, churning, market impact, etc.



# Self-Assessment of the Plans

## 10. What do you think is the single biggest hurdle (per asset class, if different) as to why asset management terms cannot be further improved?

PSERS	SERS
Overhead; Capacity.	Capacity.

PSERS partial Quote: “TRADITIONAL ASSET CLASSES: THE TWO GREATEST IMPEDIMENTS ARE THE NEED FOR THE ACTIVE ASSET MANAGER TO HAVE A MINIMUM AMOUNT OF FEES TO COVER OVERHEAD OF THE BUSINESS, ESPECIALLY DURING YEARS WHERE PERFORMANCE MAY BE MORE CHALLENGED.”

Novarca Comment: Although we respect both arguments, we believe that the **mentioned overhead is not applicable in the case of PSERS since all mandates are significant by size and create meaningful management fees for the managers.** And even if it were not the case, it is not a pension plan’s duty to provide support for inefficiencies at their service providers.

We understand that **some strategies/managers indeed have capacity constraints.** We would, **however,** also like to warn that **this is the single most-used negotiating tactic by asset managers to avoid fee conversations, whether it was applicable or not.**

## 12. Do you have procurement guidelines for asset management services in place?

PSERS	SERS
“No.”	Yes, to some degree

Novarca Comment (excerpt): We believe it is **important to have procurement guidelines in place, as they ensure a structured and replicable process** whenever investment management agreements are signed.



# SERS Mandates – Findings

US Equity Mandate, AuM, Benchmark	Findings
<b>SERS Active Mandate 1</b> <b>\$476M</b> Russell Mid Cap Index	<ul style="list-style-type: none"><li>• 0.49% (terms unclear)</li><li>• <b>Active Mandate</b></li><li>• No visibility on contract details.</li><li>• This is a candidate for review, <b>contract 9 years old</b>, recent returns (3Y ending June '17) are poor.</li><li>• This is expensive! SERS has a Small Cap mandate that is cheaper than this Mid-Cap mandate. <b>We think that this nearly-\$500M mandate should be about 25-30 bps.</b></li></ul>
<b>SERS Passive Mandate 1</b> <b>\$5,570M</b> Russell 1000 Index	<ul style="list-style-type: none"><li>• &lt;1bp (terms unclear)</li><li>• <b>Passive Mandate</b></li><li>• No visibility on contract details.</li><li>• <b>This mandate appears to be priced fairly.</b></li></ul>
<b>SERS Active Mandate 2</b> <b>\$680M</b> Russell 2000 Growth Index	<ul style="list-style-type: none"><li>• 0.46% (terms unclear)</li><li>• <b>Active Mandate</b></li><li>• No visibility on contract details.</li><li>• This mandate has return 1.01% above benchmark over previous 3 years. This implies that <b>almost half of the gross alpha is being paid to the manager.</b></li><li>• PSERS has a contract for similar mandate with this manager at a base fee of only 0.05% with 20% Perf Fee above hurdle of MSCI US Small Cap Growth Index. This is an attractive fee structure to compare to.</li><li>• Although this mandate is priced better than the Mid Cap Value portfolio above (SERS Active Mandate 1), we think an active US Small Cap mandate of \$600-750M <b>should be priced at about 25-30 bps.</b></li></ul>
<b>SERS Passive Mandate 2</b> <b>\$336M</b> Russell 2000 Core Index	<ul style="list-style-type: none"><li>• 0.02% (terms unclear)</li><li>• <b>Passive Mandate</b></li><li>• No visibility on contract details.</li><li>• <b>This mandate appears to be priced fairly.</b></li></ul>
<b>SERS Passive Mandate 3</b> <b>\$615M</b> Russell 2000 Value Index	<ul style="list-style-type: none"><li>• 0.02% (terms unclear)</li><li>• <b>Passive Mandate</b></li><li>• No visibility on contract details.</li><li>• <b>This mandate appears to be priced fairly.</b></li></ul>



# SERS Mandates – Findings

International Equity – Developed World Mandate, AuM, Benchmark	Findings
<b>SERS Passive Mandate 4</b> <b>\$4,926M</b> MSCI World ex-US Index	<ul style="list-style-type: none"><li>• &lt;1bp fee (terms unclear)</li><li>• <b>Passive Mandate</b></li><li>• No visibility on contract details.</li><li>• <b>This mandate appears to be priced fairly.</b></li></ul>
<b>SERS Active Mandate 3</b> <b>\$604M</b> MSCI World ex-US (Small Cap) Index	<ul style="list-style-type: none"><li>• 0.68% (terms unclear)</li><li>• <b>Active Mandate</b></li><li>• No visibility on contract details.</li><li>• This mandate is very expensive for Developed World Small Cap. We think the fee <b>should be 40-45 bps for AuM between \$300M-\$600M.</b></li></ul>
<b>SERS Active Mandate 4</b> <b>\$913M</b> MSCI World Index	<ul style="list-style-type: none"><li>• 0.39% fee (terms unclear)</li><li>• <b>Active Mandate</b></li><li>• No visibility on contract details.</li><li>• <b>We think 25-30 bps tiered fee rate</b> is the fair price for Developed World mandates for \$1B.</li></ul>



# SERS Mandates – Findings

International Equity – Emerging Markets Mandate, AuM, Benchmark	Findings
<p><b>SERS Passive Mandate 5</b> <b>\$681M</b> MSCI Emerging Markets (All Cap) Index</p>	<ul style="list-style-type: none"><li>• 0.09% (terms unclear)</li><li>• <b>Passive Mandate</b></li><li>• No visibility on contract details.</li><li>• Additional allocation appears to have been made to this mandate as the AuM was \$331M at the end of Dec '17.</li><li>• Similar products from competing managers are priced equivalently for allocations &gt;\$100M. In light of recent additional allocation, we believe SERS has <b>room to negotiate</b> an improvement and will particularly benefit from switching to a tiered fee structure if and when they allocate more.</li></ul>
<p><b>SERS Active Mandate 5</b> <b>\$320M</b> MSCI Emerging Markets (All Cap) Index</p>	<ul style="list-style-type: none"><li>• 0.40% fee (terms unclear)</li><li>• <b>Active Mandate</b></li><li>• No visibility on contract details.</li><li>• <b>This appears to be priced fairly.</b></li></ul>
<p><b>SERS Active Mandate 6</b> <b>\$99M</b> MSCI Emerging Markets (Small Cap) Index</p>	<ul style="list-style-type: none"><li>• 0.65% fee (terms unclear)</li><li>• <b>Active Mandate</b></li><li>• <b>No visibility on contract details.</b></li></ul>
<p><b>SERS Active Mandate 7</b> <b>\$326M</b> MSCI Emerging Markets (All Cap) Index</p>	<ul style="list-style-type: none"><li>• 0.40% fee (terms unclear)</li><li>• <b>Active Mandate</b></li><li>• No visibility on contract details.</li><li>• <b>This appears to be priced fairly.</b></li></ul>



# SERS Mandates – Comments

## Public Equity

**Novarca has not been given unredacted contracts.** Only one party's interests are served by not being transparent on asset managers' contractual details: that of the asset managers.

From our experience, whenever clients are told that contractual terms are a trade secret of the manager, it's an indication that these should be reviewed.

**Due to the lack of transparency on contractual language, we will not be able to make meaningful statements on optimization potential (e.g., economies of scale, best practice language, etc.).**

From an RVK report we have taken the average fees paid on Public Equity and have used them for our analysis:

**Passive mandates seem generally fairly priced.**

One of the two active mandates in International Developed Equity, SERS active mandate 3, seems very expensive. We strongly advise the contractual language be reviewed in greater detail.

## Private Equity

This report is not focused on Private Equity, but we have learned that there are a large number of individual Private Equity investments in SERS' portfolio. Such a large volume of small Private Equity investments is rather unusual from our experience and, by definition, difficult to manage / monitor.

Although Private Equity allocation may be smaller than public market allocation, because the fees are higher on average, the smaller allocation to Private Equity may in fact cost more in total than the larger allocation to Public Equity.

Also, we have learned that there are thoughts of selling some of these through the secondary market. That, from experience, is a very (!! ) expensive exercise due to lower secondary market value and we strongly advise such a decision be carefully reviewed before implementing.



# PSERS Mandates – Findings

International Equity – Emerging Markets Mandate, AuM, Benchmark	Findings
<p><b>PSERS Active Mandate 1</b> <b>\$323M</b> MSCI EM (Small Cap) Index 70%, MSCI EM (All Cap) Index 15%, MSCI Frontier EM Index 15%</p>	<ul style="list-style-type: none"> <li>0.55% running costs (fee: 0.45% fixed + 25% Perf Fee above composite hurdle; projection 3y ending June 18)</li> <li><b>Active Mandate</b></li> <li>Recently switched from 0.90% flat fee to this performance fee schedule. As shown below, the new fee schedule would be expensive by a large margin in 5 out of the previous 9 years. Of particular interest would be 2011, where a -12.98% return under the old schedule would become -16.14% return under the new schedule.</li> </ul> <p>Please use “Reference Table” below*.</p>
<p><b>PSERS Passive Mandate 1</b> <b>\$467M</b> MSCI Emerging Markets (All Cap) Index</p>	<ul style="list-style-type: none"> <li>0.124% tiered-rate</li> <li><b>Passive Mandate</b></li> <li>Small part of the internally managed \$3.2B ACWI ex-US portfolio that has been allocated to an external manager.</li> <li>SERS are paying BlackRock 9bps for the same product, which until Dec '17, had a smaller allocation than PSERS.</li> <li>As an example, Vanguard (VEMIX) Institutional Plus share class is available for 9bps for investments &gt; \$100M. Consequently, we think PSERS will benefit from using an improved tiered fee structure to benefit from scale for any allocation above \$100M.</li> </ul>

\* Reference Table

PSERS Active Mandate 1					Old Fee Schedule		New Fee Schedule						
					Flat fee @		Fixed Fee @	Perf Fee @	Fixed Fee (FF)	Perf Fee (PF)	Total fee Payable (TF = FF + PF)	Net Ret w/ Perf Fee (NNR = (GR - TF))	Net Value Added (NNR - BR)
Calendar Year	Net Ret (NR)	Bnchmrk Ret (BR)	Net Value Added (NR - BR)	Gross Return (GR)	0.90%		0.45%	25%					
2017	35.73%	33.33%	2.40%	36.63%			0.45%	0.71%	1.16%	35.47%	2.14%	-0.26%	
2016	-3.95%	4.03%	-7.98%	-3.05%			0.45%	0.00%	0.45%	-3.50%	-7.53%	0.45%	
2015	-10.36%	-9.81%	-0.55%	-9.46%			0.45%	0.00%	0.45%	-9.91%	-0.10%	0.45%	
2014	2.13%	1.49%	0.64%	3.03%			0.45%	0.27%	0.72%	2.31%	0.82%	0.18%	
2013	1.87%	1.01%	0.86%	2.77%			0.45%	0.33%	0.78%	1.99%	0.98%	0.12%	
2012	28.06%	22.60%	5.46%	28.96%			0.45%	1.48%	1.93%	27.03%	4.43%	-1.03%	
2011	-12.98%	-26.96%	13.98%	-12.08%			0.45%	3.61%	4.06%	-16.14%	10.82%	-3.16%	
2010	42.87%	27.47%	15.40%	43.77%			0.45%	3.96%	4.41%	39.36%	11.89%	-3.51%	
2009	119.09%	114.32%	4.77%	119.99%			0.45%	1.31%	1.76%	118.24%	3.92%	-0.86%	



# PSERS Mandates – Findings

International Equity – All-Country World (All Cap) Mandate, AuM, Benchmark	Findings
<p><b>PSERS Active Mandate 2</b> <b>\$1,167M</b> MSCI ACWI ex-US (All Cap) Index</p>	<ul style="list-style-type: none"><li>• 0.51% running costs (fee: 23.4bps fixed + 8% Perf Fee over hurdle of MSCI ACWI ex-US +0.42%; projection 3y ending June '18)</li><li>• <b>Active Mandate</b></li><li>• Although we think that Base Fee alone is a fair price to pay for this mandate, it has performed well over last few years, especially as compared to PSERS Active Mandate 3 and it is fine to reward the manager for such out-performance. But we think that to discourage excessive risk-taking, the <b>Performance Fee component should be capped.</b></li></ul>
<p><b>PSERS Active Mandate 3</b> <b>\$1,117M</b> MSCI ACWI ex-US (All Cap) Index</p>	<ul style="list-style-type: none"><li>• 0.327% tiered-rate</li><li>• <b>Active Mandate</b></li><li>• Top tier ends at \$200M at 30bps. We think <b>additional tiers should be added at \$500M (~25bps), \$750M (~20bps) and \$1B (~15bps).</b></li></ul>
<p><b>PSERS Active Mandate New</b> <b>\$107M</b> MSCI ACWI ex-US (All Cap) Index</p>	<ul style="list-style-type: none"><li>• New allocation of \$400mln at unknown fees, as only redacted contract is available.</li><li>• <b>Active Mandate</b></li><li>• We have reviewed the investment recommendation by PSERS and Aksia, and noticed that the recommendation does not show any evidence of alternatives being considered as part of the process while negotiating fees with this manager. As noted separately in this report, this is despite PSERS answering “Yes” to our self-assessment question whether this sort of comparison was an intrinsic part of their investment process.</li></ul>
<p><b>PSERS Active Mandate 4</b> <b>\$231M</b> MSCI ACWI ex-US (All Cap) Index</p>	<ul style="list-style-type: none"><li>• 0.85% running costs (fee: 0.67% fixed + 20% Perf Fee over Hurdle; projection 3y ending June '18)</li><li>• <b>Active Mandate</b></li><li>• <b>Worst performing in the last 3 years and most expensive</b> out of the 3 MSCI ACWI (ex-US) All-Cap mandates by PSERS. High Performance fee despite having highest fixed fee out of the 3. We think this mandate <b>should be negotiated to the fee level of PSERS Active Mandate 3.</b></li></ul>





# PSERS Mandates – Findings

International Equity – All-Country World (Small Cap) Mandate, AuM, Benchmark	Findings
<b>PSERS Active Mandate 5</b> <b>\$270M</b> MSCI ACWI ex-US (Small Cap) Index	<ul style="list-style-type: none"><li>• 0.42% tiered-rate</li><li>• <b>Active Mandate</b></li><li>• <b>Cheapest and best performing mandate out of the 5 in this asset-class.</b></li></ul>
<b>PSERS Active Mandate 6</b> <b>\$306M</b> MSCI ACWI ex-US (Small Cap) Index	<ul style="list-style-type: none"><li>• 0.85% tiered-rate</li><li>• <b>Active Mandate</b></li><li>• This manager’s MSCI All Country mandate is more expensive than its MSCI Emerging Markets mandate, which is hard to explain.</li><li>• There is no reason this mandate should be paid twice that of PSERS Active Mandate 5, especially with lower returns. We think that a <b>tiered fee structure with an aggregate of 0.40% will be fair.</b></li></ul>
<b>PSERS Active Mandate 7</b> <b>\$219M</b> MSCI ACWI ex-US (Small Cap) Index	<ul style="list-style-type: none"><li>• 0.87% tiered-rate</li><li>• <b>Active Mandate</b></li><li>• There is no reason this mandate should be paid twice that of PSERS Active Mandate 5, especially with lower returns. We think that a <b>tiered fee structure with an aggregate of 0.40% will be fair.</b></li></ul>
<b>PSERS Active Mandate 8</b> <b>\$98M</b> MSCI ACWI ex-US (Small Cap) Index	<ul style="list-style-type: none"><li>• 0.74% tiered-rate</li><li>• <b>Active Mandate</b></li><li>• Smallest of the mandates, which explains the higher price on tiered schedule. We think that a mandate of this size <b>should be priced at 0.50%-0.60%.</b></li></ul>
<b>PSERS Active Mandate 9</b> <b>\$159K</b> MSCI ACWI ex-US (Small Cap) Index	<ul style="list-style-type: none"><li>• 0.80% fixed fee</li><li>• <b>Active Mandate</b></li><li>• Absence of tiered structure means that any economies of scale are to the full benefit of the manager. But since this mandate appears to have been cut (AuM has dropped from \$156M in June ’17), we will not make a recommendation.</li></ul>



# PSERS Mandates – Comments

## **Public Equity**

Two managers capture a (too) large portion of the alpha generated.

- PSERS Active Mandate 4 (38% in 2017, 3y rolling), and
- PSERS Active Mandate 1 (45% in 2017, 3y rolling).

**International Small Cap mandates show large price differences, ranging from 44bps to 88bps (on similar sizes). Interesting side note: the cheapest is the best performer in recent years.**

**30% of mandates' fee schedules have not been revised in 5 years or longer.**

**SERS is paying lower fees on the same PSERS Passive Mandate 1 product, despite SERS allocating smaller amount until recently.**

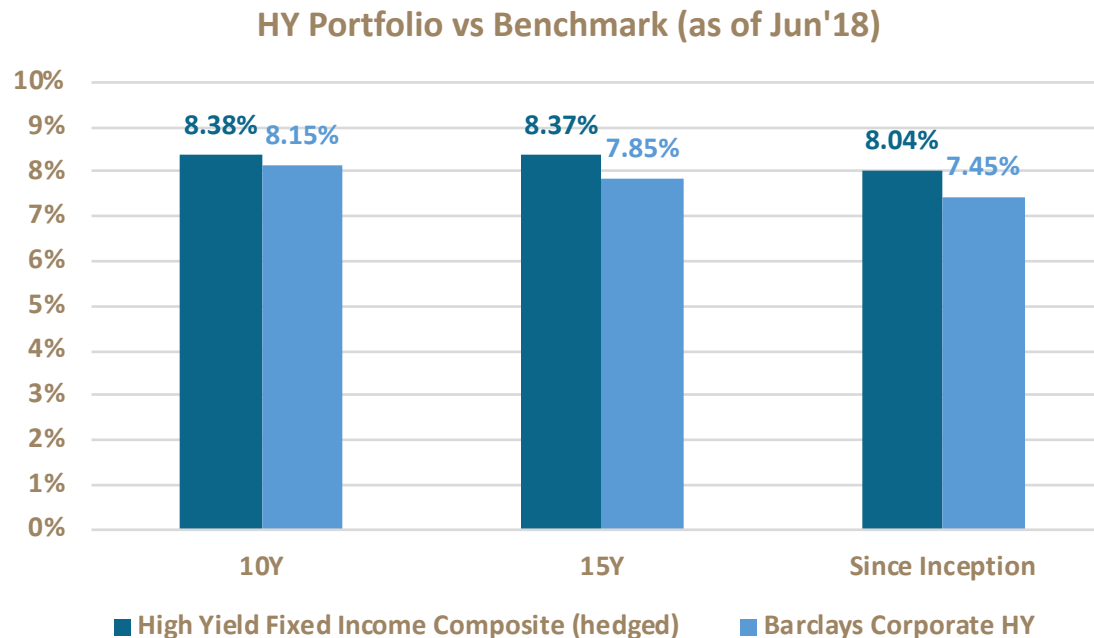
PSERS does not seem to have a sufficiently granular choice of benchmarks for their active managers. Although this helps in overall comparison, it could be problematic where performance fees are or have been introduced as one needs to make sure the benchmark properly reflects the risk of the investment.

# ✓ PSERS Mandates – High Yield / Opportunistic

PSERS' investments of \$5.02B (as of Jun '18) in this asset class are in, essentially, Private Debt Limited Partnerships. There are 41 external mandates classified under four subclasses of Mezzanine HY, Opportunistic HY, Real Asset HY and Senior Loans HY. All these investments are benchmarked against Barclays US Corp High Yield Index. The performance of each allocation within are wildly different, though. Over the previous 3 years, **the performance of various LPs have ranged from -25.57%p.a. to +22.13%p.a. compared to benchmark performance of +5.53%p.a.**

Long term performance has been similar to the benchmark. **The 10 year net value add was +0.23% p.a. (= Portfolio net return of 8.38%p.a. - Benchmark return of 8.15%p.a.).**

- Please note that in the previous reporting period, ending June 2017, over 10 years this number was actually negative -0.22% p.a. (!!)





# PSERS Mandates – High Yield / Opportunistic (cont'd)

## Base Management Fee:

- As per the report “Response to PSERB Resolution 2017-41 Re: Management Fees – July 2018,” the aggregate fees paid by PSERS is 1.14%.
- As per the presentation “General Partner Ownership Interest (a.k.a. Carried Interest),” dated Oct 12, 2018; Net Management Fee for Private Credit in CY 2016 (AuM \$4.16B) and CY 2017 (AuM \$4.82B) were both 1.20% based on end-of-year AuM.

Assuming only Base Management Fee was paid, and it was a stable 1.14% historically, following table shows that 83% of the entire alpha is being paid as Base Management Fee to the asset managers.

10Y	
High Yield Composite Net Return (NR)	8.38%
Benchmark Return (BR)	(-) 8.15%
Net Alpha (NA)=NR+BR	0.23%
Base Management Fee (BF)	(+) 1.14%
Gross Alpha (GA)=NA+BF	1.37%
Share of Gross Alpha retained by Manager BF/GA	83%

## Carried Interest:

- As per the presentation “General Partner Ownership Interest (a.k.a. Carried Interest),” dated Oct 12, 2018; Carried Interest for Private Credit in CY 2016 (AuM \$4.16B) was 1.76% and in CY 2017 (AuM \$4.82B) was 1.85% based of end-of-year AuM.

Now, if we assume an additional Carried Interest of 1.20% (average of 2016 and 2017) was paid historically, then the following table shows that **93% of gross alpha was paid as fee (Base Management Fee + Carried Interest) to the asset managers** (100% in previous 10year period).

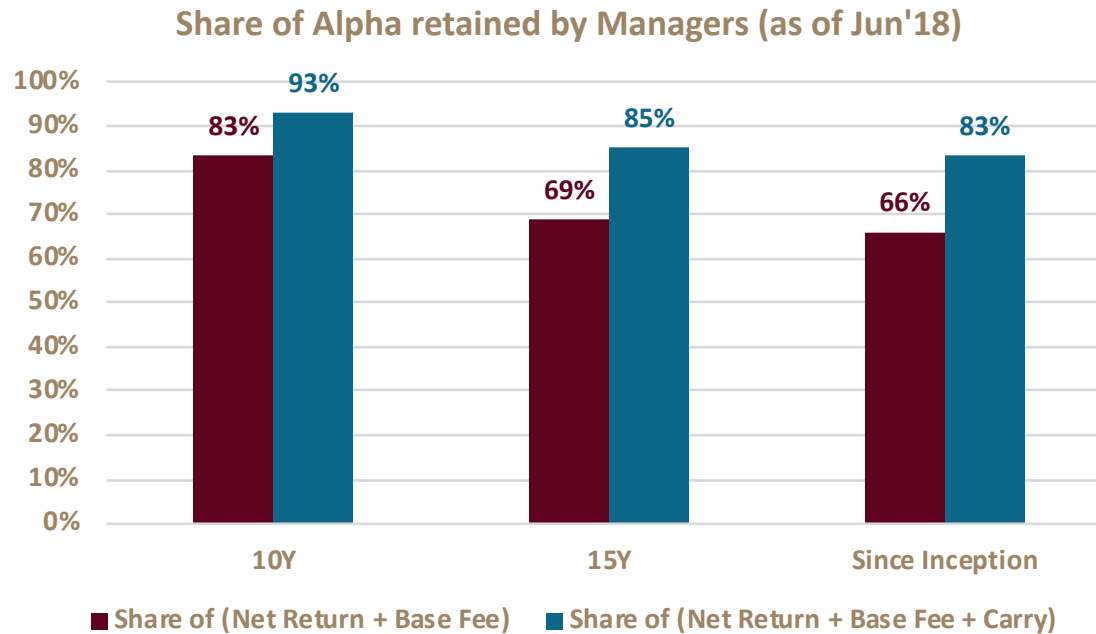
10Y	
High Yield Composite Net Return (NR)	8.38%
Benchmark Return (BR)	(-) 8.15%
Net Alpha (NA)=NR+BR	0.23%
Base Management Fee (BF)	(+) 1.14%
Carried Interest (CI)	(+) 1.80%
Gross Alpha (GA)=NA+BF+CI	3.17%
Share of Gross Alpha retained by Manager (BF+CI)/GA	93%

Both above estimates do not include the cost of an internal team that selects and manages these (currently, 41) allocations, and fund level operating expenses.



## PSERS Mandates – High Yield / Opportunistic (cont'd)

The following graph shows this share of alpha that is paid out to the manager for various periods.



Novarca has successfully renegotiated multiple **HY active mandates with fees of 25-30 bps** (compared to the 114bps paid here), **contracted without any carried interest**, for total assets that were less than a fifth of what PSERS has in its portfolio in this asset class. That represents savings of >84bps (or \$42M) annually on base fees alone, or >264bps (or \$132M) annually on total fees including carried interest.

While the performance record of PSERS' investments in this asset class over >15 years was similar to long-term returns of the asset-class benchmark, it **generated a significant multiple of the costs of a passive replication of such benchmark would have cost**. **These passive mandates would be more liquid, more transparent, have smaller Operating Expenses, and incur negligible Internal costs compared to Private Debt LPs.**



# Private Equity Savings – SERS and PSERS

## Reducing Private Equity Fees (identical for both SERS and PSERS)

Without having been given full access to the Private Equity investment details, we can't make a very thorough statement. We can, however, share some observations based on our experience with other clients. **Meaningful savings in Private Equity are best achieved upon time of reinvesting.** The average life of Private Equity investments (not specific to PSERS/SERS) is around 10 years. We, therefore, assume that within the next five years, the average of the mandates will come to the end of their lifecycle / reinvestment phase. Although the total Private Equity costs easily reach 700 bps and more, the **fee components than have some room for negotiation** (see below table as an excerpt) **account for roughly 300 bps p.a.** From our experience, **achieving savings of 10% or more on the 300 bps is feasible upon reinvesting.** Therefore we would encourage the plans to set a fee savings target of 10% upon the next reinvesting.

Please note that the plans indicate Base Management Fees of 163 bps (SERS) and 138 bps (PSERS) in their annual and consultant reports. Since we don't have enough data on the plans Private Equity investments to give a more precise estimate.

## Here are a few examples of areas in which these savings can be achieved:

- Don't pay on committed capital, only on invested (not applicable for VC)
  - Private Equity managers often charge their fees based on the committed capital, which is often subject to negotiation and makes an enormous difference in absolute fees at the beginning of the investment.
- Ensure fee reductions during the investment phases
  - Do so by trying to understand GP's budget for running the fund and negotiate lowest per-investment phase management fees upon it.
- Cap monitoring, oversight and legal fees
  - These, like other fees are often subject to negotiation.

# ✓ Private Equity Savings – SERS and PSERS (cont'd)

## Examples (contd.):

- Negotiate carry terms carefully
  - The mechanics of how carry is calculated must not leave any room for interpretation and one needs to simulate potential carry fees, based on different return scenarios, carefully.
- Re-calculate GP reported carry calculations
  - This could either be done by internal resources or using third party services, including software based solutions.
- Make pitch materials part of the IMA
  - Marketing materials often suggest terms that later on disappear in the IMA's.
- Add language to prevent Zombie funds
  - Negotiate most favorable terms for the ability to the removal of GP for non-performance.
- Invest the smallest amount possible and negotiate Sidecar / Co-investment access (as was already suggested by PSERS)
  - This has already been suggested by PSERS in their savings suggestions.



# Summary of Savings Potential – SERS

SERS		
Asset Class	Savings Potential, p.a.	Implementation
Public Equity	\$4.87 M	Assumed, immediate
Private Equity	\$12.18 M	Assumed, upon reinvestment
Other Asset Classes	<i>No view to date</i>	
Total (p.a.)	\$17.05 M	
Total 30 Years (compounded) (@ 7.25% assumed return)	<b>\$1.51 B</b>	
	<i>Assuming 30 years for Public Equity = \$584 M Assuming 25 years for Private Equity = \$926 M</i>	

For SERS, we are confident that savings can be achieved but because **we don't have unredacted contracts** to base our view upon, there remains a **level of uncertainty**.

Due to a lack of data on Private Equity for both plans, we are working under the following, conservative assumptions based on our experience:

- Negotiable fee components of 3.00% p.a. (whereas, total Private Equity Costs are higher)
- Average life of Private Equity investment of 10 years, resulting in an average 5 years before reinvesting
- Achievable savings of 10% upon reinvesting of each Private Equity allocation





# Summary of Savings Potential – PSERS

PSERS		
Asset Class	Savings Potential, p.a.	Implementation
Public Equity	\$4.91 M	Firm, immediate
Private Equity	\$15.48 M	Assumed, upon reinvestment
High Yield	\$42.50 M	Firm, upon reinvestment
Other Asset Classes	<i>No view to date</i>	
Total (p.a.)	\$62.89 M	
Total 30 Years (compounded) (@ 7.25% assumed return)	<b>\$4.96 B</b>	
	<i>Assuming 30 years for Public Equity = \$560 M</i> <i>Assuming 25 years for Private Equity = \$1.17 B</i> <i>Assuming 25 years for High Yield = \$3.23 B</i>	

For PSERS, we have a **high-conviction** view of how **savings can be achieved in Public Equity and High Yield**, as detailed in the report. For HY we have assumed an average life before reinvesting of 5 years, identical to Private Equity, although it is likely to be shorter.

Due to lack of data on Private Equity for both plans, we are working under the following, conservative assumptions based on our experience:

- Negotiable fee components of 3.00% p.a. (whereas total Private Equity Costs are higher)
- Average life of Private Equity investment of 10 years, resulting in average 5 years before reinvesting
- Achievable savings of 10% upon reinvesting of each Private Equity allocation



# Shared Investment Mandates – Additional Savings ?

We were asked to give our view on whether shared investment mandates would bear the potential for additional savings. Both the Plans very likely have different coverage ratios or investment objectives based on their own liability profiles. But, wherever there are opportunities on the investment side, it would be wise to look for synergies.

**We believe there is potential for some additional savings**, but that depends on:

- **Asset Allocation – SAA/TAA decisions** contribute the most to returns. The Plans could look to homogenize their Macro views to come up with uniform asset allocation.
- **Manager Selection – Manager due-diligence** is a time-consuming and manpower intensive process. Both the Plans will greatly benefit by pooling their highly skilled resources.
- **Passive Mandates** – These will be the easiest to streamline but will probably bring the smallest savings.
- **Assets per Mandate** – An asset manager's **production costs** for each mandate are not related to its asset size. By combining assets, the Plans will not incur these base costs separately and will benefit from **reduced marginal rates**. In our experience, tiered schedules reduce fees by 10-15% per tier. PSERS currently has \$3.7B in active mandates, compared to \$3.4B for SERS. **Cutting half** of the total mandates and **doubling the other half** would accrue significant **additional savings**. However, we can't currently put a number to this as the mandates of the two plans don't overlap by much.

Please note that **we refrain from any statement on organizational savings**, as we neither have data nor a view on it. Also, in order to generate above savings, we have assumed there are similarities in Plans' objectives.



# Disclaimer

This document has been produced by Novarca International, its advisers and its affiliates (together, “Novarca”).

The findings, ratings and/or opinions expressed herein are the intellectual property of Novarca and are subject to change without notice. They are not intended to convey any guarantees as to the future performance of the investment products, asset classes or capital markets discussed. Past performance does not guarantee future results. The future value of investments may rise and fall with changes in the market. This document does not constitute or form part of any offer to issue or sell, or any solicitation of any offer to subscribe or purchase, any securities nor shall it or the fact of its distribution form the basis of, or be relied on in connection with, any contract thereof. Potential investors should consult their advisers to discuss the suitability and implications of the underlying products and instruments referred to therein.

Information contained herein has been obtained from a range of third party sources and from conversations held with stakeholders. While the information is believed to be reliable and Novarca have used their best efforts in collecting the information, Novarca has not sought to verify it and has not been subject to an Audit. As such, Novarca makes no representations or warranties as to the accuracy of the information presented.

The work presented in this report represents our best efforts and judgments based on the information available at the time this report was prepared. No guarantee or warranty is made as to the reasonableness of the assumptions or the accuracy of the models or market data used by Novarca. Similarly, all the calculations made are non-binding for Novarca. Estimates contained in this Report are based upon information and assumptions that we consider reasonable, subject to uncertainties as to circumstances, and are subject to material variation. The information contained herein has not been independently verified and no representation or warranty, express or implied, is made to and no reliance should be placed on the fairness, accuracy, completeness or correctness of the information or opinions contained in this document. Novarca shall not have any liability whatsoever for any loss whatsoever arising from use of this document, its contents or otherwise arising in connection with this document.

The document has been provided by Novarca exclusively for the use of the selected recipient and shall not be altered in any way, transmitted to, copied or distributed, in part or in whole, to any other person or to the media or reproduced in any form.

This document cannot be considered to meet all decision requirements the recipient may have. The latter is therefore not exempt to conduct its own analysis and due diligence it deems appropriate to make an investment decision.

By accepting this presentation and not immediately returning it the recipient warrants, represents and agrees that to have read and agreed and to comply with the contents of this disclaimer.

# ✓ Novarca International



Marcel Staub  
CEO  
marcel.staub@novarca.com



Amit Bansal, CFA  
Head of Analysis  
amit.bansal@novarca.com



Novarca International | Oberdorfstrasse 11 | 8808 Pfaeffikon SZ | Switzerland

<http://www.novarca.com>

+41 55 511 21 21



Los Angeles • New York

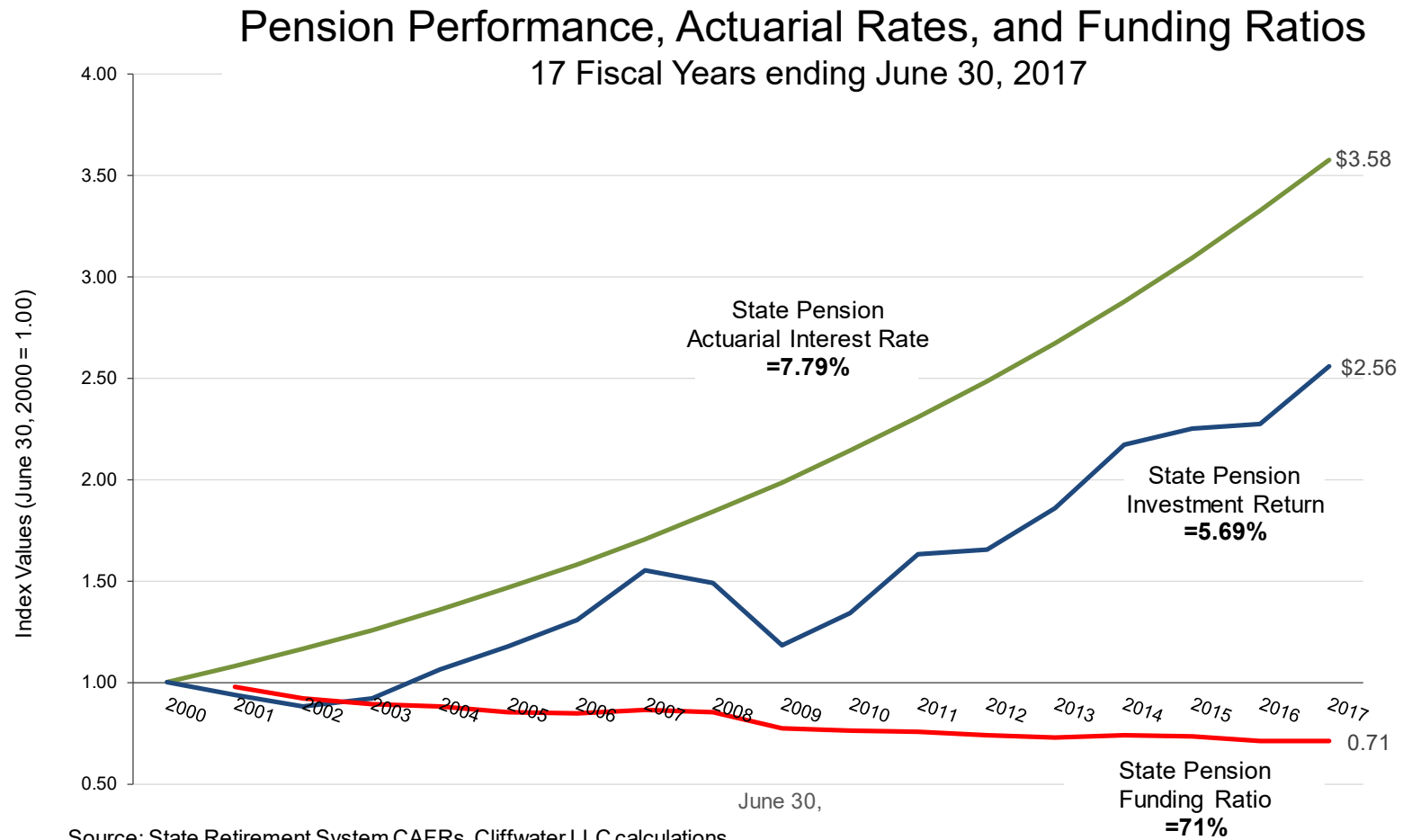
*The Collective Wisdom in Managing Public Pension Assets*

Stephen L Nesbitt, CEO, Cliffwater LLC

Testimony before the Public Pension Management & Asset Investment  
Review Commission (PPMAIRC)

October 25, 2018

# 1. The Inconvenient Truth in Public Pensions



## 2. Asset Allocation

---

### *Best practices*

- Set long-term target asset class weights; resist change
- Diversify, diversify, diversify
- Don't market-time, rebalance
- Revisit every 3-5 years

### *Industry experience*

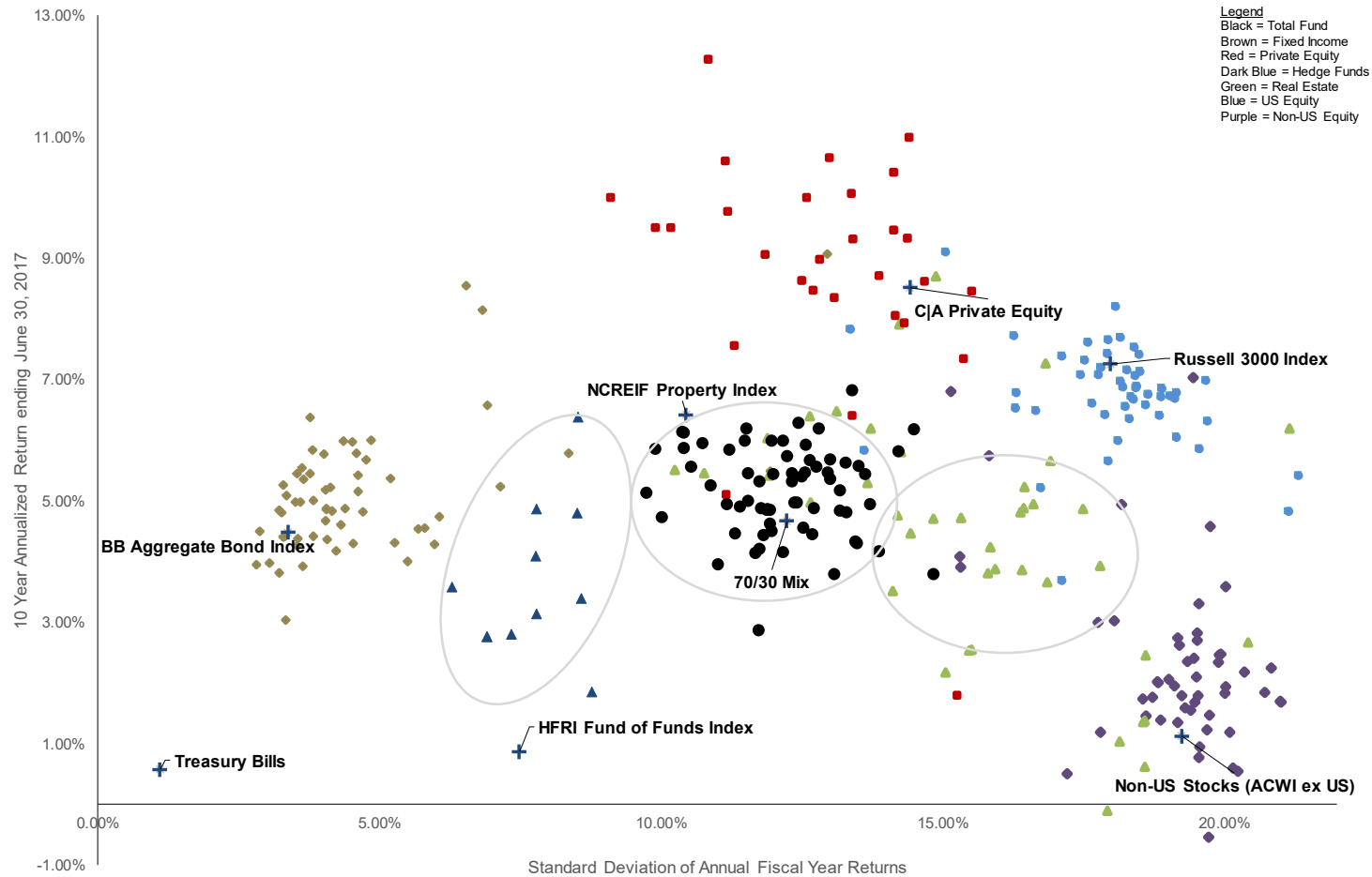
- Most public pensions “cluster” with similar allocations
  - General consensus on methodology and assumptions
  - A few “allocators” drive the process
  - Liabilities ignored
  - Different risk levels across DC, public DB, endowments
-

# 3. State Pension Return & Risk, FY2001 to FY2017

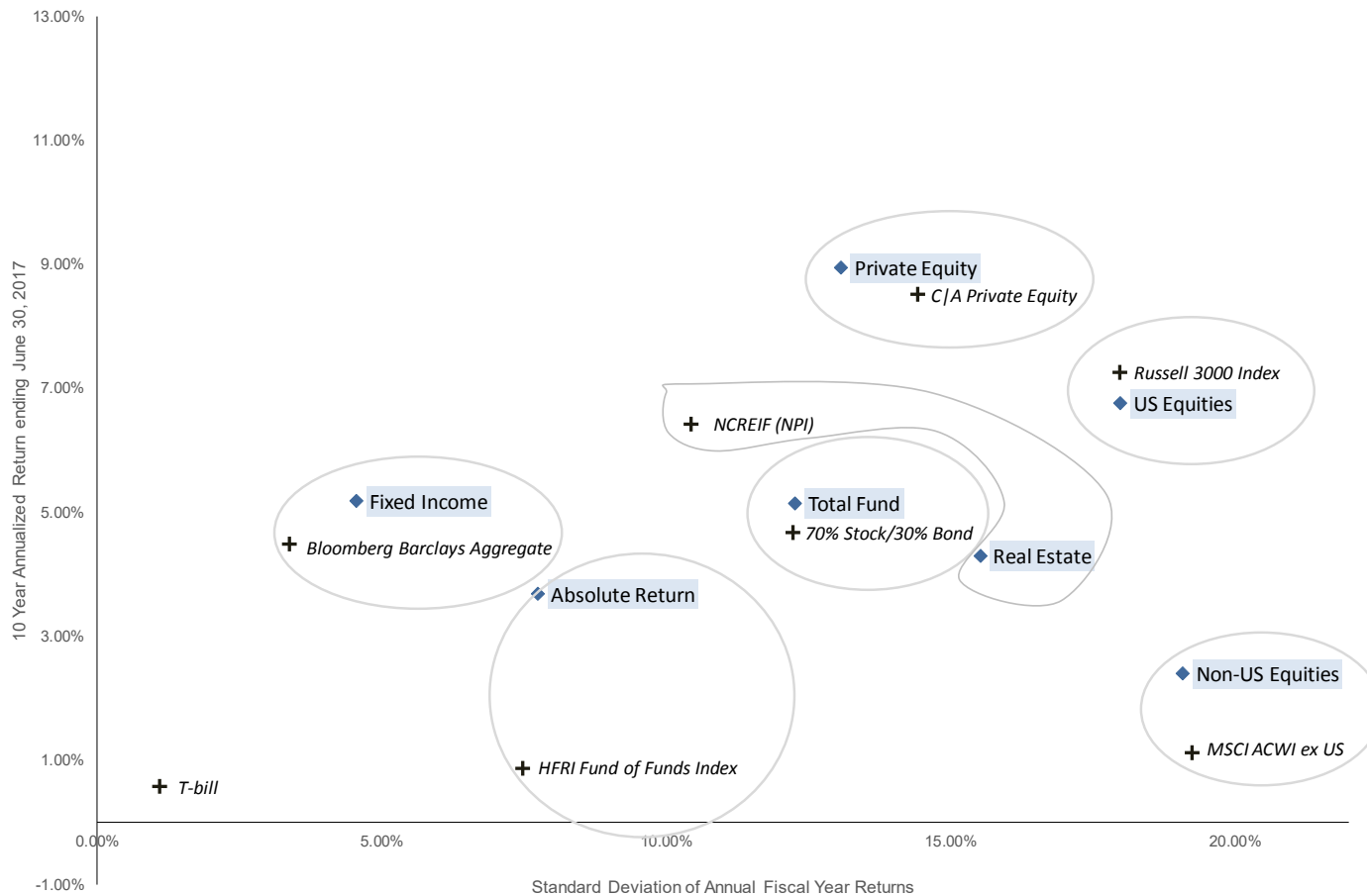




# 4. State Pension Asset Class Return & Risk 10 Fiscal Years ending FY2017



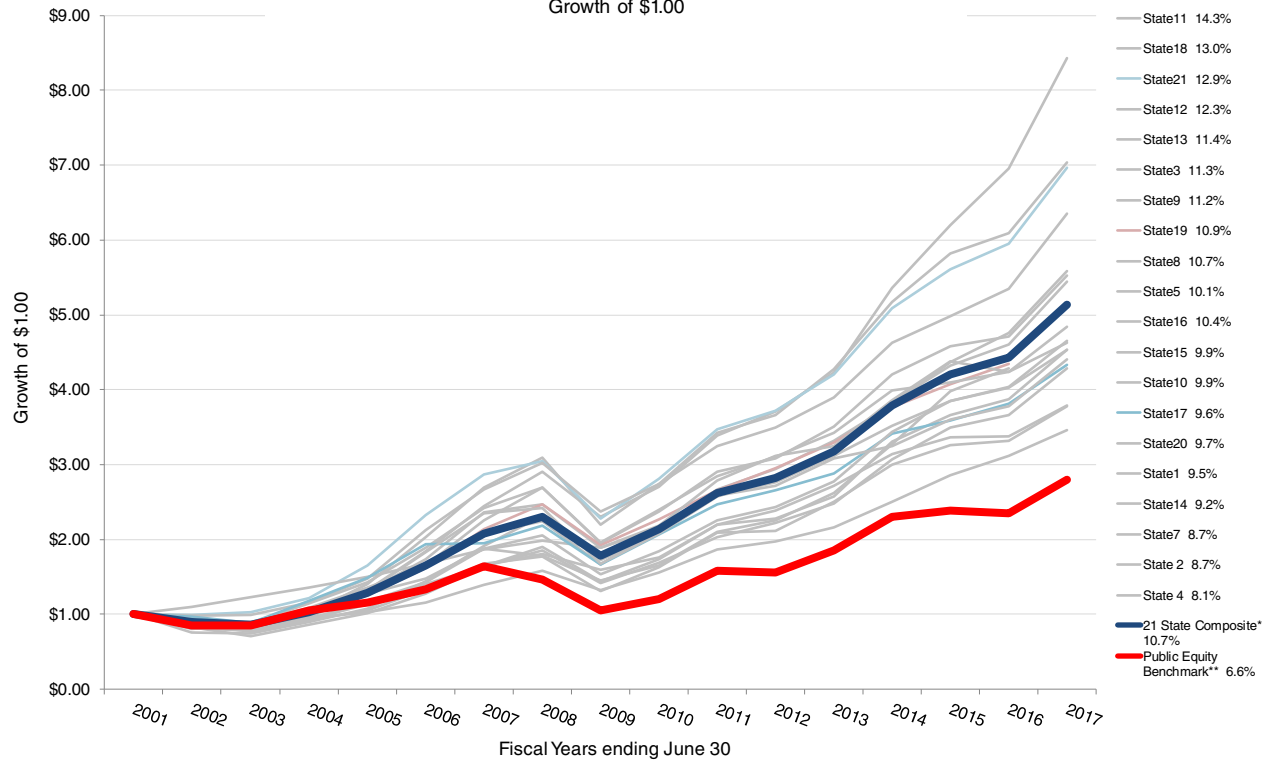
# 5. State Pension Asset Class Return & Risk 10 Fiscal Years ending FY2017 (continued)



# 6. State Pension Private Equity Performance 16 Fiscal Years ending FY2017

## Private Equity Performance among State Pension Funds

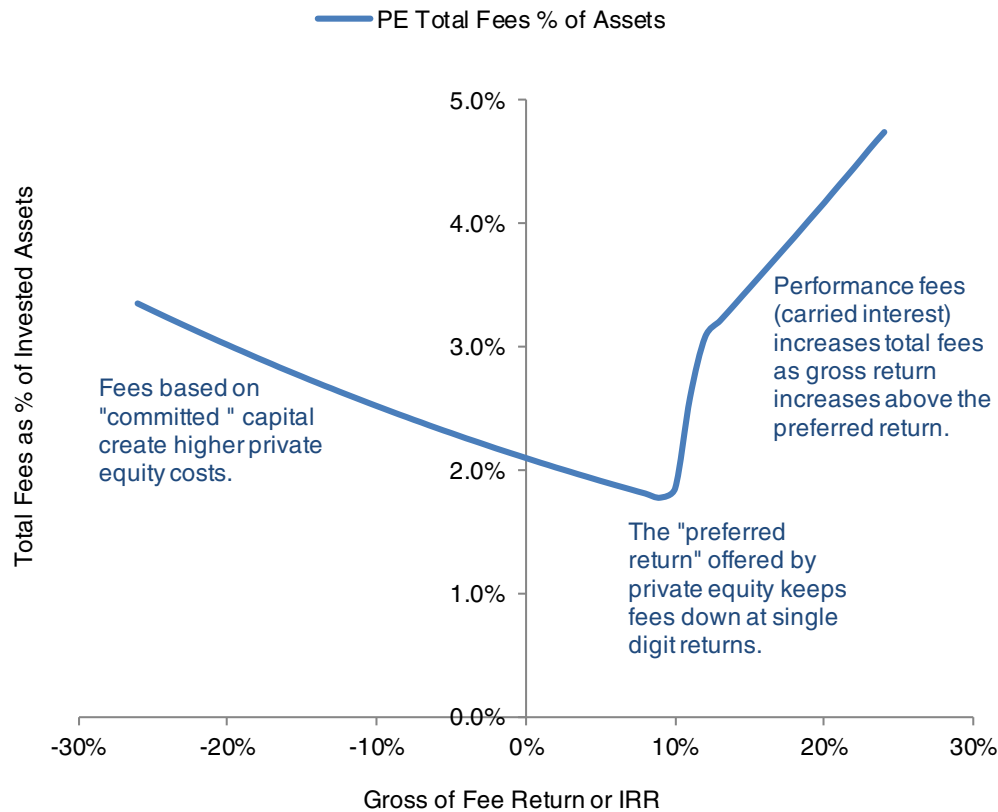
Covering 16 Years ending June 30, 2017  
Growth of \$1.00



\* An equal-weighted average of all 20 state funds who reported private equity returns in annual CAFRs for June 30 fiscal years 2002-2017.

\*\* A public equity benchmark weighted 70% to the Russell 3000 Index (6.8% annualized return) and 30% to the MSCI ACWI ex US Index (5.9% annualized return), with assigned weights reflecting Cliffwater's judgement of the US and non-US content of a diversified private equity portfolio.

# 7. Private Equity Fees & Gross-of-Fee Performance



## Fund Assumptions

Total Commitments (\$m)	\$1,000
Investment Period (yrs)	5
Fund Life (yrs)	10
Max % Funded	90%
Expected Return	15%
Standard Deviation	9%

## Investment Assumptions

Avg. Holding Period	5
Average IRR	20.0%
Implied TVPI	2.49x

## Fee Assumptions

Carry Percentage	20%
LP Preferred Return	8.0%
GP Catchup	80%
Mgmt Fee (Investment Period)	1.5%
Mgmt Fee (Post-Investment Period)	1.0%
Committed Fee Basis	<input type="checkbox"/>
Transaction Fees % of TEV	0.5%
Monitoring Fees % of Invested Capita	0.25%
Fee Offset %	80.0%

*Expected private equity fee = 3.73% of net assets, 25% of gross profits*

*The Collective Wisdom in Managing Public Pension Assets*

Stephen L Nesbitt, CEO, Cliffwater LLC

Testimony before the Public Pension Management & Asset Investment Review  
Commission (PPMAIRC)

October 25, 2018

Mr. Chairman, Mr. Vice-Chairman, Commissioners, thank you for having me here today. I was asked to come to share my thoughts on the issues of performance, transparency, and fees in the context of state pension plans. I am here as an experienced institutional investment advisor, having worked with literally hundreds of public pension systems over the last 40 years. I have advised some of the largest US state and federal pensions through my career on all aspects of their investing. These include CalPERS, CalSTRS, Connecticut RS, DC Retirement System, Federal Retirement Thrift Investment Board, Iowa PERS, Maine PERS, Massachusetts PRIM, Nebraska DB, New Mexico PERA, Ohio PERS, STRS Ohio, Ohio Police & Fire, Oregon PERS, The Pension Benefit Guaranty Corporation, Pennsylvania SERS, Pennsylvania PSERS, New Jersey SIC, Rhode Island ERS, Texas CDRS, Virginia RS, and Wisconsin (SWIB). You can see that my credentials come from the school of hard knocks. As an investment consultant I have introduced and helped guide the use of both low-cost index funds and higher-cost private equity, seeing an important role for both. I have been intimately involved in virtually all aspects of pension investing as an advisor to pension boards and staffs. My objective in the next 20 minutes is to share what insight I have into the issues that I think the Commission is most interested in, providing perhaps a different perspective from several of the outsiders you have already heard from.

Let me start with Slide 1, which I call “The Inconvenient Truth” in state pensions. You have already heard this narrative in prior meetings. Actuarial rates have been too high for too long compared to the returns pensions earned. The high actuarial rates caused contributions to be too low, eroding pension funding rates from near unity (100%) in 2000 to roughly 70% today. Justifiably, all stakeholders in public pensions understand this is a problem and want to fix it.

---

I understand that one important Commission task is reviewing the state's investment strategies. No investment strategy is more important than the asset allocation adopted as policy by individual pension boards. Studies show that the choice and weighting to individual asset classes have the greatest impact on long term pension return and risk. So, the first question is whether the problem is the investment strategy or the actuarial rate? Or both? Are pension boards making asset allocation decisions that offer the best chance of achieving pension security, or not?

You have already heard testimony on long term asset allocation trends, which I won't repeat here. Instead I want to impress on you that public pensions "cluster" in almost all their investment decisions, and no more so than asset allocation, covered in Slide 2. There are several reasons. Foremost is the role of the "prudent person" in fiduciary law. Investment decisions by board members are heavily influenced by what other pensions are doing, a proxy for prudent person, and in the small community of public pensions, everybody knows what everyone else is doing. This is reinforced by the handful of investment consultants that guide asset allocation decision-making using mostly the same models and inputs.

Importantly, this all leads to similar asset allocation policies, groomed by the collective wisdom of the boards and investment professionals, and producing returns that the financial markets will allow them to earn, not what the actuaries assume they will achieve. As fiduciaries, boards are continually balancing the pull of high actuarial rates against the push of higher risk that achieving these high rates would entail. Most pensions end up in roughly the same place, as Slide 3 shows, where return and risk for state pensions cluster tightly between a commonly used low risk bond index and a higher risk stock index.

State pensions fail in asset allocation when they give up too soon on their existing asset mix, for example, moving from lower to higher risk strategies near the top of the market or moving from higher to lower risk strategies after a market downturn. Sticking with the

existing asset allocation strategy has proven as important to long term performance as which strategy you choose.

Let me also add that, statistically, state pension asset allocation has been independent of funding ratio. This means that state pensions generally ignore, or act as if they ignore, funding ratios in setting asset allocation. Anecdotally, that has also been my experience and is not necessarily a bad thing. Boards have generally viewed pension funding as an actuarial issue, not an investment issue, seeing themselves as setting prudent investment policies with expected returns that actuaries should then use to set funding amounts. An unfortunate post-Global Financial Crisis perversion has been to pressure Boards to change investment policies to be consistent with high actuarial rates and their low funding schedules, rather than fiduciary standards.

In summary, my opinion is that the health of state pension systems has not been compromised by current or past asset allocation practices.

---

Staying on the topic of investment strategy is the question of active versus passive management. First, let me say that public pension systems were some of the earliest and largest investors in index funds, because of their low fees, good performance, and the ability to get monies invested or divested quickly. None of that has changed and index funds now represent close to 70% of state pension US equity allocations and 20% of total assets.

The attraction of index funds though is not all consuming. First, there are asset classes where indexing is not possible, like private equity and private real estate. Second, there is concern with trade execution and price dislocation for index funds that track securities that are not traded on exchanges, such as high yield bonds and loans. Third, there are some asset classes that are viewed as price inefficient where investors believe active management can add to return, net of higher fees. These include small cap stocks, high yield bonds, and non-US stocks. Most state pensions use a combination of active and passive management for these asset classes, with very few 100% active or 100% passive.

Slides 4 and 5 illustrate some of the thinking behind active and passive investing. Both slides report 10-year performance for state pensions by asset class. Slide 5 provides asset class returns for individual state pension systems while Slide 6 consolidates asset class performance into a single asset class average. Also shown are the most common asset class benchmarks, which can be viewed as a proxy for passive management for the asset class.

US equity allocations generally trail index funds, represented by the Russell 3000 index, suggesting that perhaps more or all of that asset class should be indexed. However, for fixed income and non-US equity state pension returns generally outperformed index funds. State pension boards regularly weigh past performance and fees in deciding how much of every asset class to allocate to index funds.

---

Key to the well-functioning of a market system is the reallocation of capital from bad performing companies to good performing companies. This function was largely broken in the 1970s as companies grew to become large underperforming conglomerates without outside forces that could change management behavior. Terms like “entrenched management”, “enriched management” and “conglomerate discount” came to unhappily describe corporate America. At the time, corporate pensions dominated the institutional landscape and their proxy policies were to strictly vote with management so as not to rock their own boats. This capital dysfunction was corrected when large state pensions began using private equity, proxy voting, and high yield (junk) bonds to dislodge bad management and capital from poor performing companies. Private equity and high yield bonds not only directly benefited state pensions through their higher returns but also indirectly benefited index funds through merger and acquisition premiums, a form of economic “externality” that bequeaths a part of the wealth creation of private equity to index investors.

Slide 6 reports the net-of-fee performance of private equity for individual state pensions and a composite return for 16 years ending fiscal 2017. Without exception, state pension private equity returns exceeded an equivalent public equity return with the



average private equity return equaling 10.7%, compared to 6.6% for the public equity markets. The difference of 3.1% per year, if repeated over the next 10 years, would produce a cumulative 87% in additional return compared to the index fund alternative. Considering past performance, it is surprising that the average state pension allocation to private equity is less than 10% of total assets.

Previous testimony has suggested that private equity has lost its performance edge versus public equity. And it is true that, post the Global Financial Crisis, state pension private equity returns have exceeded public equities by a smaller 1%, compared to the 3% longer term average. However, drawing forward-looking conclusions from this data is premature. Historical return patterns show that most of the outperformance in private equity occurs when the public markets turn bearish, because (1) lagged private equity valuations get a chance to catch up to public valuations and (2) the value-driven strategies of private equity are most effective in stock market downturns.

If I may briefly go back to the subject of asset allocation and speak to the issue of private equity and liquidity management, which had been generally overlooked in asset allocation. Trustees learned from the Global Financial Crisis that asset allocation targets to private equity, and private assets more generally, need to take account of the cash flow needs of the pension system and the potential for large variances in actual versus target asset allocation during market downturns. Prior to the Global Financial Crisis, many large endowments, including Princeton and Stanford, had outsized allocations and unfunded commitments to private assets, well exceeding 50% of their total assets. The Crisis forced these and other endowments into potential distressed sales of their illiquid assets and unfunded commitments to meet then current spending needs. Fortunately, distressed sales were largely averted as the markets rebounded and private asset managers delayed calling uncommitted capital. But the experience was a “lesson learned” and today state pensions routinely incorporate liquidity management when stress testing their asset allocation policies. My own experience working with pensions and endowments is that allocations to private assets above 40% of total assets requires a detailed liquidity plan as part of an overall asset allocation

study. Currently, the average allocation to private assets among state pensions equals 25% of total assets.

---

Let's turn now to manager fees because despite strong historical returns produced by private equity, it is also where most state pensions spend the most in fees. One of the challenges in understanding private equity fees is that they can't be expressed as a fixed percentage of assets. In addition, there are several fee components and each component can vary depending upon performance and time.

Fee components and levels are spelled out in private equity partnership agreements, which are negotiated between the managers and investors before the partnership is activated. Large state pensions have historically played an active role in negotiating private equity partnership fees and terms and are not simply "price takers."

Slide 7 provides total fee estimates for a typical private equity partnership for different levels of gross-of-fee partnership return (IRR). Note on the right-hand side of Slide 7 the fee components and fee rates for a typical partnership. Collectively, these fee components and rates produce different fees-as-a-percent-of-invested-assets, the common measure of expressing fee rates, for different levels of gross partnership return. This uncertainty in combined private equity fee rates is frustrating when trying to answer the simple question "what am I paying for private equity." But as Slide 7 shows paying more in combined fees is probably a good thing because your net-of-fee performance is better.

Our fee analysis using Monte Carlo simulation to capture differing possible return outcomes yields an expected combined private equity fee equal to 3.73% of invested assets, which represents approximately 25% of gross profits.

How might investment professionals pass judgement on these fees? Well the 25% of profits would likely seem very reasonable to investors in private assets. On the other hand, the 3.73% combined fee as a percent of invested assets might strike investors accustomed to traditional asset fee rates as extraordinarily high. "Fee fairness" is

difficult to assess but in their allocations to private equity these fees are aggressively negotiated by state pensions against the backdrop of performance expectations and competitive pressures to access top performing funds.

My intent is to impress on the Commission that by no means is there an attitude of acceptance by state pensions when it comes to fees. In addition to pressing for best practices when it comes to partnership fees, state pensions are aggressively moving in two additional directions to lower fees. The first is co-investments which allow state pensions to potentially invest directly in the same deals as the manager puts into the fund, but at a much lower fee or no fee at all. The second is what is often called “strategic partnerships.” These are bespoke agreements between a state pension and a highly valued manager where the state pension commits significant long-term capital to the manager across multiple years and strategies in return for lower management fees and netting of performance fees. These are important tools that state pensions can use to significantly reduce overall private equity fees.

---

In my final remarks I would like to first complement all the presenters that preceded me. Their analysis, opinions, and recommendations deserve serious consideration. But I do take exception to a narrative that a couple presenters put forward; that is the claim that state pension staff are hiding fees from the public for fear of losing their jobs. I can tell you from personal experience over many years that nothing is further from the truth. I have found staff across pension systems to be qualified, hard-working, ethical, and thinking first of the beneficiaries that the assets support. In fact, today, one of the most serious issues facing state pensions is keeping staff, particularly in the nation’s state capitals where professional opportunities in public policy far outweigh the opportunities in investment policy.

Most likely, outsider distrust of pension staff comes from a lack of understanding that transparency itself is negotiated as part of the legal agreements underlying private equity and other private investments. Part of the agreed upon terms of these investments is confidentiality on the part of the investor, subject to legal redress.

Pension staffs are not turning over data to outside parties because they are abiding by these agreements, not because they are afraid for their jobs. Yes, state pensions could change these agreements and require transparency by their private equity managers as a condition of investment. Perhaps public policy overrides investment policy in this instance. But make no mistake, such action will likely result in lower returns, of some unknown magnitude, from adverse selection, particularly in today's favorable fundraising environment.

With that I conclude my testimony. Thank you, Mr. Chairman, for the opportunity to share my thoughts and I would welcome any questions you might have at this time.

# **CHANGE AND ITS IMPACT**

**Dr. Charles Ellis**

Testimony before the Public Pension Management &  
Asset Investment Review Commission (PPMAIRC)

October 25, 2018

Harrisburg, PA

# BACK THEN

---

- NYSE 3M
- Analysts 8-12
- Slide Rules
- Private Meetings
- Home Country Only
- Active Investing 5,000

# NOW

---

- NYSE 3M → 5,000 M + Derivatives
- Analysts 600,600,600
- Computer Models
- SEC Reg FD
- Global and Global
- Active Investing 1,000,000+

# IT

---

- Bloomberg Terminal      0 → 240,000
- Internet                      0 → Everyone
- Computers                    Cage → Everywhere



# SCALE

---

**Major  
Manager**

**20 B → 6,000 B**

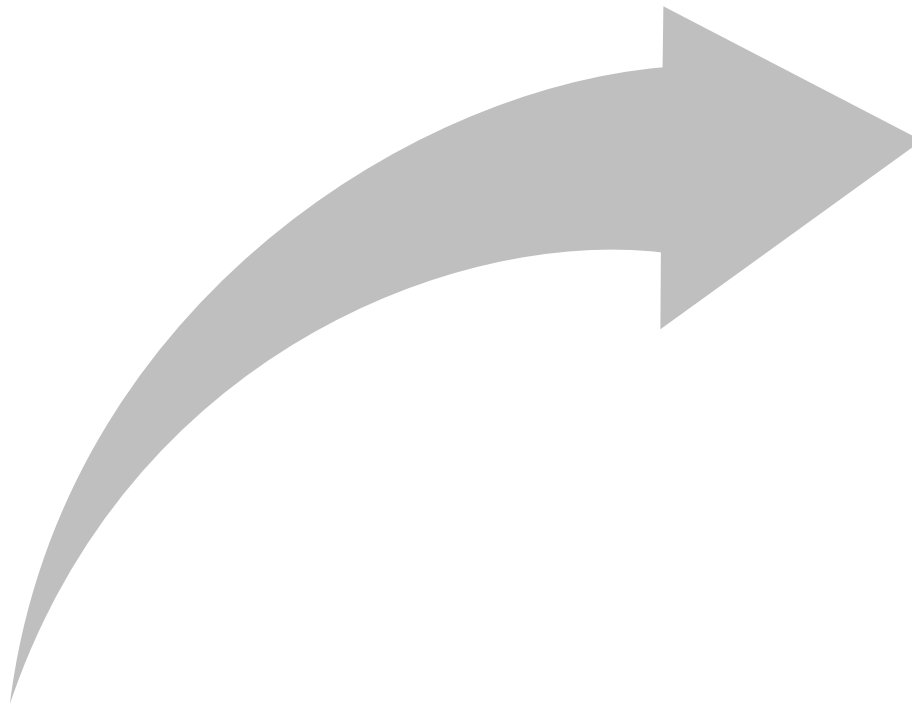
**Fees**

**1% or 15% or over 100%**

# PROFESSIONALS

---

**9%**



**99%**

# IMPACT

---

- 84% Fall Short
- Increasing Move to Indexing

# GREAT INVERSION

---

**THEN**

Client

---

Managers

**NOW**

Manager

---

Clients

# NEW COMPETITION

---

- Clients VS Clients for Access
- Money Flood
- More Coming
- Top Quality Key to Success
- Lower Returns
- Intensive Competition for Access to Best

# APPROACHES TO MEASURING RISKS FOR PUBLIC PENSIONS

SOA Blue Ribbon Panel's 2014 recommendations compared to current and proposed accounting requirements and actuarial guidelines

BLUE RIBBON PANEL REPORT CATEGORY (Purpose) <sup>a</sup>	BLUE RIBBON PANEL RECOMMENDATION	GOVERNMENTAL ACCOUNTING STANDARDS BOARD (GASB)	ACTUARIAL STANDARDS BOARD (ASB) ACTUARIAL STANDARD OF PRACTICE (ASOP) NO. 51 AND PROPOSED REVISIONS TO ASOP NO. 4 <sup>f</sup>	
			Area of Risk	Method for Assessing Risk
<b>RISK MEASURES AND ANALYSES</b>				
<b>MEASURES OF RISK TO FINANCIAL POSITION</b> (UNDERSTANDING CURRENT RISK LEVELS.)	(1) standard deviation of expected returns on asset portfolio; (2) <b>plan liability and normal cost at risk free rate</b> ; (3) standardized plan contribution.	<b>Sensitivity</b> of the net pension liabilities to changes in the discount rate at +/- 1% vs. single discount rate. <sup>b</sup>  Single (blended) discount rate is determined by comparing projections of the plan's fiduciary net position to projected benefit payments. <sup>c</sup>	<b>Investment risk defeasement measure</b> (included in exposure draft of proposed changes to ASOP No. 4) supplement disclosure of obligation (plan liability) measures to reflect the cost of defeasing investment risk. <sup>e</sup>	Calculating liabilities using discount rates consistent with market yields for a bond portfolio whose cash flows match benefits expected to be paid; based on yield for U.S. Treasuries or fixed-income securities that receive one of the two highest ratings.
<b>STRESS TESTING</b> (MEASURING INVESTMENT AND CONTRIBUTION RISKS.)	Financial projections over 30 years using baseline investment return assumptions as well as returns at +/- 3% investment returns vs. baseline and 80 to 100% of ARC payments.	10-year schedules comparing actual contribution amounts with actuarially determined contribution requirements and ratios of actual contributions to payroll allows tracking of the past impact of investment and contribution risks. <sup>d</sup>	<b>Investment, Interest rate, &amp; Contribution risk</b> (ASOP No. 51); Definition of Contribution Risk cites instances "where contributions are not made in accordance with funding policy."	<b>Stress testing, scenario, and stochastic analysis</b>
<b>ENHANCED DISCLOSURES</b>				
<b>UN-DISCOUNTED CASH FLOWS</b> (PROVIDING DATA FOR INDEPENDENT ASSESSMENT OF PLAN OBLIGATIONS.)	Disclosure of projected benefit payments for current employees to allow for independent assessment of plan obligations.	N/A	N/A	Unit credit method in ASOP No. 4 §3.11(b) uses un-discounted cash flows but does not require these calculations to be disclosed.
<b>FINANCIAL AND DEMOGRAPHIC TRENDS</b>	10 years historical data of assets, benefit payments, and liabilities to payroll, as well as recommended contributions to revenue; and actual to recommended contributions.	10-year schedule of changes to the net pension liability by source. <sup>e</sup>	<b>Longevity and Other Demographic Risks</b> (ASOP No. 51 S 3.2); <b>Plan maturity measures</b> (ASOP No. 51 §3.7) five ratios:	(a) Assets/payroll; (b) retired liability to total liability (AAL basis); (c) Cash flow to assets; (d) benefit payments/contributions; (e) duration of AAL.

## Table Notes and Sources:

- <sup>a</sup> Recommendations for Risk Measures Analyses and Disclosures. The Blue Ribbon Panel’s 2014 Report also includes recommendations for Funding Principles, Role of the Actuary (actuarial methods), and Plan Governance.
- <sup>b</sup> See GASB Statement No. 67, *Financial Reporting for Pension Plans* (2014), which revised previously existing guidance in Statement No. 2, *Disclosures Specific to Single-Employer and Cost-Sharing Pension Plans* ¶31(b)1. G (i) and (ii). Single discount rate is determined by comparing projections of the plan’s fiduciary net position to projected benefit payments. Other discount rate related disclosures include: assumed asset allocation of the plan’s portfolio, long-term expected real rates of return for each class, assumptions about projected cash inflows and outflows, and how the long-term expected rate of return was determined, including significant methods and assumptions.
- <sup>c</sup> See GASB Statement No. 67 *Measurements of the Net Pension Liability, Discount Rates* ¶ 41. “Comparing projections of the pension plan’s fiduciary net position to projected benefit payments.”
- <sup>d</sup> See GASB Statement No. 67 ¶ 106 “Information about Actuarially Determined Contributions.”
- <sup>e</sup> Additional financial and demographic disclosures include a 10-year schedule of ratios (e.g. plan net position divided by total pension liability, net pension liability divided by payroll) and a 10-year schedule of annual money-weighted rate of return on plan investments.
- <sup>f</sup> See Actuarial Standards Board (ASB), *Actuarial Standard of Practice No. 51: Assessment and Disclosure of Risk Associated with Measuring Pension Obligations and Determining Pension Plan Contribution* (2017), Transmittal Memo and proposed revision of *Actuarial Standard of Practice No. 4, Measuring Pension Obligations and Determining Pension Plan Costs or Contributions*, Exposure draft. ASOP No. 51 §3.2 identifies five risks areas: investment, asset/liability mismatch, interest rate, longevity, and contribution risk. Revisions to ASOP No. 4 proposes supplemental disclosure of plan liabilities and costs at lower discount rates.
- <sup>g</sup> See proposed revision of *Actuarial Standard of Practice No. 4, Measuring Pension Obligations and Determining Pension Plan Costs or Contributions*, Exposure Draft. ASB and its Pension Committee will be reviewing public comments and responses submitted for the exposure draft and deciding on next steps.

The background of the cover is a dark teal color. Overlaid on this are five vertical panels of varying widths. From left to right: 1. A wide panel showing a landscape with a path leading to a horizon under a cloudy sky. 2. A narrow panel showing a close-up of a path leading to a horizon under a cloudy sky. 3. A narrow panel showing a signpost with two arrows pointing in opposite directions, one left and one right, in a landscape with a path leading to a horizon under a cloudy sky. 4. A narrow panel showing a person in a white shirt from behind, with their hand on their head, in a landscape with a path leading to a horizon under a cloudy sky. 5. A wide panel showing a landscape with a path leading to a horizon under a cloudy sky. The text is centered over a white horizontal band that spans across the middle of the panels.

# REPORT OF THE BLUE RIBBON PANEL ON PUBLIC PENSION PLAN FUNDING

AN INDEPENDENT PANEL COMMISSIONED BY THE SOCIETY OF ACTUARIES FEBRUARY 2014

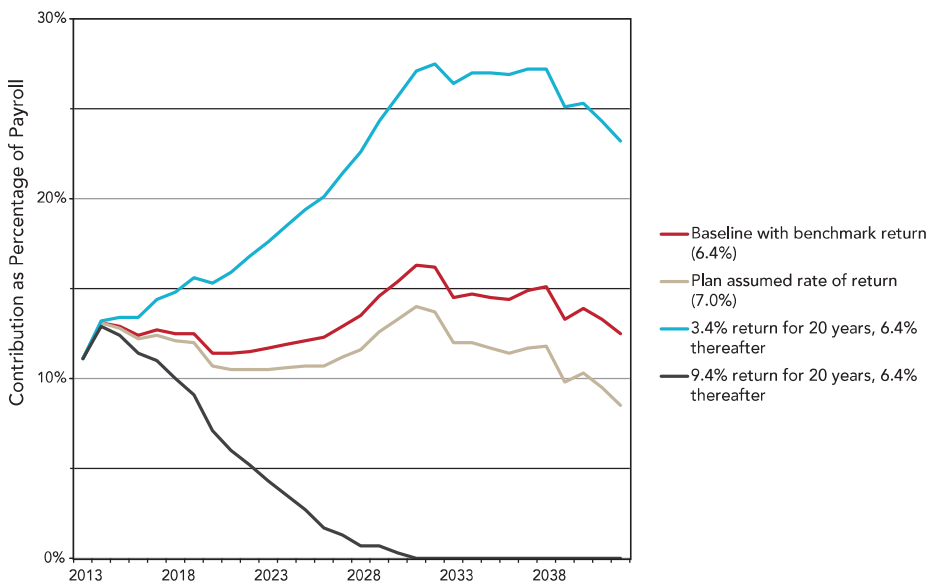


## Appendix IV—Sample Stress Testing Disclosure

The graphs below show the effects of investment and contribution stress tests on the employer contribution (shown as a percentage of payroll) and the funded status, represented in terms of the fair (market) value of assets. Figures 14 and 15 show the results for the investment stress tests; Figure 14 shows expected contribution results as a percentage of payroll. Figure 15 shows the funded status (fair value of assets as a percentage of actuarial accrued liability). Similarly, Figures 16 and 17 show the results of the contribution stress tests; Figure 16 shows expected contribution results and Figure 17 shows funded status. Each of these scenarios assumes the obligations are measured at the current basis, including a 7 percent discount rate, and that employee contributions continue at their current rate of 5 percent of payroll for each year. The table on the next page provides full disclosure of all results of the stress testing.

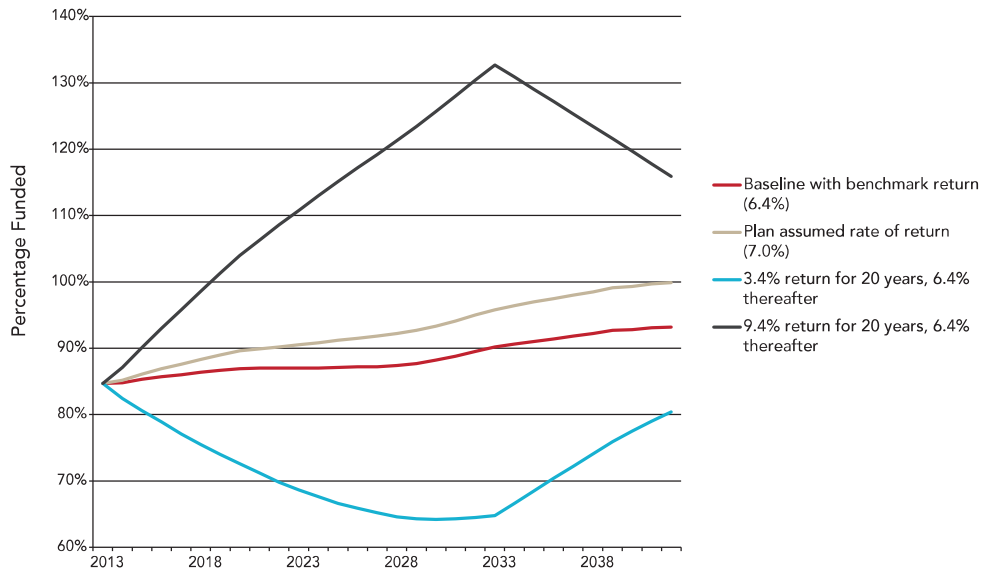
### Investment Stress Tests (Figures 14 and 15)

Figure 14  
Sample Plan: Projected Employer Contributions,  
With Investment Return Stress Tests



## Appendix IV—Sample Stress Testing Disclosure

Figure 15  
Sample Plan: Projected Funded Status (Fair Value),  
With Investment Return Stress Tests



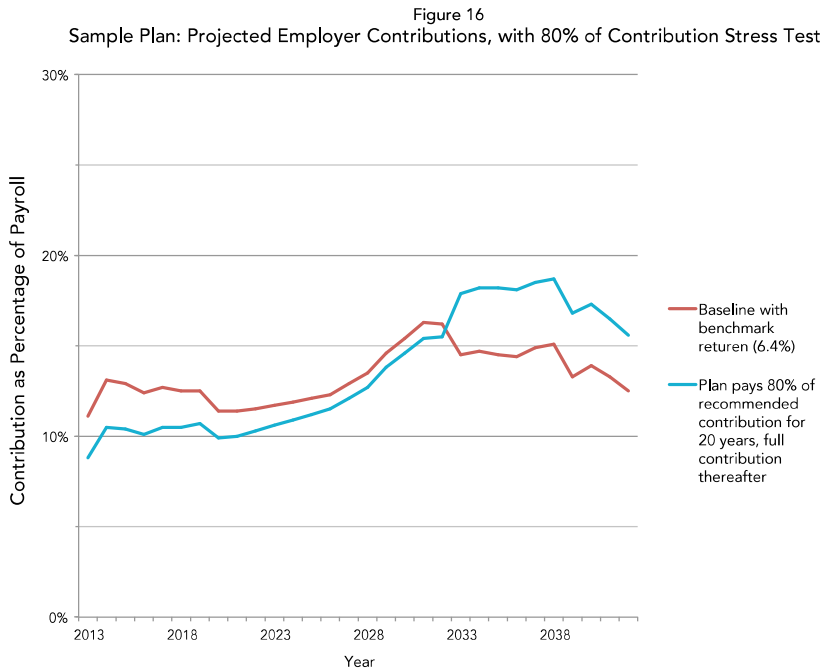
- The red line is the baseline.** In this instance, the assets earn 6.4 percent each year (the standard contribution benchmark return) over the full 30-year period. Under this scenario, the plan starts at 85 percent funded and grows slowly to 93 percent funded (it doesn't reach 100 percent because the rate of return is less than the discount rate). Contributions remain stable, dip and rise slightly to about 16 percent of pay and then fall back down to about 13 percent of pay. The dip and fall is due to the recognition of prior gains and losses. The contribution rate remains above normal cost because the plan is slowly building losses as the actual rate of return (6.4 percent) exceeds the discount rate (7.0 percent).
- The tan line shows the plan's assumed rate of return.** In this case, the plan earns 7 percent, which is its assumed discount rate. Funded status rises gradually over the period, and the contribution mirrors the shape in the baseline: dipping, then rising, peaking at 14 percent of pay before declining to about 8 percent of pay (the employer share of normal cost).
- The turquoise line shows what happens if the plan returns 3.4 percent per annum for the first 20 years, and 6.4 percent thereafter.** In this case, plan contributions rise sharply over the period from 11 percent to 27 percent of pay, and then start to fall to about 23 percent of pay. At the same time that contributions are rising, funded status falls—from 85 percent to about 65 percent at the end of the 20-year period of lower investment returns; once returns rise again to 6.4 percent, the funded status rises to 80 percent.
- The gray line shows what happens if the plan returns 9.4 percent per annum for the first 20 years, and 6.4 percent thereafter.** Because the plan is only about 85 percent funded, it still requires contributions until about 2030, and then employer contribution goes to zero (employee contributions are still being made). Funded status rises during the period to just over 130 percent, and then starts to decline once the investment returns fall back to 6.4 percent (and employer contributions fall to zero).

## Appendix IV—Sample Stress

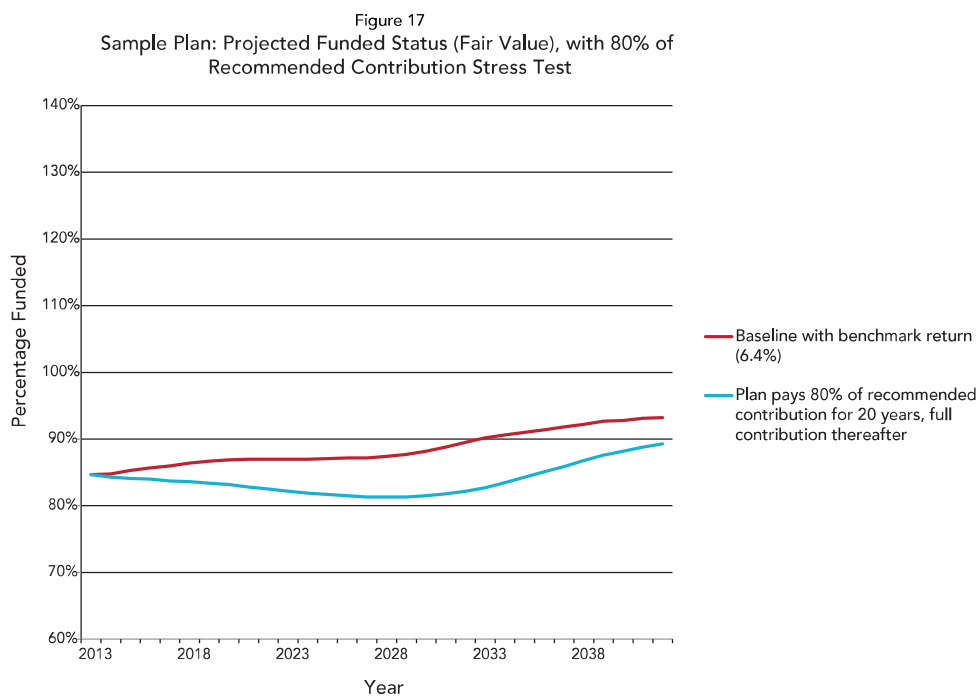
### Contribution Stress Test (Figures 16 and 17)

**The red line is the baseline.** In this instance, the assets earn 6.4 percent each year (the standard contribution benchmark return) over the full 30-year period. The baselines in Figures 16 and 17 are the same baselines shown on Figures 14 and 15 and described on page 53.

**The turquoise line shows the effect of paying 80 percent of the recommended contribution over 20 years,** and the full contribution thereafter. The contribution immediately drops from 11 percent to 9 percent of payroll, and then follows the same course as the baseline, but closing the gap over the 20-year period as the losses from unpaid contributions start to build. By 2032, when the funding entities are assumed to resume making the full contribution, it rises to 18 percent of payroll and remains about 3 percent of pay higher than the baseline for the remainder of the forecast period. Funded status only declines to about 80 percent during the forecast period, before slowly starting to rise to 90 percent once the full contribution is paid.



## Appendix IV—Sample Stress



Stress testing provides the opportunity for trustees and plan funders to have a conversation about what might happen during the what-if scenarios. For example, in the Panel's 3.4 percent return scenario, contributions increase to 27 percent of pay for a few years during the course of the 30-year forecast period. What if the trustees knew the plan funders were not able to pay costs greater than 20 percent of pay? The actuary and the trustees with the plan funders could then test what would happen if contributions were limited to 20 percent of pay, and discuss potential contingency plans.

Similarly, in the scenario where the plan earns 9.4 percent returns for 20 years, the plan eventually ends up in a surplus situation. The employer could enjoy a contribution holiday, or the trustees and funding entities could discuss today strategies they'd like to consider if such a surplus should arise.

## Appendix IV—Sample Stress

**Table VI**  
**Sample City Employee Pension Plan: Stress Test Projections—2013 to 2043**  
 Note: Illustrative only  
 Sheet 1 of 4 (2013 to 2021)

All \$ in Millions	2013	2014	2015	2016	2017	2018	2019	2020	2021
<b>Across all projections</b>									
Benefit payments	\$ 18.9	\$ 19.6	\$ 20.3	\$ 21.1	\$ 21.9	\$ 22.7	\$ 23.6	\$ 24.5	\$ 25.4
Actuarial accrued liability	353.6	370.2	387.4	405.4	424.2	443.7	464.1	485.3	507.4
Payroll	88.2	90.4	92.7	95	97.4	99.8	102.3	104.9	107.5
Benefit payments as % of payroll	21%	22%	22%	22%	22%	23%	23%	23%	24%
Actuarial accrued liability as % of payroll	401	409	418	427	436	445	454	463	472
<b>Baseline—Investments earn benchmark rate (6.4%)</b>									
Employer contribution (dollars)	\$ 9.8	\$ 11.8	\$ 12.0	\$ 11.8	\$ 12.5	\$ 12.6	\$ 12.9	\$ 12.1	\$ 12.4
Fair value of assets (dollars)	299.6	313.5	329.8	346.5	363.5	381.5	400.0	419.4	438.3
Employer contribution as % of payroll	11.1%	13.1%	12.9%	12.5%	12.8%	12.6%	12.6%	11.6%	11.5%
Funded ratio	85	85	85	85	86	86	86	86	86
Fair value of assets as % of payroll	340	347	356	365	373	382	391	400	408
<b>Investments earn assumed rate of return (7.0%)</b>									
Employer contribution (dollars)	\$ 9.8	\$ 11.8	\$ 11.9	\$ 11.6	\$ 12.1	\$ 12.1	\$ 12.3	\$ 11.3	\$ 11.3
Fair value of assets (dollars)	299.6	315.3	333.4	352.3	371.5	391.8	412.8	434.7	456.3
Employer contribution as % of payroll	11.1%	13.1%	12.8%	12.2%	12.4%	12.1%	12.0%	10.7%	10.5%
Funded ratio	85	85	86	87	88	88	89	90	90
Fair value of assets as % of payroll	340	349	360	371	381	393	403	414	424
<b>Investments earn 3.4% for 20 years, 6.4% thereafter</b>									
Employer contribution (dollars)	\$ 9.8	\$ 12.0	\$ 12.4	\$ 12.8	\$ 14.1	\$ 14.9	\$ 16.1	\$ 16.1	\$ 17.3
Fair value of assets (dollars)	299.6	304.8	311.8	318.8	325.7	333.5	341.5	350.4	358.8
Employer contribution as % of payroll	11.1%	13.2%	13.4%	13.5%	14.5%	14.9%	15.7%	15.4%	16.1%
Funded ratio	85	82	80	79	77	75	74	72	71
Fair value of assets as % of payroll	340	337	336	336	334	334	334	334	334
<b>Investments earn 9.4% for 20 years, 6.4% thereafter</b>									
Employer contribution (dollars)	\$ 9.8	\$ 11.7	\$ 11.5	\$ 10.8	\$ 10.7	\$ 10.1	\$ 9.4	\$ 7.6	\$ 6.7
Fair value of assets (dollars)	299.6	322.3	348.3	375.9	404.8	435.5	467.7	501.6	535.9
Employer contribution as % of payroll	11.1%	12.9%	12.4%	11.4%	11.0%	10.1%	9.2%	7.2%	6.2%
Funded ratio	85	87	90	93	95	98	101	103	106
Fair value of assets as % of payroll	340	356	376	396	416	436	457	478	499
<b>Pays 80% of recommended contribution for 20 years, full contribution thereafter</b>									
Employer contribution (dollars)	\$ 7.8	\$ 9.5	\$ 9.7	\$ 9.7	\$ 10.3	\$ 10.5	\$ 11.0	\$ 10.5	\$ 10.9
Fair value of assets (dollars)	299.6	311.6	325.3	339.5	353.9	369.1	384.8	401.2	417.4
Employer contribution as % of payroll	8.8%	10.5%	10.4%	10.2%	10.6%	10.5%	10.7%	10.0%	10.2%
Funded ratio	85	84	84	84	83	83	83	83	82
Fair value of assets as % of payroll	340	345	351	357	363	370	376	383	388

## Appendix IV—Sample Stress

**Table VI**  
**Sample City Employee Pension Plan: Stress Test Projections—2013 to 2043**  
 Note: Illustrative only  
 Sheet 2 of 4 (2022 to 2030)

All \$ in Millions	2022	2023	2024	2025	2026	2027	2028	2029	2030
<b>Across all projections</b>									
Benefit payments	\$ 26.4	\$ 27.4	\$ 28.4	\$ 29.5	\$ 30.6	\$ 31.8	\$33.0	\$ 34.3	\$ 35.6
Actuarial accrued liability	530.4	554.4	579.4	605.4	632.5	660.7	690.1	720.6	752.5
Payroll	110.2	112.9	115.8	118.7	121.6	124.7	127.8	131	134.3
Benefit payments as % of payroll	24%	24%	25%	25%	25%	26%	26%	26%	26%
Actuarial accrued liability as % of payroll	481	491	500	510	520	530	540	550	560
<b>Baseline—Investments earn benchmark rate (6.4%)</b>									
Employer contribution (dollars)	\$ 12.9	\$ 13.4	\$ 14.1	\$ 14.7	\$ 15.3	\$ 16.5	\$ 17.7	\$ 19.6	\$ 21.3
Fair value of assets (dollars)	457.9	478.4	499.8	522.4	546.0	570.7	597.1	625.3	656.2
Employer contribution as % of payroll	11.7%	11.9%	12.2%	12.4%	12.6%	13.2%	13.8%	15.0%	15.8%
Funded ratio	86	86	86	86	86	86	87	87	87
Fair value of assets as % of payroll	416	424	432	440	449	458	467	477	489
<b>Investments earn assumed rate of return (7.0%)</b>									
Employer contribution (dollars)	\$ 11.6	\$ 11.9	\$ 12.3	\$ 12.7	\$ 13.0	\$ 14.0	\$ 14.9	\$ 16.5	\$ 17.9
Fair value of assets (dollars)	478.6	502.0	526.3	551.9	578.6	606.5	636.3	667.9	702.3
Employer contribution as % of payroll	10.5%	10.5%	10.6%	10.7%	10.7%	11.2%	11.6%	12.6%	13.3%
Funded ratio	90	91	91	91	91	92	92	93	93
Fair value of assets as % of payroll	434	444	455	465	476	487	498	510	523
<b>Investments earn 3.4% for 20 years, 6.4% thereafter</b>									
Employer contribution (dollars)	\$ 18.6	\$ 20.1	\$ 21.7	\$ 23.2	\$ 24.7	\$ 26.9	\$ 29.1	\$ 32.1	\$ 34.8
Fair value of assets (dollars)	367.8	377.6	388.3	400.0	412.8	426.5	441.8	458.8	478.3
Employer contribution as % of payroll	16.9%	17.8%	18.7%	19.6%	20.3%	21.6%	22.8%	24.5%	26.0%
Funded ratio	69	68	67	66	65	65	64	64	64
Fair value of assets as % of payroll	334	334	335	337	339	342	346	350	356
<b>Investments earn 9.4% for 20 years, 6.4% thereafter</b>									
Employer contribution (dollars)	\$ 5.9	\$ 5.2	\$ 4.4	\$ 3.6	\$ 2.6	\$ 2.1	\$ 1.5	\$ 1.6	\$ 1.2
Fair value of assets (dollars)	571.8	609.4	648.8	690.3	733.9	779.5	827.8	879.0	934.0
Employer contribution as % of payroll	5.4%	4.6%	3.8%	3.0%	2.1%	1.7%	1.2%	1.2%	0.9%
Funded ratio	108	110	112	114	116	118	120	122	124
Fair value of assets as % of payroll	519	540	560	582	603	625	648	671	696
<b>Pays 80% of recommended contribution for 20 years, full contribution thereafter</b>									
Employer contribution (dollars)	\$ 11.5	\$ 12.1	\$ 12.9	\$ 13.6	\$ 14.2	\$ 15.4	\$ 16.6	\$ 18.4	\$ 20.0
Fair value of assets (dollars)	434.2	451.8	470.2	489.6	510.0	531.4	554.3	578.7	605.4
Employer contribution as % of payroll	10.4%	10.7%	11.1%	11.4%	11.7%	12.4%	13.0%	14.1%	14.9%
Funded ratio	82	81	81	81	81	80	80	80	80
Fair value of assets as % of payroll	394	400	406	413	419	426	434	442	451

## Appendix IV—Sample Stress

**Table VI**  
**Sample City Employee Pension Plan: Stress Test Projections—2013 to 2043**  
 Note: Illustrative only  
 Sheet 3 of 4 (2031 to 2039)

All \$ in Millions	2031	2032	2033	2034	2035	2036	2037	2038	2039
<b>Across all projections</b>									
Benefit payments	\$ 36.9	\$ 38.3	\$ 39.8	\$ 41.3	\$ 42.9	\$ 44.5	\$ 46.2	\$ 47.9	\$ 49.7
Actuarial accrued liability	785.6	820.1	856	893.3	932.1	972.6	1014.6	1058.4	1103.9
Payroll	137.6	141	144.6	148.2	151.9	155.7	159.6	163.6	167.7
Benefit payments as % of payroll	27%	27%	28%	28%	28%	29%	29%	29%	30%
Actuarial accrued liability as % of payroll	571	581	592	603	614	625	636	647	658
<b>Baseline—Investments earn benchmark rate (6.4%)</b>									
Employer contribution (dollars)	\$ 23.0	\$ 23.4	\$ 21.7	\$ 22.5	\$ 22.9	\$ 23.4	\$ 24.8	\$ 25.8	\$ 23.5
Fair value of assets (dollars)	689.5	725.5	762.9	799.6	838.1	878.1	919.6	963.5	1,009.7
Employer contribution as % of payroll	16.7%	16.6%	15.0%	15.2%	15.1%	15.0%	15.5%	15.8%	14.0%
Funded ratio	88	88	89	90	90	90	91	91	91
Fair value of assets as % of payroll	501	514	528	540	552	564	576	589	602
<b>Investments earn assumed rate of return (7.0%)</b>									
Employer contribution (dollars)	\$ 19.3	\$ 19.4	\$ 17.3	\$ 17.7	\$ 17.7	\$ 17.8	\$ 18.7	\$ 19.3	\$ 16.5
Fair value of assets (dollars)	739.3	779.0	820.3	861.1	903.9	948.1	994.1	1,042.6	1,093.5
Employer contribution as % of payroll	14.0%	13.7%	12.0%	12.0%	11.7%	11.4%	11.7%	11.8%	9.8%
Funded ratio	94	95	96	96	97	97	98	99	99
Fair value of assets as % of payroll	537	552	567	581	595	609	623	637	652
<b>Investments earn 3.4% for 20 years, 6.4% thereafter</b>									
Employer contribution (dollars)	\$ 37.7	\$ 39.2	\$ 38.7	\$ 40.5	\$ 41.6	\$ 42.5	\$ 44.0	\$ 45.2	\$ 42.7
Fair value of assets (dollars)	499.9	523.9	549.1	589.1	632.2	677.6	725.3	776.1	829.7
Employer contribution as % of payroll	27.4%	27.8%	26.8%	27.3%	27.4%	27.3%	27.6%	27.6%	25.5%
Funded ratio	64	64	64	66	68	70	71	73	75
Fair value of assets as % of payroll	363	371	380	398	416	435	454	474	495
<b>Investments earn 9.4% for 20 years, 6.4% thereafter</b>									
Employer contribution (dollars)	\$ 0.9	-	-	-	-	-	-	-	-
Fair value of assets (dollars)	992.5	\$1,055.0	\$ 1,120.2	\$ 1,153.0	\$ 1,185.3	\$ 1,217.3	\$ 1,249.4	\$ 1,282.7	\$ 1,317.1
Employer contribution as % of payroll	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Funded ratio	126	129	131	129	127	125	123	121	119
Fair value of assets as % of payroll	721	748	775	778	780	782	783	784	786
<b>Pays 80% of recommended contribution for 20 years, full contribution thereafter</b>									
Employer contribution (dollars)	\$ 21.7	\$ 22.4	\$ 26.6	\$ 27.8	\$ 28.5	\$ 29.1	\$ 30.5	\$ 31.7	\$ 29.3
Fair value of assets (dollars)	634.2	665.3	697.7	735.2	775.0	816.4	859.7	905.6	954.0
Employer contribution as % of payroll	15.8%	15.9%	18.4%	18.8%	18.7%	18.7%	19.1%	19.3%	17.5%
Funded ratio	81	81	82	82	83	84	85	86	86
Fair value of assets as % of payroll	461	472	483	496	510	524	539	554	569

## Appendix IV—Sample Stress

Table VI Sample City Employee Pension Plan: Stress Test Projections—2013 to 2043 Note: Illustrative only Sheet 4 of 4 (2040 to 2043)				
All \$ in Millions	2040	2041	2042	2043
<b>Across all projections</b>				
Benefit payments	\$ 51.6	\$ 53.6	\$ 55.6	\$ 57.7
Actuarial accrued liability	1151.3	1,200.5	1,251.7	1,305
Payroll	171.9	176.2	180.6	185.1
Benefit payments as % of payroll	30%	30%	31%	31%
Actuarial accrued liability as % of payroll	670	682	693	705
<b>Baseline—Investments earn benchmark rate (6.4%)</b>				
Employer contribution (dollars)	\$ 25.1	\$ 24.6	\$ 23.9	\$ 25.0
Fair value of assets (dollars)	1,054.9	1,102.8	1,151.6	1,200.8
Employer contribution as % of payroll	14.6%	14.0%	13.2%	13.5%
Funded ratio	92	92	92	92
Fair value of assets as % of payroll	614	626	638	649
<b>Investments earn assumed rate of return (7.0%)</b>				
Employer contribution (dollars)	\$ 17.6	\$ 16.7	\$ 15.3	\$ 15.9
Fair value of assets (dollars)	1,143.5	1,196.4	1,250.1	1,304.5
Employer contribution as % of payroll	10.3%	9.5%	8.5%	8.6%
Funded ratio	99	100	100	100
Fair value of assets as % of payroll	665	679	692	705
<b>Investments earn 3.4% for 20 years, 6.4% thereafter</b>				
Employer contribution (dollars)	\$ 44.3	\$ 43.7	\$ 42.8	\$ 43.9
Fair value of assets (dollars)	882.6	938.6	995.9	1,054.1
Employer contribution as % of payroll	25.8%	24.8%	23.7%	23.7%
Funded ratio	77	78	80	81
Fair value of assets as % of payroll	514	533	552	570
<b>Investments earn 9.4% for 20 years, 6.4% thereafter</b>				
Employer contribution (dollars)	-	-	-	-
Fair value of assets (dollars)	\$ 1,350.3	\$ 1,385.3	\$ 1,420.5	\$ 1,455.6
Employer contribution as % of payroll	0.0%	0.0%	0.0%	0.0%
Funded ratio	117	115	113	112
Fair value of assets as % of payroll	786	786	787	787
<b>Pays 80% of recommended contribution for 20 years, full contribution thereafter</b>				
Employer contribution (dollars)	\$ 30.9	\$ 30.4	\$ 29.6	\$ 30.7
Fair value of assets (dollars)	1,001.4	1,051.7	1,102.9	1,154.7
Employer contribution as % of payroll	18.0%	17.3%	16.4%	16.6%
Funded ratio	87	88	88	88
Fair value of assets as % of payroll	583	597	611	624





2005 Market Street, Suite 2800      215.575.9050 Phone  
Philadelphia, PA 19103-7077

901 E Street NW      202.552.2000 Phone  
Washington, DC 20004

[www.pewtrusts.org](http://www.pewtrusts.org)

November 19, 2018

Public Pension Management and Asset Investment Review Commission  
Pennsylvania State Capitol Complex  
501 N 3<sup>rd</sup> Street  
Harrisburg, PA 17120

**Subject: Pennsylvania Pension Stress Test Report**

Dear Chairman Tobash, Vice-Chairman Torsella and Commission Members:

Thank you again for the opportunity to share Pew's research and analysis on pension risk reporting as the Public Pension Management and Asset Investment Review Commission (PPMAIRC) evaluates and makes recommendations around implementation of pension stress testing. As part of our letter to the Commission last month, we introduced an approach to pension risk reporting that is designed to help policymakers and budget officials assess the impact of investment risk on government budgets; evaluate the impact of contribution risk on pension system insolvency; quantify the range of likely costs for current benefits; and assess the impact of market volatility on expected employer contributions. We also applied a component of this approach to Pennsylvania and presented sample results.

The purpose of this letter is to present and describe in greater detail the specific financial projections, scenarios, and analyses that serve as the foundation of this approach (Exhibit A) and also provide the Commission with a full stress test report that is tailored to the plans in Pennsylvania (Exhibit B).

Please let us know if you have any questions or additional requests for research or analysis.

Thank you,

David Draine  
Senior Officer, Strengthening Public Sector Retirement Systems  
The Pew Charitable Trusts

## Exhibit A

The information below is presented as a more detailed description of the specific financial projections, scenarios and analyses that serve as the foundation of the report contained in Exhibit B. These specifications are informed by the Actuarial Standards Board's recently published guidance on risk reporting and track closely with the approach required under Hawaii's annual stress testing requirement outlined in Hawaii Revised Statutes §88-105.5.

### Stress Testing Specifications for Pennsylvania Report: Projections, Scenarios, and Analyses

The twelve exhibits that follow include:

1. A “**baseline**” projection of assets, liabilities, unfunded liabilities, service cost, employee contributions, employer contributions, benefit payments, payroll, funded ratio and change in the unfunded liability, for the Public School Employees’ Retirement System (PSERS) and the State Employees Retirement System (SERS) for each of the next thirty years based on current plan assumptions and existing policies for actuarial required contributions (“**state contribution policy**”).
2. Two projections of the same items for PSERS and SERS using the following investment scenarios:
  - a. A “**low return**” scenario assuming a fixed 5% annual return.
  - b. An “**asset shock**” scenario, based on the financial market and economic assumptions used in the Dodd-Frank Adverse Stress Test scenario published by the Federal Reserve, including a significant one-time loss in asset values followed by a period of economic and financial market recovery, and 5% fixed returns after that period.
3. To assess contribution risk, projections for the low return and asset shock scenario with employer contributions growing at the same rate as projected own source revenue (“**revenue constrained contributions**”) instead of following the current actuarial funding policy.
4. A simulation analysis showing the range of employer contribution rates and funded ratios over 10- and 20-year intervals, assuming that annual returns fluctuate with the market, but the 20-year return matches the plans’ assumed rates of return.
5. Sensitivity analysis of total normal cost and employer normal cost for new employees using investment return assumptions of +/-1% of the discount rate and 5% fixed rate of return. This analysis will incorporate any variation in employee contributions from investment performance under current plan provisions.
6. Sensitivity analysis of liabilities and unfunded liabilities based the existing disclosures required by the Governmental Accounting Standards Board (GASB) of pension liability at +/- 1% of the discount rate and the investment risk defeasement measure as outlined in proposed draft changes to Actuarial Standard of Practice (ASOP) No. 4.

<b>Exhibit</b>	<b>Plans Included</b>	<b>Description</b>
1	SERS and PSERS Combined	30-year Projection: State Contribution Policy; 7.25% Deterministic Return
2	SERS and PSERS Combined	30-year Projection: Revenue Constrained Contribution Policy; 7.25% Deterministic Return
3	SERS and PSERS Combined	30-year Projection: State Contribution Policy; 5% Deterministic Return
4	SERS and PSERS Combined	30-year Projection: Revenue Constrained Contribution Policy; 5% Deterministic Return
5	SERS and PSERS Combined	30-year Projection: State Contribution Policy; Asset Shock Scenario
6	SERS and PSERS Combined	30-year Projection: Revenue Constrained Contribution Policy; Asset Shock Scenario
7	SERS	30-year Projections: State Contribution Policy, Revenue Constrained Contribution Policy; 7.25%, 5%, and Asset Shock Scenario
8	PSERS	30-year Projections: State Contribution Policy, Revenue Constrained Contribution Policy; 7.25%, 5%, and Asset Shock Scenario
9	SERS	Stochastic Analysis of Employer Contributions and Funded Ratio
10	PSERS	Stochastic Analysis of Employer Contributions and Funded Ratio
11	SERS	Sensitivity of Liability and Normal Costs
12	PSERS	Sensitivity of Liability and Normal Costs

# Exhibit 1

## Pennsylvania Retirement System 30 Year Projections

Plans included: State Employees' Retirement System, Public School Employees' Retirement System  
 State contribution policy under assumed rate of return (7.25%)

SMMs

Fiscal Year	Pension Liability (Actuarial Accrued Liability)						Pension Assets (Market Value)					Change in Pension Debt			Cash Flow		Employer Contribution		
	Payroll	Beginning of Period	Service Cost	Interest	Benefit Payments	End of Period	Beginning of Period	Total Contribution	Interest	Benefit Payments	End of Period	Debt	\$	% of Payroll	% Funded	% of Assets	\$	% Change	% Payroll
2018	19,443	150,412	2,747	13,042	(10,184)	156,017	82,682	7,631	5,904	(10,184)	86,033	69,985	2,254	12%	55%	-3%	6,254	N/A	32%
2019	19,878	156,017	2,389	11,128	(10,464)	159,070	86,033	7,820	6,143	(10,464)	89,531	69,539	(446)	-2%	56%	-3%	6,421	3%	32%
2020	20,324	159,070	2,412	11,343	(10,752)	162,073	89,531	8,211	6,401	(10,752)	93,391	68,682	(857)	-4%	58%	-3%	6,789	6%	33%
2021	20,779	162,073	2,402	8,752	(11,047)	162,179	93,391	8,342	6,675	(11,047)	97,360	64,819	(3,863)	-19%	60%	-3%	6,897	2%	33%
<b>2022</b>	<b>21,245</b>	<b>162,179</b>	<b>3,056</b>	<b>11,575</b>	<b>(11,351)</b>	<b>165,459</b>	<b>97,360</b>	<b>8,553</b>	<b>6,959</b>	<b>(11,351)</b>	<b>101,521</b>	<b>63,938</b>	<b>(881)</b>	<b>-4%</b>	<b>61%</b>	<b>-3%</b>	<b>7,085</b>	<b>3%</b>	<b>33%</b>
2023	21,722	165,459	3,071	11,805	(11,663)	168,672	101,521	8,888	7,261	(11,663)	106,007	62,665	(1,273)	-6%	63%	-3%	7,397	4%	34%
2024	22,210	168,672	3,085	12,030	(11,984)	171,803	106,007	9,067	7,582	(11,984)	110,672	61,131	(1,534)	-7%	64%	-3%	7,554	2%	34%
2025	22,710	171,803	3,098	12,248	(12,314)	174,834	110,672	9,243	7,914	(12,314)	115,515	59,319	(1,812)	-8%	66%	-3%	7,708	2%	34%
2026	23,221	174,834	3,108	12,458	(12,652)	177,748	115,515	9,443	8,261	(12,652)	120,567	57,181	(2,138)	-9%	68%	-3%	7,886	2%	34%
<b>2027</b>	<b>23,744</b>	<b>177,748</b>	<b>3,116</b>	<b>12,660</b>	<b>(13,000)</b>	<b>180,525</b>	<b>120,567</b>	<b>9,631</b>	<b>8,621</b>	<b>(13,000)</b>	<b>125,819</b>	<b>54,706</b>	<b>(2,475)</b>	<b>-10%</b>	<b>70%</b>	<b>-3%</b>	<b>8,052</b>	<b>2%</b>	<b>34%</b>
2028	24,280	180,525	3,123	12,851	(13,358)	183,141	125,819	9,799	8,995	(13,358)	131,255	51,886	(2,820)	-12%	72%	-3%	8,200	2%	34%
2029	24,828	183,141	3,127	13,030	(13,725)	185,573	131,255	9,973	9,382	(13,725)	136,885	48,688	(3,198)	-13%	74%	-3%	8,354	2%	34%
2030	25,389	185,573	3,129	13,196	(14,103)	187,795	136,885	10,149	9,783	(14,103)	142,714	45,080	(3,608)	-14%	76%	-3%	8,512	2%	34%
2031	25,963	187,795	3,128	13,345	(14,490)	189,778	142,714	10,329	10,199	(14,490)	148,752	41,026	(4,055)	-16%	78%	-3%	8,674	2%	33%
<b>2032</b>	<b>26,551</b>	<b>189,778</b>	<b>3,125</b>	<b>13,477</b>	<b>(14,869)</b>	<b>191,511</b>	<b>148,752</b>	<b>10,511</b>	<b>10,629</b>	<b>(14,869)</b>	<b>155,023</b>	<b>36,487</b>	<b>(4,538)</b>	<b>-17%</b>	<b>81%</b>	<b>-3%</b>	<b>8,839</b>	<b>2%</b>	<b>33%</b>
2033	27,152	191,511	3,120	13,592	(15,219)	193,004	155,023	10,707	11,078	(15,219)	161,590	31,414	(5,073)	-19%	84%	-3%	9,018	2%	33%
2034	27,768	193,004	3,114	13,691	(15,536)	194,273	161,590	10,912	11,551	(15,536)	168,517	25,755	(5,659)	-20%	87%	-3%	9,207	2%	33%
2035	28,399	194,273	3,105	13,774	(15,818)	195,333	168,517	11,118	12,050	(15,818)	175,867	19,466	(6,289)	-22%	90%	-3%	9,398	2%	33%
2036	29,044	195,333	3,095	13,843	(16,064)	196,207	175,867	8,023	12,464	(16,064)	180,290	15,918	(3,548)	-12%	92%	-5%	6,288	-33%	22%
<b>2037</b>	<b>29,704</b>	<b>196,207</b>	<b>3,085</b>	<b>13,900</b>	<b>(16,272)</b>	<b>196,921</b>	<b>180,290</b>	<b>7,267</b>	<b>12,750</b>	<b>(16,272)</b>	<b>184,035</b>	<b>12,886</b>	<b>(3,032)</b>	<b>-10%</b>	<b>93%</b>	<b>-5%</b>	<b>5,517</b>	<b>-12%</b>	<b>19%</b>
2038	30,380	196,921	3,074	13,946	(16,440)	197,502	184,035	6,961	13,005	(16,440)	187,561	9,940	(2,945)	-10%	95%	-5%	5,196	-6%	17%
2039	31,072	197,502	3,063	13,985	(16,567)	197,983	187,561	6,588	13,243	(16,567)	190,825	7,157	(2,783)	-9%	96%	-5%	4,808	-7%	15%
2040	31,781	197,983	3,053	14,017	(16,652)	198,400	190,825	6,289	13,466	(16,652)	193,928	4,472	(2,685)	-8%	98%	-5%	4,493	-7%	14%
2041	32,506	198,400	3,044	14,046	(16,696)	198,794	193,928	6,022	13,680	(16,696)	196,934	1,860	(2,612)	-8%	99%	-6%	4,210	-6%	13%
<b>2042</b>	<b>33,249</b>	<b>198,794</b>	<b>3,036</b>	<b>14,075</b>	<b>(16,698)</b>	<b>199,208</b>	<b>196,934</b>	<b>5,077</b>	<b>13,864</b>	<b>(16,698)</b>	<b>199,176</b>	<b>31</b>	<b>(1,829)</b>	<b>-6%</b>	<b>100%</b>	<b>-6%</b>	<b>3,247</b>	<b>-23%</b>	<b>10%</b>
2043	34,009	199,208	3,030	14,107	(16,659)	199,686	199,176	4,066	13,992	(16,659)	200,575	(889)	(920)	-3%	100%	-6%	2,217	-32%	7%
2044	34,788	199,686	3,027	14,145	(16,578)	200,280	200,575	3,231	14,066	(16,578)	201,294	(1,015)	(126)	0%	101%	-7%	1,363	-39%	4%
2045	35,585	200,280	3,026	14,193	(16,458)	201,040	201,294	3,220	14,122	(16,458)	202,179	(1,139)	(124)	0%	101%	-7%	1,332	-2%	4%
2046	36,401	201,040	3,028	14,255	(16,300)	202,022	202,179	3,223	14,192	(16,300)	203,293	(1,271)	(133)	0%	101%	-6%	1,312	-1%	4%
<b>2047</b>	<b>37,236</b>	<b>202,022</b>	<b>3,033</b>	<b>14,334</b>	<b>(16,105)</b>	<b>203,283</b>	<b>203,293</b>	<b>3,155</b>	<b>14,278</b>	<b>(16,105)</b>	<b>204,620</b>	<b>(1,337)</b>	<b>(66)</b>	<b>0%</b>	<b>101%</b>	<b>-6%</b>	<b>1,220</b>	<b>-7%</b>	<b>3%</b>

Source: Analysis by The Pew Charitable Trusts and The Terry Group based on data from retirement system actuarial valuations and annual reports

# Exhibit 2

## Pennsylvania Retirement System 30 Year Projections

Plans included: State Employees' Retirement System, Public School Employees' Retirement System  
Revenue-constrained policy under assumed rate of return (7.25%)

SMMs

Fiscal Year	Pension Liability (Actuarial Accrued Liability)						Pension Assets (Market Value)					Change in Pension Debt			Cash Flow		Employer Contribution		
	Payroll	Beginning of Period	Service Cost	Interest	Benefit Payments	End of Period	Beginning of Period	Total Contribution	Interest	Benefit Payments	End of Period	Debt	\$	% of Payroll	% Funded	% of Assets	\$	% Change	% Payroll
2018	19,443	150,412	2,747	13,042	(10,184)	156,017	82,682	7,409	5,896	(10,184)	85,802	70,215	2,484	13%	55%	-3%	6,032	N/A	31%
2019	19,878	156,017	2,389	11,128	(10,464)	159,070	85,802	7,747	6,124	(10,464)	89,209	69,861	(354)	-2%	56%	-3%	6,348	5%	32%
2020	20,324	159,070	2,412	11,343	(10,752)	162,073	89,209	7,921	6,367	(10,752)	92,745	69,328	(533)	-3%	57%	-3%	6,499	2%	32%
2021	20,779	162,073	2,402	8,752	(11,047)	162,179	92,745	8,234	6,624	(11,047)	96,555	65,624	(3,704)	-18%	60%	-3%	6,789	4%	33%
<b>2022</b>	<b>21,245</b>	<b>162,179</b>	<b>3,056</b>	<b>11,575</b>	<b>(11,351)</b>	<b>165,459</b>	<b>96,555</b>	<b>8,544</b>	<b>6,900</b>	<b>(11,351)</b>	<b>100,648</b>	<b>64,811</b>	<b>(813)</b>	<b>-4%</b>	<b>61%</b>	<b>-3%</b>	<b>7,076</b>	<b>4%</b>	<b>33%</b>
2023	21,722	165,459	3,071	11,805	(11,663)	168,672	100,648	8,833	7,196	(11,663)	105,013	63,659	(1,152)	-5%	62%	-3%	7,342	4%	34%
2024	22,210	168,672	3,085	12,030	(11,984)	171,803	105,013	9,114	7,511	(11,984)	109,655	62,148	(1,511)	-7%	64%	-3%	7,601	4%	34%
2025	22,710	171,803	3,098	12,248	(12,314)	174,834	109,655	9,383	7,846	(12,314)	114,570	60,264	(1,883)	-8%	66%	-3%	7,847	3%	35%
2026	23,221	174,834	3,108	12,458	(12,652)	177,748	114,570	9,647	8,199	(12,652)	119,764	57,984	(2,280)	-10%	67%	-3%	8,090	3%	35%
<b>2027</b>	<b>23,744</b>	<b>177,748</b>	<b>3,116</b>	<b>12,660</b>	<b>(13,000)</b>	<b>180,525</b>	<b>119,764</b>	<b>9,911</b>	<b>8,573</b>	<b>(13,000)</b>	<b>125,248</b>	<b>55,277</b>	<b>(2,707)</b>	<b>-11%</b>	<b>69%</b>	<b>-3%</b>	<b>8,332</b>	<b>3%</b>	<b>35%</b>
2028	24,280	180,525	3,123	12,851	(13,358)	183,141	125,248	10,204	8,968	(13,358)	131,062	52,079	(3,198)	-13%	72%	-3%	8,605	3%	35%
2029	24,828	183,141	3,127	13,030	(13,725)	185,573	131,062	10,500	9,387	(13,725)	137,224	48,349	(3,730)	-15%	74%	-2%	8,882	3%	36%
2030	25,389	185,573	3,129	13,196	(14,103)	187,795	137,224	10,785	9,831	(14,103)	143,737	44,058	(4,291)	-17%	77%	-2%	9,147	3%	36%
2031	25,963	187,795	3,128	13,345	(14,490)	189,778	143,737	11,072	10,299	(14,490)	150,618	39,159	(4,898)	-19%	79%	-2%	9,417	3%	36%
<b>2032</b>	<b>26,551</b>	<b>189,778</b>	<b>3,125</b>	<b>13,477</b>	<b>(14,869)</b>	<b>191,511</b>	<b>150,618</b>	<b>11,363</b>	<b>10,795</b>	<b>(14,869)</b>	<b>157,906</b>	<b>33,604</b>	<b>(5,555)</b>	<b>-21%</b>	<b>82%</b>	<b>-2%</b>	<b>9,690</b>	<b>3%</b>	<b>36%</b>
2033	27,152	191,511	3,120	13,592	(15,219)	193,004	157,906	11,657	11,321	(15,219)	165,666	27,339	(6,265)	-23%	86%	-2%	9,968	3%	37%
2034	27,768	193,004	3,114	13,691	(15,536)	194,273	165,666	11,951	11,883	(15,536)	173,963	20,309	(7,030)	-25%	90%	-2%	10,246	3%	37%
2035	28,399	194,273	3,105	13,774	(15,818)	195,333	173,963	12,249	12,485	(15,818)	182,880	12,454	(7,855)	-28%	94%	-2%	10,529	3%	37%
2036	29,044	195,333	3,095	13,843	(16,064)	196,207	182,880	12,547	13,134	(16,064)	192,496	3,711	(8,742)	-30%	98%	-2%	10,812	3%	37%
<b>2037</b>	<b>29,704</b>	<b>196,207</b>	<b>3,085</b>	<b>13,900</b>	<b>(16,272)</b>	<b>196,921</b>	<b>192,496</b>	<b>12,859</b>	<b>13,834</b>	<b>(16,272)</b>	<b>202,918</b>	<b>(5,998)</b>	<b>(9,709)</b>	<b>-33%</b>	<b>103%</b>	<b>-2%</b>	<b>11,109</b>	<b>3%</b>	<b>37%</b>
2038	30,380	196,921	3,074	13,946	(16,440)	197,502	202,918	13,189	14,596	(16,440)	214,263	(16,762)	(10,764)	-35%	108%	-2%	11,424	3%	38%
2039	31,072	197,502	3,063	13,985	(16,567)	197,983	214,263	13,530	15,426	(16,567)	226,653	(28,670)	(11,908)	-38%	114%	-1%	11,750	3%	38%
2040	31,781	197,983	3,053	14,017	(16,652)	198,400	226,653	13,887	16,334	(16,652)	240,221	(41,820)	(13,150)	-41%	121%	-1%	12,090	3%	38%
2041	32,506	198,400	3,044	14,046	(16,696)	198,794	240,221	14,242	17,329	(16,696)	255,096	(56,301)	(14,481)	-45%	128%	-1%	12,430	3%	38%
<b>2042</b>	<b>33,249</b>	<b>198,794</b>	<b>3,036</b>	<b>14,075</b>	<b>(16,698)</b>	<b>199,208</b>	<b>255,096</b>	<b>14,600</b>	<b>18,420</b>	<b>(16,698)</b>	<b>271,418</b>	<b>(72,210)</b>	<b>(15,909)</b>	<b>-48%</b>	<b>136%</b>	<b>-1%</b>	<b>12,770</b>	<b>3%</b>	<b>38%</b>
2043	34,009	199,208	3,030	14,107	(16,659)	199,686	271,418	14,971	19,618	(16,659)	289,348	(89,662)	(17,452)	-51%	145%	-1%	13,123	3%	39%
2044	34,788	199,686	3,027	14,145	(16,578)	200,280	289,348	15,343	20,934	(16,578)	309,047	(108,767)	(19,105)	-55%	154%	0%	13,476	3%	39%
2045	35,585	200,280	3,026	14,193	(16,458)	201,040	309,047	15,722	22,380	(16,458)	330,690	(129,650)	(20,883)	-59%	164%	0%	13,833	3%	39%
2046	36,401	201,040	3,028	14,255	(16,300)	202,022	330,690	16,113	23,968	(16,300)	354,471	(152,449)	(22,799)	-63%	175%	0%	14,202	3%	39%
<b>2047</b>	<b>37,236</b>	<b>202,022</b>	<b>3,033</b>	<b>14,334</b>	<b>(16,105)</b>	<b>203,283</b>	<b>354,471</b>	<b>16,508</b>	<b>25,713</b>	<b>(16,105)</b>	<b>380,587</b>	<b>(177,304)</b>	<b>(24,855)</b>	<b>-67%</b>	<b>187%</b>	<b>0%</b>	<b>14,573</b>	<b>3%</b>	<b>39%</b>

Source: Analysis by The Pew Charitable Trusts and The Terry Group based on data from retirement system actuarial valuations and annual reports

# Exhibit 3

## Pennsylvania Retirement System 30 Year Projections

Plans included: State Employees' Retirement System, Public School Employees' Retirement System  
 State contribution policy under low rate of return (5.00%)

SMMs

Fiscal Year	Pension Liability (Actuarial Accrued Liability)						Pension Assets (Market Value)					Change in Pension Debt			Cash Flow		Employer Contribution		
	Payroll	Beginning of Period	Service Cost	Interest	Benefit Payments	End of Period	Beginning of Period	Total Contribution	Interest	Benefit Payments	End of Period	Debt	\$	% of Payroll	% Funded	% of Assets	\$	% Change	% Payroll
2018	19,443	150,412	2,747	13,042	(10,184)	156,017	82,682	7,631	4,071	(10,184)	84,200	71,817	4,087	21%	54%	-3%	6,254	N/A	32%
2019	19,878	156,017	2,389	11,128	(10,464)	159,070	84,200	7,825	4,145	(10,464)	85,706	73,365	1,547	8%	54%	-3%	6,426	3%	32%
2020	20,324	159,070	2,412	11,343	(10,752)	162,073	85,706	8,241	4,223	(10,752)	87,418	74,655	1,290	6%	54%	-3%	6,819	6%	34%
2021	20,779	162,073	2,402	8,752	(11,047)	162,179	87,418	8,442	4,307	(11,047)	89,120	73,060	(1,595)	-8%	55%	-3%	6,975	2%	34%
<b>2022</b>	<b>21,245</b>	<b>162,179</b>	<b>3,056</b>	<b>11,575</b>	<b>(11,351)</b>	<b>165,459</b>	<b>89,120</b>	<b>8,725</b>	<b>4,391</b>	<b>(11,351)</b>	<b>90,884</b>	<b>74,575</b>	<b>1,515</b>	<b>7%</b>	<b>55%</b>	<b>-3%</b>	<b>7,231</b>	<b>4%</b>	<b>34%</b>
2023	21,722	165,459	3,071	11,805	(11,663)	168,672	90,884	9,157	4,482	(11,663)	92,860	75,812	1,237	6%	55%	-3%	7,636	6%	35%
2024	22,210	168,672	3,085	12,030	(11,984)	171,803	92,860	9,485	4,581	(11,984)	94,942	76,861	1,049	5%	55%	-3%	7,905	4%	36%
2025	22,710	171,803	3,098	12,248	(12,314)	174,834	94,942	9,796	4,685	(12,314)	97,109	77,725	864	4%	56%	-3%	8,187	4%	36%
2026	23,221	174,834	3,108	12,458	(12,652)	177,748	97,109	10,169	4,794	(12,652)	99,420	78,329	604	3%	56%	-3%	8,510	4%	37%
<b>2027</b>	<b>23,744</b>	<b>177,748</b>	<b>3,116</b>	<b>12,660</b>	<b>(13,000)</b>	<b>180,525</b>	<b>99,420</b>	<b>10,566</b>	<b>4,911</b>	<b>(13,000)</b>	<b>101,896</b>	<b>78,629</b>	<b>300</b>	<b>1%</b>	<b>56%</b>	<b>-2%</b>	<b>8,831</b>	<b>4%</b>	<b>37%</b>
2028	24,280	180,525	3,123	12,851	(13,358)	183,141	101,896	10,921	5,035	(13,358)	104,494	78,647	19	0%	57%	-2%	9,151	4%	38%
2029	24,828	183,141	3,127	13,030	(13,725)	185,573	104,494	11,310	5,165	(13,725)	107,244	78,330	(318)	-1%	58%	-2%	9,494	4%	38%
2030	25,389	185,573	3,129	13,196	(14,103)	187,795	107,244	11,760	5,304	(14,103)	110,205	77,589	(740)	-3%	59%	-2%	9,850	4%	39%
2031	25,963	187,795	3,128	13,345	(14,490)	189,778	110,205	12,168	5,453	(14,490)	113,336	76,441	(1,148)	-4%	60%	-2%	10,217	4%	39%
<b>2032</b>	<b>26,551</b>	<b>189,778</b>	<b>3,125</b>	<b>13,477</b>	<b>(14,869)</b>	<b>191,511</b>	<b>113,336</b>	<b>12,601</b>	<b>5,611</b>	<b>(14,869)</b>	<b>116,679</b>	<b>74,832</b>	<b>(1,610)</b>	<b>-6%</b>	<b>61%</b>	<b>-2%</b>	<b>10,594</b>	<b>4%</b>	<b>40%</b>
2033	27,152	191,511	3,120	13,592	(15,219)	193,004	116,679	13,046	5,780	(15,219)	120,286	72,718	(2,114)	-8%	62%	-2%	10,997	4%	40%
2034	27,768	193,004	3,114	13,691	(15,536)	194,273	120,286	13,507	5,964	(15,536)	124,222	70,051	(2,667)	-10%	64%	-2%	11,415	4%	41%
2035	28,399	194,273	3,105	13,774	(15,818)	195,333	124,222	14,002	6,166	(15,818)	128,571	66,762	(3,289)	-12%	66%	-1%	11,847	4%	42%
2036	29,044	195,333	3,095	13,843	(16,064)	196,207	128,571	11,186	6,308	(16,064)	130,001	66,206	(555)	-2%	66%	-4%	8,986	-24%	31%
<b>2037</b>	<b>29,704</b>	<b>196,207</b>	<b>3,085</b>	<b>13,900</b>	<b>(16,272)</b>	<b>196,921</b>	<b>130,001</b>	<b>10,722</b>	<b>6,363</b>	<b>(16,272)</b>	<b>130,814</b>	<b>66,106</b>	<b>(100)</b>	<b>0%</b>	<b>66%</b>	<b>-4%</b>	<b>8,476</b>	<b>-6%</b>	<b>29%</b>
2038	30,380	196,921	3,074	13,946	(16,440)	197,502	130,814	10,718	6,399	(16,440)	131,491	66,010	(96)	0%	67%	-4%	8,425	-1%	28%
2039	31,072	197,502	3,063	13,985	(16,567)	197,983	131,491	10,659	6,429	(16,567)	132,012	65,971	(39)	0%	67%	-4%	8,319	-1%	27%
2040	31,781	197,983	3,053	14,017	(16,652)	198,400	132,012	10,687	6,453	(16,652)	132,500	65,901	(70)	0%	67%	-5%	8,298	0%	26%
2041	32,506	198,400	3,044	14,046	(16,696)	198,794	132,500	10,756	6,478	(16,696)	133,038	65,756	(145)	0%	67%	-4%	8,318	0%	26%
<b>2042</b>	<b>33,249</b>	<b>198,794</b>	<b>3,036</b>	<b>14,075</b>	<b>(16,698)</b>	<b>199,208</b>	<b>133,038</b>	<b>10,160</b>	<b>6,490</b>	<b>(16,698)</b>	<b>132,991</b>	<b>66,217</b>	<b>461</b>	<b>1%</b>	<b>67%</b>	<b>-5%</b>	<b>7,671</b>	<b>-8%</b>	<b>23%</b>
2043	34,009	199,208	3,030	14,107	(16,659)	199,686	132,991	9,863	6,482	(16,659)	132,677	67,009	792	2%	66%	-5%	7,322	-5%	22%
2044	34,788	199,686	3,027	14,145	(16,578)	200,280	132,677	9,585	6,461	(16,578)	132,144	68,135	1,126	3%	66%	-5%	6,990	-5%	20%
2045	35,585	200,280	3,026	14,193	(16,458)	201,040	132,144	9,595	6,438	(16,458)	131,718	69,321	1,186	3%	66%	-5%	6,944	-1%	20%
2046	36,401	201,040	3,028	14,255	(16,300)	202,022	131,718	9,636	6,421	(16,300)	131,476	70,546	1,225	3%	65%	-5%	6,929	0%	19%
<b>2047</b>	<b>37,236</b>	<b>202,022</b>	<b>3,033</b>	<b>14,334</b>	<b>(16,105)</b>	<b>203,283</b>	<b>131,476</b>	<b>9,744</b>	<b>6,417</b>	<b>(16,105)</b>	<b>131,532</b>	<b>71,751</b>	<b>1,205</b>	<b>3%</b>	<b>65%</b>	<b>-5%</b>	<b>6,978</b>	<b>1%</b>	<b>19%</b>

Source: Analysis by The Pew Charitable Trusts and The Terry Group based on data from retirement system actuarial valuations and annual reports

# Exhibit 4

## Pennsylvania Retirement System 30 Year Projections

Plans included: State Employees' Retirement System, Public School Employees' Retirement System  
Revenue-constrained policy under low rate of return (5.00%)

SMMs

Fiscal Year	Pension Liability (Actuarial Accrued Liability)						Pension Assets (Market Value)					Change in Pension Debt			Cash Flow		Employer Contribution		
	Payroll	Beginning of Period	Service Cost	Interest	Benefit Payments	End of Period	Beginning of Period	Total Contribution	Interest	Benefit Payments	End of Period	Debt	\$	% of Payroll	% Funded	% of Assets	\$	% Change	% Payroll
2018	19,443	150,412	2,747	13,042	(10,184)	156,017	82,682	7,409	4,066	(10,184)	83,972	72,045	4,314	22%	54%	-3%	6,032	N/A	31%
2019	19,878	156,017	2,389	11,128	(10,464)	159,070	83,972	7,747	4,132	(10,464)	85,387	73,684	1,639	8%	54%	-3%	6,348	5%	32%
2020	20,324	159,070	2,412	11,343	(10,752)	162,073	85,387	7,921	4,199	(10,752)	86,755	75,318	1,634	8%	54%	-3%	6,499	2%	32%
2021	20,779	162,073	2,402	8,752	(11,047)	162,179	86,755	8,257	4,269	(11,047)	88,233	73,946	(1,372)	-7%	54%	-3%	6,789	4%	33%
<b>2022</b>	<b>21,245</b>	<b>162,179</b>	<b>3,056</b>	<b>11,575</b>	<b>(11,351)</b>	<b>165,459</b>	<b>88,233</b>	<b>8,570</b>	<b>4,343</b>	<b>(11,351)</b>	<b>89,795</b>	<b>75,664</b>	<b>1,718</b>	<b>8%</b>	<b>54%</b>	<b>-3%</b>	<b>7,076</b>	<b>4%</b>	<b>33%</b>
2023	21,722	165,459	3,071	11,805	(11,663)	168,672	89,795	8,862	4,421	(11,663)	91,415	77,257	1,594	7%	54%	-3%	7,342	4%	34%
2024	22,210	168,672	3,085	12,030	(11,984)	171,803	91,415	9,181	4,502	(11,984)	93,113	78,690	1,433	6%	54%	-3%	7,601	4%	34%
2025	22,710	171,803	3,098	12,248	(12,314)	174,834	93,113	9,457	4,585	(12,314)	94,841	79,994	1,304	6%	54%	-3%	7,847	3%	35%
2026	23,221	174,834	3,108	12,458	(12,652)	177,748	94,841	9,749	4,670	(12,652)	96,607	81,141	1,147	5%	54%	-3%	8,090	3%	35%
<b>2027</b>	<b>23,744</b>	<b>177,748</b>	<b>3,116</b>	<b>12,660</b>	<b>(13,000)</b>	<b>180,525</b>	<b>96,607</b>	<b>10,067</b>	<b>4,758</b>	<b>(13,000)</b>	<b>98,432</b>	<b>82,093</b>	<b>952</b>	<b>4%</b>	<b>55%</b>	<b>-3%</b>	<b>8,332</b>	<b>3%</b>	<b>35%</b>
2028	24,280	180,525	3,123	12,851	(13,358)	183,141	98,432	10,375	4,848	(13,358)	100,297	82,844	751	3%	55%	-3%	8,605	3%	35%
2029	24,828	183,141	3,127	13,030	(13,725)	185,573	100,297	10,698	4,940	(13,725)	102,209	83,364	519	2%	55%	-3%	8,882	3%	36%
2030	25,389	185,573	3,129	13,196	(14,103)	187,795	102,209	11,057	5,035	(14,103)	104,200	83,595	232	1%	55%	-3%	9,147	3%	36%
2031	25,963	187,795	3,128	13,345	(14,490)	189,778	104,200	11,368	5,133	(14,490)	106,210	83,568	(28)	0%	56%	-3%	9,417	3%	36%
<b>2032</b>	<b>26,551</b>	<b>189,778</b>	<b>3,125</b>	<b>13,477</b>	<b>(14,869)</b>	<b>191,511</b>	<b>106,210</b>	<b>11,697</b>	<b>5,232</b>	<b>(14,869)</b>	<b>108,270</b>	<b>83,241</b>	<b>(327)</b>	<b>-1%</b>	<b>57%</b>	<b>-3%</b>	<b>9,690</b>	<b>3%</b>	<b>36%</b>
2033	27,152	191,511	3,120	13,592	(15,219)	193,004	108,270	12,017	5,334	(15,219)	110,402	82,602	(639)	-2%	57%	-3%	9,968	3%	37%
2034	27,768	193,004	3,114	13,691	(15,536)	194,273	110,402	12,338	5,441	(15,536)	112,645	81,628	(975)	-4%	58%	-3%	10,246	3%	37%
2035	28,399	194,273	3,105	13,774	(15,818)	195,333	112,645	12,684	5,555	(15,818)	115,065	80,268	(1,360)	-5%	59%	-3%	10,529	3%	37%
2036	29,044	195,333	3,095	13,843	(16,064)	196,207	115,065	13,012	5,678	(16,064)	117,691	78,516	(1,752)	-6%	60%	-3%	10,812	3%	37%
<b>2037</b>	<b>29,704</b>	<b>196,207</b>	<b>3,085</b>	<b>13,900</b>	<b>(16,272)</b>	<b>196,921</b>	<b>117,691</b>	<b>13,355</b>	<b>5,813</b>	<b>(16,272)</b>	<b>120,587</b>	<b>76,333</b>	<b>(2,183)</b>	<b>-7%</b>	<b>61%</b>	<b>-2%</b>	<b>11,109</b>	<b>3%</b>	<b>37%</b>
2038	30,380	196,921	3,074	13,946	(16,440)	197,502	120,587	13,716	5,962	(16,440)	123,826	73,676	(2,658)	-9%	63%	-2%	11,424	3%	38%
2039	31,072	197,502	3,063	13,985	(16,567)	197,983	123,826	14,090	6,130	(16,567)	127,479	70,504	(3,172)	-10%	64%	-2%	11,750	3%	38%
2040	31,781	197,983	3,053	14,017	(16,652)	198,400	127,479	14,479	6,320	(16,652)	131,626	66,775	(3,729)	-12%	66%	-2%	12,090	3%	38%
2041	32,506	198,400	3,044	14,046	(16,696)	198,794	131,626	14,868	6,536	(16,696)	136,333	62,461	(4,314)	-13%	69%	-1%	12,430	3%	38%
<b>2042</b>	<b>33,249</b>	<b>198,794</b>	<b>3,036</b>	<b>14,075</b>	<b>(16,698)</b>	<b>199,208</b>	<b>136,333</b>	<b>15,259</b>	<b>6,781</b>	<b>(16,698)</b>	<b>141,676</b>	<b>57,532</b>	<b>(4,929)</b>	<b>-15%</b>	<b>71%</b>	<b>-1%</b>	<b>12,770</b>	<b>3%</b>	<b>38%</b>
2043	34,009	199,208	3,030	14,107	(16,659)	199,686	141,676	15,665	7,059	(16,659)	147,741	51,945	(5,587)	-16%	74%	-1%	13,123	3%	39%
2044	34,788	199,686	3,027	14,145	(16,578)	200,280	147,741	15,883	7,370	(16,578)	154,415	45,864	(6,081)	-17%	77%	0%	13,476	3%	39%
2045	35,585	200,280	3,026	14,193	(16,458)	201,040	154,415	16,283	7,716	(16,458)	161,957	39,083	(6,781)	-19%	81%	0%	13,833	3%	39%
2046	36,401	201,040	3,028	14,255	(16,300)	202,022	161,957	16,696	8,108	(16,300)	170,460	31,562	(7,521)	-21%	84%	0%	14,202	3%	39%
<b>2047</b>	<b>37,236</b>	<b>202,022</b>	<b>3,033</b>	<b>14,334</b>	<b>(16,105)</b>	<b>203,283</b>	<b>170,460</b>	<b>17,165</b>	<b>8,549</b>	<b>(16,105)</b>	<b>180,069</b>	<b>23,214</b>	<b>(8,348)</b>	<b>-22%</b>	<b>89%</b>	<b>1%</b>	<b>14,573</b>	<b>3%</b>	<b>39%</b>

Source: Analysis by The Pew Charitable Trusts and The Terry Group based on data from retirement system actuarial valuations and annual reports

# Exhibit 5

## Pennsylvania Retirement System 30 Year Projections

Plans included: State Employees' Retirement System, Public School Employees' Retirement System  
State contribution policy under asset shock

SMMs

Fiscal Year	Pension Liability (Actuarial Accrued Liability)						Pension Assets (Market Value)					Change in Pension Debt			Cash Flow		Employer Contribution		
	Payroll	Beginning of Period	Service Cost	Interest	Benefit Payments	End of Period	Beginning of Period	Total Contribution	Interest	Benefit Payments	End of Period	Debt	\$	% of Payroll	% Funded	% of Assets	\$	% Change	% Payroll
2018	19,443	150,412	2,747	13,042	(10,184)	156,017	82,682	7,631	(18,219)	(10,184)	61,910	94,108	26,377	136%	40%	-3%	6,254	N/A	32%
2019	19,878	156,017	2,389	11,128	(10,464)	159,070	61,910	7,898	6,606	(10,464)	65,950	93,120	(987)	-5%	41%	-4%	6,499	4%	33%
2020	20,324	159,070	2,412	11,343	(10,752)	162,073	65,950	8,787	7,858	(10,752)	71,843	90,229	(2,891)	-14%	44%	-3%	7,355	13%	36%
2021	20,617	162,073	2,402	8,478	(11,047)	161,905	71,843	8,957	6,806	(11,047)	76,559	85,346	(4,883)	-24%	47%	-3%	7,489	2%	36%
<b>2022</b>	<b>20,916</b>	<b>161,905</b>	<b>3,032</b>	<b>11,279</b>	<b>(11,351)</b>	<b>164,864</b>	<b>76,559</b>	<b>9,280</b>	<b>3,584</b>	<b>(11,351)</b>	<b>78,071</b>	<b>86,793</b>	<b>1,447</b>	<b>7%</b>	<b>47%</b>	<b>-3%</b>	<b>7,796</b>	<b>4%</b>	<b>37%</b>
2023	21,219	164,864	3,024	11,479	(11,663)	167,704	78,071	9,818	3,938	(11,663)	80,163	87,541	747	4%	48%	-2%	8,304	7%	39%
2024	21,530	167,704	3,014	11,675	(11,984)	170,408	80,163	10,170	4,046	(11,984)	82,395	88,014	473	2%	48%	-2%	8,607	4%	40%
2025	21,846	170,408	3,003	11,857	(12,314)	172,954	82,395	10,435	4,158	(12,314)	84,675	88,279	266	1%	49%	-2%	8,853	3%	41%
2026	22,167	172,954	2,990	12,027	(12,652)	175,318	84,675	10,780	4,275	(12,652)	87,077	88,241	(38)	0%	50%	-2%	9,158	3%	41%
<b>2027</b>	<b>22,508</b>	<b>175,318</b>	<b>2,975</b>	<b>12,209</b>	<b>(13,000)</b>	<b>177,502</b>	<b>87,077</b>	<b>11,184</b>	<b>4,399</b>	<b>(13,000)</b>	<b>89,660</b>	<b>87,842</b>	<b>(399)</b>	<b>-2%</b>	<b>51%</b>	<b>-2%</b>	<b>9,499</b>	<b>4%</b>	<b>42%</b>
2028	22,855	177,502	2,960	12,353	(13,358)	179,457	89,660	11,558	4,532	(13,358)	92,391	87,066	(776)	-3%	51%	-2%	9,849	4%	43%
2029	23,209	179,457	2,944	12,480	(13,725)	181,155	92,391	11,952	4,672	(13,725)	95,290	85,865	(1,201)	-5%	53%	-2%	10,219	4%	44%
2030	23,568	181,155	2,925	12,589	(14,103)	182,566	95,290	12,323	4,821	(14,103)	98,331	84,235	(1,630)	-7%	54%	-2%	10,512	3%	45%
2031	23,934	182,566	2,904	12,676	(14,490)	183,656	98,331	12,666	4,975	(14,490)	101,481	82,175	(2,060)	-9%	55%	-2%	10,828	3%	45%
<b>2032</b>	<b>24,305</b>	<b>183,656</b>	<b>2,882</b>	<b>12,741</b>	<b>(14,869)</b>	<b>184,409</b>	<b>101,481</b>	<b>13,046</b>	<b>5,136</b>	<b>(14,869)</b>	<b>104,794</b>	<b>79,615</b>	<b>(2,560)</b>	<b>-11%</b>	<b>57%</b>	<b>-2%</b>	<b>11,167</b>	<b>3%</b>	<b>46%</b>
2033	24,684	184,409	2,858	12,782	(15,219)	184,830	104,794	13,445	5,307	(15,219)	108,328	76,502	(3,113)	-13%	59%	-2%	11,540	3%	47%
2034	25,069	184,830	2,832	12,801	(15,536)	184,928	108,328	13,856	5,491	(15,536)	112,139	72,789	(3,714)	-15%	61%	-2%	11,923	3%	48%
2035	25,460	184,928	2,805	12,798	(15,818)	184,713	112,139	14,281	5,690	(15,818)	116,291	68,422	(4,367)	-17%	63%	-1%	12,321	3%	48%
2036	25,859	184,713	2,777	12,774	(16,064)	184,200	116,291	11,459	5,825	(16,064)	117,511	66,688	(1,733)	-7%	64%	-4%	9,473	-23%	37%
<b>2037</b>	<b>26,264</b>	<b>184,200</b>	<b>2,749</b>	<b>12,730</b>	<b>(16,272)</b>	<b>183,407</b>	<b>117,511</b>	<b>10,954</b>	<b>5,869</b>	<b>(16,272)</b>	<b>118,063</b>	<b>65,344</b>	<b>(1,345)</b>	<b>-5%</b>	<b>64%</b>	<b>-5%</b>	<b>8,941</b>	<b>-6%</b>	<b>34%</b>
2038	26,677	183,407	2,721	12,667	(16,440)	182,355	118,063	10,898	5,892	(16,440)	118,413	63,942	(1,402)	-5%	65%	-5%	8,857	-1%	33%
2039	27,097	182,355	2,694	12,586	(16,567)	181,069	118,413	10,786	5,904	(16,567)	118,537	62,532	(1,410)	-5%	65%	-5%	8,719	-2%	32%
2040	27,524	181,069	2,667	12,491	(16,652)	179,574	118,537	10,758	5,907	(16,652)	118,550	61,024	(1,508)	-5%	66%	-5%	8,663	-1%	31%
2041	27,959	179,574	2,641	12,382	(16,696)	177,901	118,550	10,773	5,907	(16,696)	118,534	59,367	(1,657)	-6%	67%	-5%	8,650	0%	31%
<b>2042</b>	<b>28,401</b>	<b>177,901</b>	<b>2,617</b>	<b>12,262</b>	<b>(16,698)</b>	<b>176,081</b>	<b>118,534</b>	<b>10,126</b>	<b>5,889</b>	<b>(16,698)</b>	<b>117,851</b>	<b>58,230</b>	<b>(1,137)</b>	<b>-4%</b>	<b>67%</b>	<b>-6%</b>	<b>7,975</b>	<b>-8%</b>	<b>28%</b>
2043	28,851	176,081	2,594	12,132	(16,659)	174,149	117,851	9,786	5,847	(16,659)	116,825	57,324	(906)	-3%	67%	-6%	7,605	-5%	26%
2044	29,309	174,149	2,574	11,996	(16,578)	172,141	116,825	8,726	5,769	(16,578)	114,741	57,399	75	0%	67%	-7%	6,516	-14%	22%
2045	29,776	172,141	2,556	11,856	(16,458)	170,095	114,741	8,852	5,669	(16,458)	112,803	57,291	(108)	0%	66%	-7%	6,612	1%	22%
2046	30,250	170,095	2,541	11,715	(16,300)	168,050	112,803	8,789	5,572	(16,300)	110,864	57,186	(105)	0%	66%	-7%	6,518	-1%	22%
<b>2047</b>	<b>30,733</b>	<b>168,050</b>	<b>2,529</b>	<b>11,574</b>	<b>(16,105)</b>	<b>166,049</b>	<b>110,864</b>	<b>8,712</b>	<b>5,476</b>	<b>(16,105)</b>	<b>108,946</b>	<b>57,102</b>	<b>(84)</b>	<b>0%</b>	<b>66%</b>	<b>-7%</b>	<b>6,410</b>	<b>-2%</b>	<b>21%</b>

Source: Analysis by The Pew Charitable Trusts and The Terry Group based on data from retirement system actuarial valuations and annual reports



# Exhibit 6

## Pennsylvania Retirement System 30 Year Projections

Plans included: State Employees' Retirement System, Public School Employees' Retirement System  
Revenue-constrained policy under asset shock

\$MMs

Fiscal Year	Pension Liability (Actuarial Accrued Liability)						Pension Assets (Market Value)					Change in Pension Debt			Cash Flow		Employer Contribution		
	Payroll	Beginning of Period	Service Cost	Interest	Benefit Payments	End of Period	Beginning of Period	Total Contribution	Interest	Benefit Payments	End of Period	Debt	\$	% of Payroll	% Funded	% of Assets	\$	% Change	% Payroll
2018	19,443	150,412	2,747	13,042	(10,184)	156,017	82,682	7,103	(18,158)	(10,184)	61,442	94,575	26,844	138%	39%	-4%	5,725	N/A	29%
2019	19,878	156,017	2,389	11,128	(10,464)	159,070	61,442	7,299	6,526	(10,464)	64,803	94,267	(307)	-2%	41%	-5%	5,900	3%	30%
2020	20,324	159,070	2,412	11,343	(10,752)	162,073	64,803	7,619	7,658	(10,752)	69,328	92,744	(1,523)	-7%	43%	-5%	6,187	5%	30%
2021	20,617	162,073	2,402	8,478	(11,047)	161,905	69,328	7,965	6,530	(11,047)	72,775	89,129	(3,615)	-18%	45%	-4%	6,497	5%	32%
<b>2022</b>	<b>20,916</b>	<b>161,905</b>	<b>3,032</b>	<b>11,279</b>	<b>(11,351)</b>	<b>164,864</b>	<b>72,775</b>	<b>8,228</b>	<b>3,381</b>	<b>(11,351)</b>	<b>73,033</b>	<b>91,832</b>	<b>2,702</b>	<b>13%</b>	<b>44%</b>	<b>-4%</b>	<b>6,744</b>	<b>4%</b>	<b>32%</b>
2023	21,219	164,864	3,024	11,479	(11,663)	167,704	73,033	8,511	3,647	(11,663)	73,528	94,176	2,345	11%	44%	-4%	6,997	4%	33%
2024	21,530	167,704	3,014	11,675	(11,984)	170,408	73,528	8,807	3,672	(11,984)	74,022	96,386	2,210	10%	43%	-4%	7,244	4%	34%
2025	21,846	170,408	3,003	11,857	(12,314)	172,954	74,022	9,061	3,695	(12,314)	74,465	98,488	2,102	10%	43%	-4%	7,479	3%	34%
2026	22,167	172,954	2,990	12,027	(12,652)	175,318	74,465	9,331	3,716	(12,652)	74,860	100,458	1,969	9%	43%	-4%	7,710	3%	35%
<b>2027</b>	<b>22,508</b>	<b>175,318</b>	<b>2,975</b>	<b>12,209</b>	<b>(13,000)</b>	<b>177,502</b>	<b>74,860</b>	<b>9,625</b>	<b>3,735</b>	<b>(13,000)</b>	<b>75,221</b>	<b>102,281</b>	<b>1,823</b>	<b>8%</b>	<b>42%</b>	<b>-5%</b>	<b>7,941</b>	<b>3%</b>	<b>35%</b>
2028	22,855	177,502	2,960	12,353	(13,358)	179,457	75,221	9,910	3,752	(13,358)	75,525	103,932	1,651	7%	42%	-5%	8,201	3%	36%
2029	23,209	179,457	2,944	12,480	(13,725)	181,155	75,525	10,198	3,765	(13,725)	75,762	105,393	1,461	6%	42%	-5%	8,464	3%	36%
2030	23,568	181,155	2,925	12,589	(14,103)	182,566	75,762	10,528	3,776	(14,103)	75,964	106,603	1,210	5%	42%	-5%	8,717	3%	37%
2031	23,934	182,566	2,904	12,676	(14,490)	183,656	75,964	10,812	3,784	(14,490)	76,069	107,587	985	4%	41%	-5%	8,974	3%	37%
<b>2032</b>	<b>24,305</b>	<b>183,656</b>	<b>2,882</b>	<b>12,741</b>	<b>(14,869)</b>	<b>184,409</b>	<b>76,069</b>	<b>11,127</b>	<b>3,788</b>	<b>(14,869)</b>	<b>76,114</b>	<b>108,295</b>	<b>708</b>	<b>3%</b>	<b>41%</b>	<b>-5%</b>	<b>9,235</b>	<b>3%</b>	<b>38%</b>
2033	24,684	184,409	2,858	12,782	(15,219)	184,830	76,114	11,419	3,789	(15,219)	76,104	108,727	432	2%	41%	-5%	9,499	3%	38%
2034	25,069	184,830	2,832	12,801	(15,536)	184,928	76,104	11,712	3,788	(15,536)	76,067	108,860	134	1%	41%	-5%	9,764	3%	39%
2035	25,460	184,928	2,805	12,798	(15,818)	184,713	76,067	12,009	3,786	(15,818)	76,044	108,669	(192)	-1%	41%	-5%	10,034	3%	39%
2036	25,859	184,713	2,777	12,774	(16,064)	184,200	76,044	12,306	3,786	(16,064)	76,072	108,128	(541)	-2%	41%	-5%	10,304	3%	40%
<b>2037</b>	<b>26,264</b>	<b>184,200</b>	<b>2,749</b>	<b>12,730</b>	<b>(16,272)</b>	<b>183,407</b>	<b>76,072</b>	<b>12,616</b>	<b>3,790</b>	<b>(16,272)</b>	<b>76,206</b>	<b>107,201</b>	<b>(927)</b>	<b>-4%</b>	<b>42%</b>	<b>-5%</b>	<b>10,587</b>	<b>3%</b>	<b>40%</b>
2038	26,677	183,407	2,721	12,667	(16,440)	182,355	76,206	12,942	3,801	(16,440)	76,510	105,846	(1,355)	-5%	42%	-5%	10,887	3%	41%
2039	27,097	182,355	2,694	12,586	(16,567)	181,069	76,510	13,280	3,822	(16,567)	77,045	104,024	(1,822)	-7%	43%	-4%	11,198	3%	41%
2040	27,524	181,069	2,667	12,491	(16,652)	179,574	77,045	13,632	3,855	(16,652)	77,880	101,694	(2,330)	-8%	43%	-4%	11,522	3%	42%
2041	27,959	179,574	2,641	12,382	(16,696)	177,901	77,880	13,983	3,906	(16,696)	79,073	98,828	(2,866)	-10%	44%	-3%	11,845	3%	42%
<b>2042</b>	<b>28,401</b>	<b>177,901</b>	<b>2,617</b>	<b>12,262</b>	<b>(16,698)</b>	<b>176,081</b>	<b>79,073</b>	<b>14,336</b>	<b>3,975</b>	<b>(16,698)</b>	<b>80,685</b>	<b>95,396</b>	<b>(3,432)</b>	<b>-12%</b>	<b>46%</b>	<b>-3%</b>	<b>12,170</b>	<b>3%</b>	<b>43%</b>
2043	28,851	176,081	2,594	12,132	(16,659)	174,149	80,685	14,701	4,067	(16,659)	82,794	91,354	(4,041)	-14%	48%	-2%	12,506	3%	43%
2044	29,309	174,149	2,574	11,996	(16,578)	172,141	82,794	15,066	4,185	(16,578)	85,467	86,674	(4,681)	-16%	50%	-2%	12,842	3%	44%
2045	29,776	172,141	2,556	11,856	(16,458)	170,095	85,467	15,436	4,334	(16,458)	88,778	81,317	(5,357)	-18%	52%	-1%	13,183	3%	44%
2046	30,250	170,095	2,541	11,715	(16,300)	168,050	88,778	15,818	4,516	(16,300)	92,812	75,239	(6,078)	-20%	55%	-1%	13,535	3%	45%
<b>2047</b>	<b>30,733</b>	<b>168,050</b>	<b>2,529</b>	<b>11,574</b>	<b>(16,105)</b>	<b>166,049</b>	<b>92,812</b>	<b>16,202</b>	<b>4,735</b>	<b>(16,105)</b>	<b>97,644</b>	<b>68,404</b>	<b>(6,835)</b>	<b>-22%</b>	<b>59%</b>	<b>0%</b>	<b>13,888</b>	<b>3%</b>	<b>45%</b>

Source: Analysis by The Pew Charitable Trusts and The Terry Group based on data from retirement system actuarial valuations and annual reports

Exhibit 7

Pennsylvania Retirement System 30 Year Projections

Plans included: State Employees' Retirement System

SMMs	State Contribution Policy										Revenue Constrained Contributions									
	5% Returns					Asset Shock Scenario					5% Returns					Asset Shock Scenario				
	Fiscal Year	Payroll	Employer Contribution (ERC)	ERC as a Share of Payroll	% Funded	Operating Cash Flow to Assets Ratio	Payroll	Employer Contribution (ERC)	ERC as a Share of Payroll	% Funded	Operating Cash Flow to Assets Ratio	Payroll	Employer Contribution (ERC)	ERC as a Share of Payroll	% Funded	Operating Cash Flow to Assets Ratio	Payroll	Employer Contribution (ERC)	ERC as a Share of Payroll	% Funded
2018	6,158	2,037	33%	58%	-3.4%	6,158	2,037	33%	41%	-3.4%	6,158	2,000	32%	58%	-3.5%	6,158	1,898	31%	40%	-3.9%
2019	6,336	2,011	32%	58%	-3.7%	6,336	2,084	33%	43%	-5.0%	6,336	2,105	33%	58%	-3.4%	6,336	1,956	31%	43%	-5.6%
2020	6,520	1,940	30%	58%	-4.2%	6,520	2,154	33%	47%	-4.7%	6,520	2,155	33%	59%	-3.5%	6,520	2,052	31%	46%	-5.2%
2021	6,709	1,932	29%	62%	-4.5%	6,664	2,249	34%	52%	-4.3%	6,709	2,251	34%	63%	-3.4%	6,664	2,154	32%	51%	-4.8%
2022	6,904	2,049	30%	61%	-4.4%	6,811	2,443	36%	52%	-3.6%	6,904	2,346	34%	63%	-3.4%	6,811	2,236	33%	51%	-4.5%
2023	7,104	2,245	32%	61%	-4.1%	6,961	2,702	39%	53%	-2.9%	7,104	2,434	34%	63%	-3.3%	6,961	2,320	33%	51%	-4.5%
2024	7,310	2,309	32%	61%	-4.1%	7,115	2,753	39%	54%	-3.0%	7,310	2,520	34%	63%	-3.3%	7,115	2,402	34%	50%	-4.6%
2025	7,522	2,369	31%	60%	-4.2%	7,273	2,729	38%	54%	-3.4%	7,522	2,602	35%	64%	-3.3%	7,273	2,480	34%	50%	-4.6%
2026	7,740	2,430	31%	60%	-4.3%	7,434	2,726	37%	54%	-3.7%	7,740	2,682	35%	64%	-3.3%	7,434	2,556	34%	50%	-4.7%
2027	7,965	2,494	31%	60%	-4.4%	7,603	2,752	36%	55%	-3.9%	7,965	2,763	35%	65%	-3.3%	7,603	2,633	35%	50%	-4.7%
2028	8,196	2,558	31%	60%	-4.5%	7,777	2,790	36%	55%	-4.1%	8,196	2,853	35%	66%	-3.3%	7,777	2,719	35%	50%	-4.8%
2029	8,433	2,623	31%	60%	-4.6%	7,954	2,830	36%	55%	-4.4%	8,433	2,945	35%	67%	-3.3%	7,954	2,807	35%	50%	-4.9%
2030	8,678	2,688	31%	60%	-4.7%	8,136	2,872	35%	56%	-4.6%	8,678	3,033	35%	68%	-3.3%	8,136	2,890	36%	50%	-5.0%
2031	8,930	2,752	31%	60%	-4.9%	8,322	2,915	35%	56%	-4.8%	8,930	3,122	35%	69%	-3.3%	8,322	2,976	36%	50%	-5.2%
2032	9,189	2,816	31%	60%	-5.0%	8,511	2,958	35%	57%	-5.0%	9,189	3,213	35%	70%	-3.3%	8,511	3,062	36%	50%	-5.1%
2033	9,455	2,889	31%	60%	-5.0%	8,706	3,010	35%	57%	-5.1%	9,455	3,305	35%	72%	-3.2%	8,706	3,150	36%	51%	-5.1%
2034	9,729	2,964	30%	61%	-4.9%	8,904	3,064	34%	58%	-5.1%	9,729	3,397	35%	73%	-3.0%	8,904	3,238	36%	51%	-5.0%
2035	10,011	3,037	30%	61%	-4.8%	9,108	3,116	34%	58%	-5.1%	10,011	3,491	35%	75%	-2.8%	9,108	3,327	37%	52%	-4.9%
2036	10,302	3,108	30%	62%	-4.6%	9,316	3,166	34%	59%	-5.0%	10,302	3,585	35%	78%	-2.5%	9,316	3,417	37%	53%	-4.6%
2037	10,600	3,176	30%	63%	-4.4%	9,528	3,215	34%	60%	-4.9%	10,600	3,683	35%	81%	-2.2%	9,528	3,510	37%	55%	-4.2%
2038	10,908	3,243	30%	64%	-4.1%	9,746	3,263	33%	62%	-4.7%	10,908	3,788	35%	84%	-1.9%	9,746	3,610	37%	56%	-3.8%
2039	11,224	3,309	29%	65%	-3.7%	9,968	3,309	33%	63%	-4.4%	11,224	3,896	35%	88%	-1.5%	9,968	3,713	37%	59%	-3.2%
2040	11,550	3,372	29%	67%	-3.3%	10,196	3,354	33%	65%	-4.0%	11,550	4,009	35%	92%	-1.0%	10,196	3,820	37%	61%	-2.5%
2041	11,885	3,433	29%	69%	-2.8%	10,428	3,396	33%	68%	-3.5%	11,885	4,121	35%	97%	-0.5%	10,428	3,928	38%	65%	-1.8%
2042	12,229	3,337	27%	71%	-2.7%	10,667	3,282	31%	70%	-3.5%	12,229	4,234	35%	102%	0.0%	10,667	4,035	38%	69%	-1.0%
2043	12,584	2,947	23%	72%	-3.4%	10,910	2,892	27%	72%	-4.4%	12,584	4,351	35%	108%	0.4%	10,910	4,147	38%	74%	-0.2%
2044	12,949	2,672	21%	73%	-3.7%	11,159	2,603	23%	74%	-4.9%	12,949	4,468	35%	114%	0.6%	11,159	4,258	38%	79%	0.6%
2045	13,324	2,410	18%	73%	-4.0%	11,414	2,324	20%	75%	-5.3%	13,324	4,587	34%	121%	1.0%	11,414	4,371	38%	86%	1.4%
2046	13,711	2,182	16%	74%	-4.1%	11,674	2,080	18%	75%	-5.5%	13,711	4,709	34%	128%	1.4%	11,674	4,488	38%	94%	2.1%
2047	14,108	2,101	15%	74%	-3.7%	11,941	1,980	17%	76%	-5.3%	14,108	4,832	34%	135%	1.9%	11,941	4,605	39%	102%	2.8%

Source: Analysis by The Pew Charitable Trusts and The Terry Group based on data from retirement system actuarial valuations and annual reports

Exhibit 8

Pennsylvania Retirement System 30 Year Projections

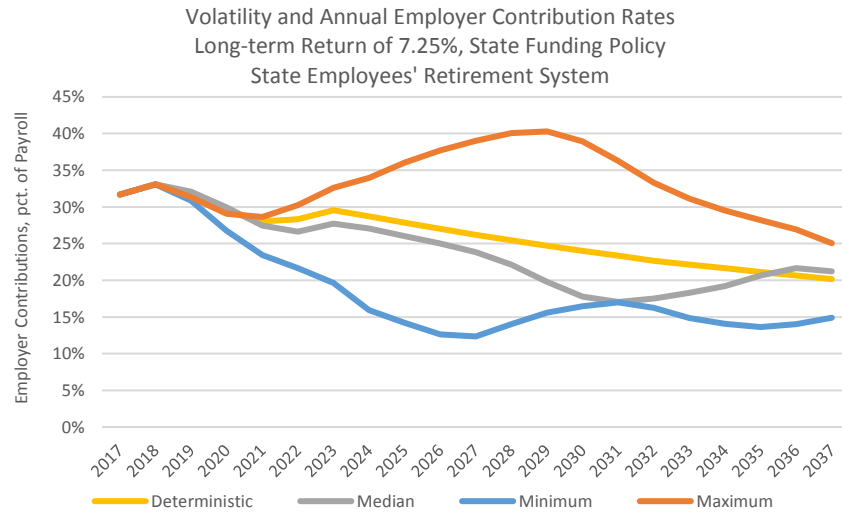
Plans included: Public School Employees' Retirement System

SMMs	State Contribution Policy										Revenue Constrained Contributions									
	5% Returns					Asset Shock Scenario					5% Returns					Asset Shock Scenario				
	Fiscal Year	Payroll	Employer Contribution (ERC)	ERC as a Share of Payroll	% Funded	Operating Cash Flow to Assets Ratio	Payroll	Employer Contribution (ERC)	ERC as a Share of Payroll	% Funded	Operating Cash Flow to Assets Ratio	Payroll	Employer Contribution (ERC)	ERC as a Share of Payroll	% Funded	Operating Cash Flow to Assets Ratio	Payroll	Employer Contribution (ERC)	ERC as a Share of Payroll	% Funded
2018	13,286	4,217	32%	52%	-2.9%	13,286	4,217	32%	39%	-2.9%	13,286	4,032	30%	52%	-3.3%	13,286	3,827	29%	39%	-3.6%
2019	13,542	4,415	33%	52%	-2.8%	13,542	4,415	33%	41%	-3.7%	13,542	4,243	31%	51%	-3.1%	13,542	3,944	29%	40%	-4.9%
2020	13,803	4,879	35%	52%	-2.2%	13,803	5,201	38%	43%	-2.1%	13,803	4,344	31%	51%	-3.2%	13,803	4,136	30%	41%	-4.6%
2021	14,070	5,043	36%	52%	-2.2%	13,953	5,240	38%	45%	-2.2%	14,070	4,538	32%	51%	-3.1%	13,953	4,343	31%	42%	-4.3%
<b>2022</b>	<b>14,341</b>	<b>5,182</b>	<b>36%</b>	<b>52%</b>	<b>-2.2%</b>	<b>14,105</b>	<b>5,353</b>	<b>38%</b>	<b>45%</b>	<b>-2.2%</b>	<b>14,341</b>	<b>4,730</b>	<b>33%</b>	<b>50%</b>	<b>-3.0%</b>	<b>14,105</b>	<b>4,508</b>	<b>32%</b>	<b>41%</b>	<b>-4.2%</b>
2023	14,618	5,391	37%	53%	-2.1%	14,259	5,602	39%	46%	-2.1%	14,618	4,907	34%	50%	-3.0%	14,259	4,677	33%	41%	-4.2%
2024	14,900	5,597	38%	53%	-2.0%	14,415	5,854	41%	46%	-1.9%	14,900	5,081	34%	50%	-2.9%	14,415	4,842	34%	40%	-4.2%
2025	15,188	5,818	38%	53%	-1.9%	14,573	6,124	42%	47%	-1.7%	15,188	5,245	35%	50%	-2.9%	14,573	4,999	34%	40%	-4.3%
2026	15,481	6,079	39%	54%	-1.7%	14,733	6,433	44%	48%	-1.5%	15,481	5,407	35%	50%	-2.9%	14,733	5,153	35%	40%	-4.4%
<b>2027</b>	<b>15,780</b>	<b>6,337</b>	<b>40%</b>	<b>55%</b>	<b>-1.5%</b>	<b>14,905</b>	<b>6,747</b>	<b>45%</b>	<b>49%</b>	<b>-1.2%</b>	<b>15,780</b>	<b>5,570</b>	<b>35%</b>	<b>50%</b>	<b>-2.9%</b>	<b>14,905</b>	<b>5,308</b>	<b>36%</b>	<b>39%</b>	<b>-4.4%</b>
2028	16,084	6,593	41%	56%	-1.4%	15,079	7,058	47%	50%	-1.0%	16,084	5,752	36%	50%	-2.9%	15,079	5,482	36%	39%	-4.5%
2029	16,395	6,871	42%	57%	-1.3%	15,254	7,389	48%	51%	-0.8%	16,395	5,937	36%	50%	-2.9%	15,254	5,658	37%	39%	-4.5%
2030	16,711	7,162	43%	58%	-1.1%	15,432	7,640	50%	53%	-0.7%	16,711	6,114	37%	51%	-2.8%	15,432	5,827	38%	38%	-4.6%
2031	17,034	7,466	44%	60%	-1.0%	15,612	7,914	51%	55%	-0.6%	17,034	6,295	37%	51%	-2.8%	15,612	5,999	38%	38%	-4.7%
<b>2032</b>	<b>17,362</b>	<b>7,778</b>	<b>45%</b>	<b>61%</b>	<b>-0.8%</b>	<b>15,794</b>	<b>8,210</b>	<b>52%</b>	<b>57%</b>	<b>-0.5%</b>	<b>17,362</b>	<b>6,477</b>	<b>37%</b>	<b>51%</b>	<b>-2.8%</b>	<b>15,794</b>	<b>6,173</b>	<b>39%</b>	<b>38%</b>	<b>-4.8%</b>
2033	17,697	8,107	46%	63%	-0.7%	15,978	8,529	53%	59%	-0.4%	17,697	6,663	38%	52%	-2.8%	15,978	6,349	40%	38%	-4.9%
2034	18,039	8,451	47%	65%	-0.5%	16,164	8,860	55%	62%	-0.2%	18,039	6,849	38%	52%	-2.8%	16,164	6,527	40%	37%	-5.0%
2035	18,387	8,809	48%	67%	-0.3%	16,353	9,205	56%	65%	-0.1%	18,387	7,038	38%	53%	-2.8%	16,353	6,707	41%	37%	-5.1%
2036	18,742	9,177	49%	68%	-0.2%	16,543	9,546	57%	66%	0.0%	18,742	7,227	39%	54%	-2.7%	16,543	6,887	42%	37%	-5.1%
<b>2037</b>	<b>19,104</b>	<b>9,549</b>	<b>50%</b>	<b>69%</b>	<b>-0.1%</b>	<b>16,736</b>	<b>9,893</b>	<b>58%</b>	<b>67%</b>	<b>-0.1%</b>	<b>19,104</b>	<b>7,426</b>	<b>39%</b>	<b>54%</b>	<b>-2.6%</b>	<b>16,736</b>	<b>7,077</b>	<b>42%</b>	<b>37%</b>	<b>-5.1%</b>
2038	19,472	9,926	51%	70%	0.0%	16,931	10,242	60%	68%	0.1%	19,472	7,616	39%	55%	-2.5%	16,931	7,277	43%	37%	-5.0%
2039	19,848	10,313	52%	71%	0.1%	17,129	10,567	61%	69%	0.2%	19,848	7,804	40%	56%	-2.3%	17,129	7,485	44%	37%	-4.9%
2040	20,231	10,706	53%	72%	0.2%	17,328	10,892	62%	70%	0.3%	20,231	8,001	40%	58%	-2.1%	17,328	7,702	44%	37%	-4.7%
2041	20,622	11,105	54%	73%	0.3%	17,530	11,217	63%	71%	0.4%	20,622	8,208	40%	59%	-1.8%	17,530	7,918	45%	38%	-4.4%
<b>2042</b>	<b>21,020</b>	<b>11,510</b>	<b>55%</b>	<b>74%</b>	<b>0.4%</b>	<b>17,734</b>	<b>11,642</b>	<b>64%</b>	<b>72%</b>	<b>0.4%</b>	<b>21,020</b>	<b>8,416</b>	<b>41%</b>	<b>61%</b>	<b>-1.6%</b>	<b>17,734</b>	<b>8,135</b>	<b>46%</b>	<b>38%</b>	<b>-4.1%</b>
2043	21,425	11,921	56%	75%	0.4%	17,941	12,067	65%	73%	0.5%	21,425	8,622	41%	63%	-1.3%	17,941	8,360	47%	39%	-3.7%
2044	21,839	12,337	57%	76%	0.5%	18,150	12,412	66%	74%	0.5%	21,839	8,837	41%	65%	-1.0%	18,150	8,584	47%	40%	-3.3%
2045	22,260	12,759	58%	77%	0.5%	18,362	12,767	67%	75%	0.6%	22,260	9,064	42%	68%	-0.7%	18,362	8,812	48%	42%	-2.8%
2046	22,690	13,187	59%	78%	0.6%	18,576	13,122	68%	76%	0.6%	22,690	9,299	42%	70%	-0.4%	18,576	9,047	49%	43%	-2.3%
<b>2047</b>	<b>23,128</b>	<b>13,621</b>	<b>59%</b>	<b>79%</b>	<b>0.6%</b>	<b>18,792</b>	<b>13,477</b>	<b>69%</b>	<b>76%</b>	<b>0.6%</b>	<b>23,128</b>	<b>9,538</b>	<b>42%</b>	<b>73%</b>	<b>-0.1%</b>	<b>18,792</b>	<b>9,283</b>	<b>49%</b>	<b>45%</b>	<b>-1.7%</b>

Source: Analysis by The Pew Charitable Trusts and The Terry Group based on data from retirement system actuarial valuations and annual reports

# Exhibit 9

## Pennsylvania Retirement System State Employees' Retirement System Simulation analysis



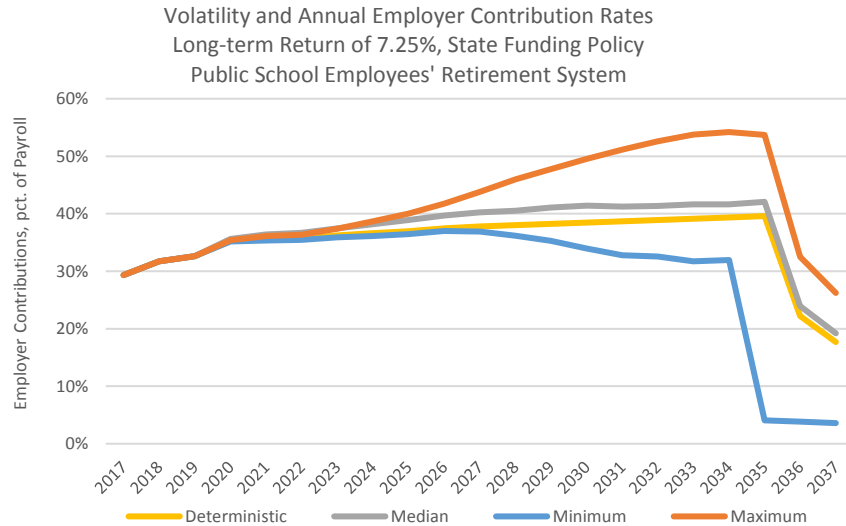
Source: The Terry Group and The Pew Charitable Trusts

Simulation Analysis of Employer Contributions Percent of Payroll and Plan Funded Ratio State Employees' Retirement System				
10 trials with 7.25% returns	10-Year Average Contribution Rate	Funded Ratio in 2027	20-Year Average Contribution Rate	Funded Ratio in 2037
Minimum	21%	52%	19%	76%
Maximum	32%	88%	33%	102%
Median	27%	66%	24%	86%
Deterministic : 7.25% Returns	29%	74%	26%	89%

With fixed returns of 7.25 percent, employer contributions to SERS are expected to take up 29 percent of payroll over the next 10 years and 26 percent over the next 20. Examining 10 trials, each with 20 year returns of about 7.25 percent, but simulated volatility in investment returns each year, employer costs can range 19 percent to 33 percent of payroll across a 20-year period where overall returns meet the plan's assumed rate of return.

# Exhibit 10

## Pennsylvania Retirement System Public School Employees' Retirement System Simulation analysis



Source: The Terry Group and The Pew Charitable Trusts

Simulation Analysis of Employer Contributions Percent of Payroll and Plan Funded Ratio Public School Employees' Retirement System				
10 trials with 7.25% returns	10-Year Average Contribution Rate	Funded Ratio in 2027	20-Year Average Contribution Rate	Funded Ratio in 2037
Minimum	34%	51%	32%	84%
Maximum	37%	90%	40%	107%
Median	36%	64%	37%	100%
Deterministic: 7.25% Returns	35%	68%	35%	95%

With fixed returns of 7.25 percent, employer contributions to PSERS are expected to take up 35 percent of payroll over the next 10 years and 35 percent over the next 20. Examining 10 trials, each with 20 year returns of about 7.25 percent, but simulated volatility in investment returns each year, employer costs can range 32 percent to 40 percent of payroll across a 20-year period where overall returns meet the plan's assumed rate of return.

# Exhibit 11

## Pennsylvania Retirement System State Employees' Retirement System

### Sensitivity of Liabilities

	<b>Assumed Defeasement Rate (4.00%)</b>	<b>1% Decrease (6.25%)</b>	<b>Current Discount Rate (7.25%)</b>	<b>1% Increase (8.25%)</b>
System's total pension liability	\$64,954,887	\$51,353,571	\$46,696,709	\$42,707,567
System's net pension liability	\$35,549,887	\$21,948,571	\$17,291,709	\$13,302,567
Funded ratio	45%	57%	63%	69%

### Sensitivity of Normal Cost

	<b>Low Discount Rate (5.00%)</b>	<b>1% Decrease (6.25%)</b>	<b>Current Discount Rate (7.25%)</b>	<b>1% Increase (8.25%)</b>
Total service cost as a percentage of covered payroll	15.2%	13.3%	12.0%	10.9%
Employee service cost as a percentage of covered payroll	9.5%	8.8%	8.3%	8.1%
Employer service cost as a percentage of covered payroll	5.6%	4.5%	3.8%	2.8%

Note: Numbers in thousands. Normal cost includes costs associated with DC benefits. Liability and funded ratio as of fiscal year 2016.

# Exhibit 12

## Pennsylvania Retirement System Public School Employees' Retirement System

### Sensitivity of Liabilities

	<b>Assumed Defeasement Rate (4.00%)</b>	<b>1% Decrease (6.25%)</b>	<b>Current Discount Rate (7.25%)</b>	<b>1% Increase (8.25%)</b>
System's total pensions liability	\$148,126,628	\$113,948,167	\$102,543,741	\$92,915,178
System's net pension liability	\$94,971,292	\$60,792,831	\$49,388,405	\$39,759,842
Funded Ratio	36%	47%	52%	57%

### Sensitivity of Normal Cost

	<b>Low Discount Rate (5.00%)</b>	<b>1% Decrease (6.25%)</b>	<b>Current Discount Rate (7.25%)</b>	<b>1% Increase (8.25%)</b>
Total service cost as a percentage of covered payroll	14.2%	12.2%	10.9%	9.9%
Employee service cost as a percentage of covered payroll	9.5%	8.8%	8.3%	7.8%
Employer service cost as a percentage of covered payroll	4.6%	3.5%	2.7%	2.0%

Note: Numbers in thousands. Normal cost includes costs associated with DC benefits. Liability and funded ratio as of fiscal year 2016.

# Exhibit B

## Overview

---

This stress test analysis is designed to aid the members of the Pennsylvania Public Pension Management and Asset Investment Review Commission (PPMAIRC) in their evaluation and recommendations on stress testing, as required by Pennsylvania Act 5 of 2017. The results are based on projections for the State Employees' Retirement System (SERS) and the Public School Employees' Retirement System (PSERS) on both an individual and combined basis.

The analysis is informed by the Actuarial Standards Board's recently published guidance on risk reporting and was created using Pew's stress test methodology as described in our research paper, *Assessing the Risk of Fiscal Distress for Public Pension: State Stress Test Analysis*.<sup>1</sup>

We focus specifically on investment risk—the risk that investments deviate from expected performance—and contribution risk—the risk that contributions fall below the rate required to meet funding objectives. This resulting analysis is intended to be accessible to all stakeholders and was designed to inform planning and decision making.

Specifically, this report provides information designed to help policymakers: (1) plan for the possibility of an extended period of lower investment returns and higher budget costs; (2) prepare for the impact of the next recession on pension system solvency and government budgets; (3) assess whether current policies are sufficient to effectively manage financial market volatility throughout the business cycle; (4) estimate the impact of investment risk on the range of potential costs for current benefits and liabilities; and (5) provide budget officials and legislators with a tool to assess the impact of proposed and enacted policy changes.

The key findings of our analysis include:

- **Pennsylvania does not face steep increases in employer costs or drops in funded levels, even if returns are lower than expected.** In a 5 percent return scenario, for example, we estimate that total employer contributions required under state policy would increase from 10 percent of revenue currently to 12 percent by 2035.
- **Pennsylvania SERS has minimal exposure to solvency risk or fiscal distress under an adverse recession scenario; however, PSERS may face fiscal distress if required contributions are not met.** We assess the risk of insolvency or fiscal distress using a recession scenario under both current funding policy and assuming contributions are constrained as a share of revenue. The scenario includes an initial 22 percent decline, or asset shock, in pension fund assets followed by low returns after an initial recovery. Even under these assumptions, the funded ratio for SERS remains stable and assets continue to grow. In contrast, PSERS would face a risk of declining assets in an asset shock scenario in which contributions only increase at the same rate as state revenues. This result highlights the importance of maintaining the funding commitments set in Act 120 and Act 5.

---

<sup>1</sup> Mennis, G., Banta, S., & Draine, D. (2018). *Assessing the Risk of Fiscal Distress for Public Pension: State Stress Test Analysis*. Harvard Kennedy School Mossavar-Rahmani Center for Business and Government Working Paper No.92.



- **Recent benefit changes will increase cost-predictability over the long-run.** The plan design adopted in Act 5 will substantially reduce risk to plan sponsors compared to that of Act 120, which also shared risk with employees. In fact, the Act 5 benefit design changes reduce pre-reform volatility in employer costs by more than half in comparison to Act 120.
- **Pennsylvania's public plans still face uncertain future employer costs due to financial market volatility, even if investments meet their long-term targets.** The long-term cost for SERS will be unpredictable, even if long-term investment performance meets plan assumptions. While the expected cost for PSERS is higher as a share of payroll than for SERS, those costs are less subject to investment volatility and are more predictable. These risks largely reflect legacy liabilities incurred before the changes in Act 5 and Act 120; understanding these risks can improve future decisions around contribution policy and asset allocation and help with budget planning.
- **Low funded levels may result in persistently high costs for decades if investments underperform and employer contributions fail to adjust.** If policymakers keep to the funding policies set in Act 120 and Act 5, even in a 5 percent return scenario we project funded ratios to improve and unfunded liabilities to decline. However, in a revenue constrained scenario, where contributions only grow at the rate of increase in own source revenue, funded levels remain static and current high cost levels could continue indefinitely.

## Summary of Methodology

---

To meet the goals and objectives outlined above, we employ a stress test simulation model that forecasts pension balance sheet and income statement metrics over a thirty-year period, using both deterministic and stochastic methods. Deterministic simulations are used to test how portfolios perform under precise circumstances of our own design, for example by measuring the impact of lower than expected investment returns on pension costs and fiscal position. Stochastic simulations are used to evaluate the probable impact of financial market volatility on pension plan finances and government budgets, highlighting the risk inherent in the system even if long-term return assumptions are met.

To examine the impact of investment risk on Pennsylvania’s retirement systems we use two economic scenarios. In the fixed 5 percent return scenario, a single low rate of return is applied to the model for each year in the forecast period, providing estimates of pension costs to the state should long-term target returns not be met. And in the asset shock scenario, we incorporate an initial decline in the stock market of approximately 22 percent with a three-year recovery followed by low returns over the long term.<sup>2</sup> This scenario is designed to model the impact of another recession on asset levels and pension costs.

Although modeling market downturns is at the heart of stress testing, policymakers’ responses to investment losses are a source of equal risk to plans’ fiscal health, and therefore should be accounted for as part of a comprehensive stress test analysis. Our model examines two behavioral assumptions to assess this contribution risk. First, the state policy assumption, under which Pennsylvania increases funding to offset losses based on written state policy. And second, the revenue constrained assumption, under which contribution are set at a fixed percentage of state revenue (modeling a situation where policymakers choose to avoid crowding out other spending to allow for increased pension contributions). A more comprehensive discussion of our methodology can be found in our research paper, referenced above.<sup>3</sup>

The analysis in this report is based on public plan documents and includes actuarial forecasts by the Terry Group and analysis by the Pew Charitable Trusts. Actuarial projections are intended to match projections from SERS and PSERS as closely as possible and have been submitted to the plans for their review; however, they are not intended to replicate or replace the plan’s actuarial valuation.

## Contents

Section 1: Planning for Lower Returns and Higher Costs Over the Long –term .....	5
Section 2: Preparing for the Next Recession .....	7
Section 3: Managing Financial Market Volatility.....	9
Section 4: Sensitivity of Costs and Liabilities to Investment Returns.....	12
Section 5: Applying Stress Testing to Measure the Impact of Policy Changes.....	14
Appendix.....	16

---

<sup>2</sup> The asset shock scenario is based on the Federal Reserve’s “2017 Supervisory Scenarios for Annual Stress Tests Required under the Dodd-Frank Act Stress Testing Rules.”

<sup>3</sup> Mennis, et al. (2018).

## Glossary of Terms

---

**Asset shock scenario:** Economic scenario used in Pew’s stress test analysis that incorporates an initial adverse shock followed by low returns over the long term. The scenario is based on the Federal Reserve’s scenarios for stress testing under the Dodd-Frank Act.

**Deterministic simulation:** Simulation used in Pew’s stress test analysis to illustrate how portfolios perform under precise circumstances of our own design, by modeling a single trial that strictly applies the same user-specified assumptions on investment returns and economic metrics to each year in the forecast.

**Fixed 5 percent returns scenario:** Scenario applied to Pew’s stress test analysis that uses a low rate of return of 5 percent over an entire forecast period. The 5 percent return assumption represents an approximately 25<sup>th</sup> percentile scenario based on Pew’s capital market assumptions. The purpose of this scenario is to assess how plans perform when investment returns are lower than expected over the long term.

**Funded ratio:** The level of assets at market value in proportion to accrued pension liability. This is an annual point-in-time measure, as of the valuation date. We refer to the funded ratio based on the plan’s assumed rate of return as the Actuarial Funded Ratio, and the ratio using a lower rate to approximate state borrowing costs as a Defeasement Ratio.

**Investment Risk Defeasement Measure:** An adjustment of pension liabilities at a rate approximating state borrowing costs, based on draft amendments to Actuarial Standard of Practice (ASOP) No. 4, which would require this measure. Pew’s analysis uses a discount rate of 4 percent in this calculation.

**Normal Cost:** The cost of benefits earned by employees in any given year. Also called service cost.

**Operating cash flow ratio:** A metric based on the difference between contributions and benefits (operating cash flow), applied mainly as an early indicator of insolvency risk for poorly funded plans. Measured as

$$[(Total\ Contributions - Benefit\ Payments) / Plan\ Assets\ at\ the\ Beginning\ of\ the\ Year].$$

Most public pension funds exhibit negative operating cash flow, and this ratio provides a benchmark for the rate of return required to ensure that assets do not decline. Plans with negative operating cash flow ratio that is consistently greater than the assumed rate of return will face asset depletion.

**State policy (behavioral) assumption:** Condition applied to Pew’s stress test analysis that assumes strict adherence to current funding requirements, actuarial or otherwise, based on states’ written contribution policy.

**Stochastic simulations:** Simulations used in Pew’s stress test analysis that model the probabilities of various financial outcomes given specified means and standard deviations of economic variables and market returns. Our stress test model generates 10,000 runs for each simulation, which yields a distribution of investment returns for each year.

**Revenue Constrained (behavioral) assumption:** Condition applied to Pew’s stress test analysis that assumes contributions are set at a fixed percentage of state revenue. The revenue constrained assumption implicitly sets a limit on what is affordable so as not to place strain on the budget at a time when other state obligations may also require increases in funding. Even in plans where a portion of contributions come from local governments or school districts, growth in state revenue serves as a proxy for overall increases in public resources.

## Section 1: Planning for Lower Returns and Higher Costs Over the Long – term

### Fixed 5 Percent Return Scenario

Financial experts expect Investments to perform below historical averages going forward, and we project a one-in-four chance that long-term returns could be as low as 5 percent for the typical public pension fund in the future. In the fixed 5 percent return scenario, a single low rate of return is applied to the model for each year in the forecast period to generate estimates of pension costs to the state, and the projected funded status of the state’s pension plans, should long-term target returns not be met. This scenario was designed to provide a reasonably likely downside scenario and a close approximation for the 25th percentile of 20-year projected returns (i.e., plans face a one-in-four chance of earning 5 percent or less over a 20-year time horizon).

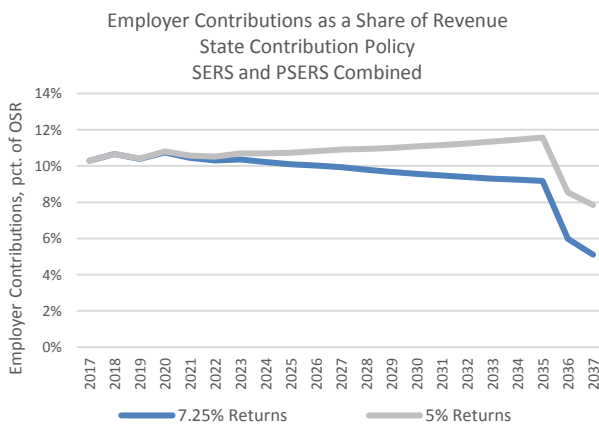
For this scenario, we estimate the impact on the state budget and retirement system financials under both the **state policy** and **revenue constrained** contribution assumptions described in the methodology.

#### Impact to State Budget if Required Contributions under State Policy are Made

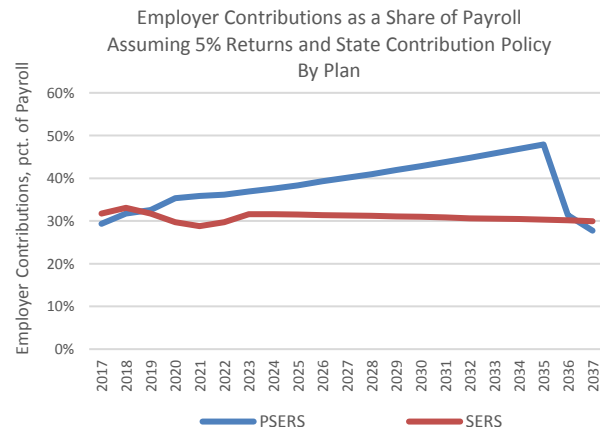
We analyze the potential impact of lower returns on the state budget by applying a **fixed 5 percent** return (i.e. **deterministic**) scenario, and assuming that all required pension contributions are made in accordance with **state policy**. Under these conditions, total employer contribution rates for SERS and PSERS combined are projected to increase from 10 percent of revenue in 2017 to 11 percent in 2027, peaking at 12 percent of revenue in 2035. By way of comparison, if Pennsylvania’s pension plans meet their assumed rate of return, employer pension costs are expected to decline as a share of state revenue (see **Figure 1**). Measuring pension costs as a share of state revenue offers a proxy for whether the rate of increase in pension costs will exceed the increase in public resources and crowd out other spending.

At a plan level, contribution rates are assessed as a percentage of participant payroll rather than state revenue. **Figure 2** illustrates that the bulk of the projected increase in state contributions under this scenario can be attributed to PSERS: contributions from the plan are projected to increase from 29 percent of payroll in 2017 to 40 percent in 2027 and over 47 percent in 2035. The results for SERS are more stable, with contributions decreasing from 32 percent of payroll in 2017 to 31 percent in 2027.

**Figure 1**



**Figure 2**

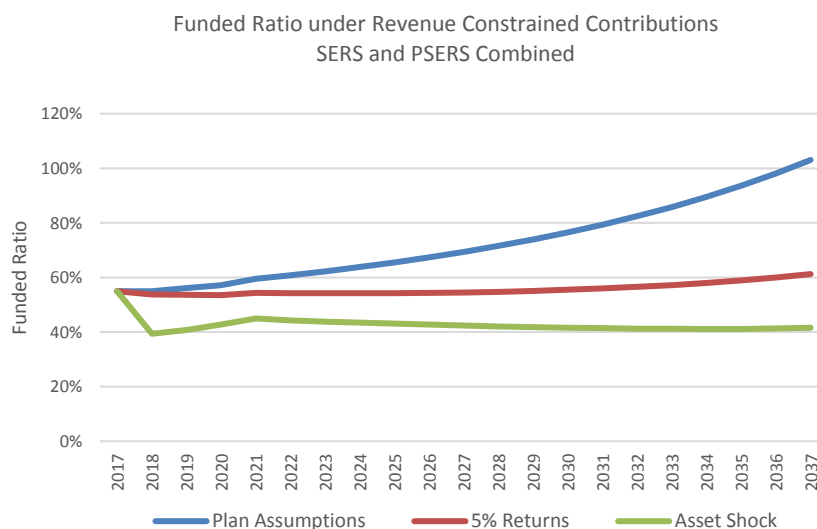


Note: See “Legislative Stress Test Report for Pennsylvania Public Pensions,” Exhibits 1 & 3 (for Figure 1) and Exhibits 7 & 8 (for Figure 2).  
Source: The Terry Group and The Pew Charitable Trusts

### Impact to State Pension Balance Sheet if Contributions Fall Short of Required Amounts

We also assess the potential impact on state plans' balance sheets should employer contributions fall short of required levels during a prolonged market downturn. Using the **5 percent return** scenario and the **revenue constrained** assumption, in which annual contributions increase only at the rate of revenue growth, we project a relatively static **actuarial funded ratio** of between 55 percent and 61 percent over the 20-year forecast period. Asset levels would increase modestly from \$83 billion in 2017 to \$98 billion in 2027 under this scenario (see detailed financial metrics in the Appendix).

**Figure 3**



Note: See "Legislative Stress Test Report for Pennsylvania Public Pensions," Exhibits 2, 4, & 6.  
Source: The Terry Group and The Pew Charitable Trusts

These relatively stable outcomes are primarily a function of the contributions Pennsylvania is currently making towards the state's pension systems. The ratio of total contributions to benefit payments were 64 percent in 2016—24<sup>th</sup> highest across the 50 states. If long-term returns are lower than expected, Pennsylvania will either need to dedicate an increased share of revenue to paying for pensions—as shown in Figure 1—or face persistently low funded ratios and persistently high costs. In either case, these projections show that even in an **asset shock** scenario with **revenue constrained** contributions, the funded ratio for Pennsylvania's pension plans would remain stable.

## Section 2: Preparing for the Next Recession

### Asset Shock Scenario

---

Evaluating the risk of a steep decline in asset values – as typically occurs during the onset of a recession – is a primary function of public pensions stress test analysis. The asset shock scenario is based on assumptions used by the Federal Reserve Bank to stress test financial institutions as required under the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010. When applied to Pennsylvania’s state pension plans, these assumptions result in an initial 22 percent drop in asset value, followed by a 3-year recovery period with an average of 11 percent returns. To further test long-term resiliency, we assume long-term returns of approximately 5 percent after the period of economic recovery. We also assume an initial decline in state revenues, followed by steady recovery, for purposes of assessing impacts to the state budget under an asset shock scenario.

#### Measuring Solvency Risk

The asset shock scenario can be used to evaluate potential pressures on state budgets, as well as the likelihood of plan fiscal distress, during an economic downturn. We define fiscal distress using three criteria: (1) declining asset levels, due to negative operating cash flows that exceed the offsetting impact of annual investment earnings; (2) a high probability that system assets will be depleted within 20 years; and (3) the resulting transition to pay-go funding, which would require substantial increases in contributions from the state budget.

The ratio of operating cash flow to assets is an important early indicator of long-term fiscal solvency for poorly funded plans. This metric is based on the difference between contributions and benefits (operating cash flow) and is calculated as a ratio of plan assets.

Most mature public pension funds exhibit negative operating cash flow – in aggregate, US state pension plans had an operating cash flow ratio of -3.2 percent in 2016. The ratio serves as a benchmark for the rate of return that a plan must earn to prevent assets from declining. We closely monitor states with a cash flow ratio below -5 percent, as they are more likely to experience declining assets – an early signal of potential insolvency.

#### Impact of Asset Shock on Pennsylvania Plans

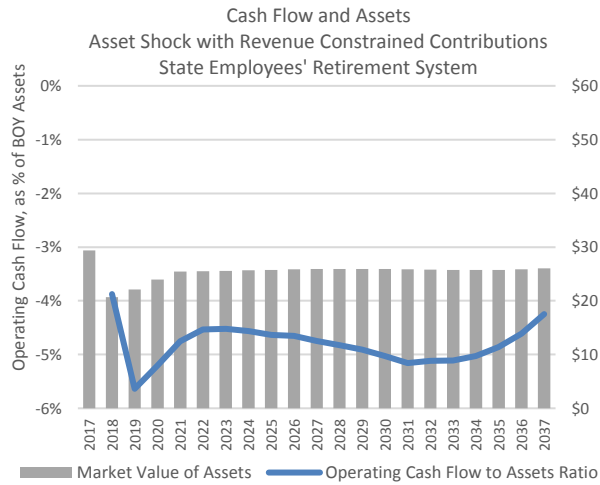
We first analyze the potential for insolvency in Pennsylvania’s pension plans by applying the **asset shock** scenario assuming **revenue constrained** employer contributions. For both SERS and PSERS, assets stay relatively stable, even under these adverse conditions, indicating no immediate risk of insolvency.

One difference is in the operating cash flow ratio—the difference between employer and employee contributions and benefit payments as a percentage of assets. A negative ratio, which is common for mature pension plans, means more money is going out in pension checks than coming in through contributions. A declining ratio suggests that a plan is more dependent on investments to maintain asset levels and is more vulnerable to declines in assets.

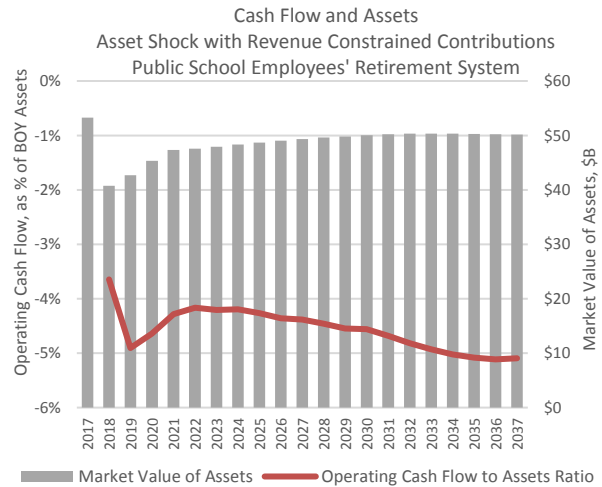
The results for SERS in the **asset shock** scenario with **revenue constrained** employer contributions show the operating cash flow initially declining but recovering over the projection period (see **Figure 4**).

Conversely, PSERS does not fare as well, with the operating cash flow ratio ultimately falling below -5% (see **Figure 5**)—meaning that if annual returns stayed at 5%, plan assets would continue to decline.

**Figure 4**



**Figure 5**



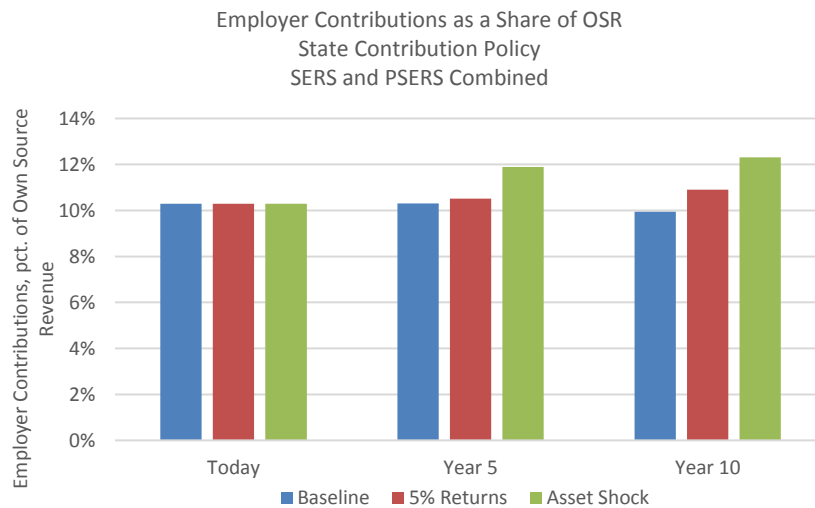
Note: See “Legislative Stress Test Report for Pennsylvania Public Pensions,” Exhibits 7 & 8. Cash flow metrics do not include employer contributions to DC accounts.

Source: The Terry Group and The Pew Charitable Trusts

**Budget Impact if State Policy Contributions are Made**

We also employ an **asset shock** scenario under which full contributions are made based on **state policy** to assess the potential impact of an economic downturn on the Pennsylvania state budget. In this analysis, we see a more pronounced version of the spike in employer contributions calculated for Pennsylvania plans under the **5 percent return** scenario discussed in Section 1. Pension costs for SERS and PSERS combined would increase from 10 percent of Pennsylvania’s own-source revenue (OSR) in 2017 to 12 percent in 2027 (**Figure 6**). These increases would consume 10 percent of projected new revenue over that period, potentially crowding-out approximately \$11 billion in spending for other budget priorities, unless new revenue sources are generated.

**Figure 6**



Note: See “Legislative Stress Test Report for Pennsylvania Public Pensions,” Exhibits 1, 3, & 5.

Source: The Terry Group and The Pew Charitable Trusts

## Section 3: Managing Financial Market Volatility

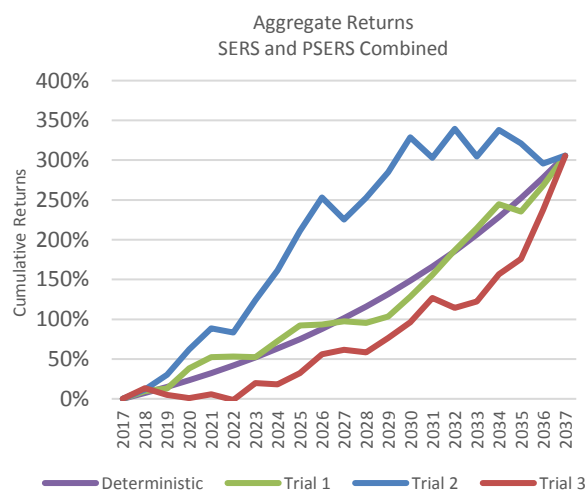
### Stochastic Simulation Analysis

Annual fluctuations in market returns can cause volatility in required employer contributions or result in decreased pension plan funding even if long-term returns match the assumptions used by plan actuaries. Indeed, the cost of investment and contribution risks can be significantly amplified when market swings are included in stress test analysis.

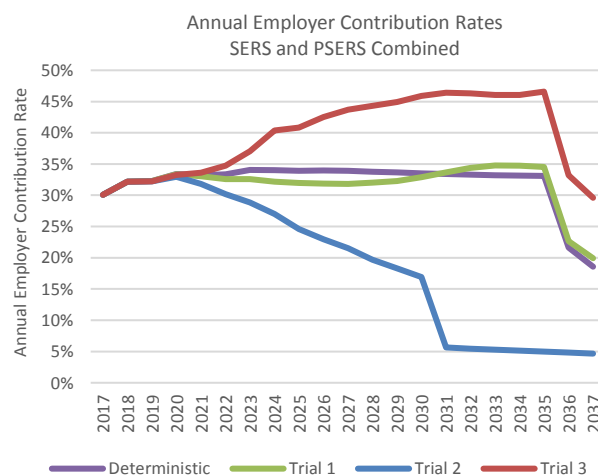
The analyses presented in Sections 1 and 2 of this report do not capture this effect, as they are calculated using a single rate of return or similar pre-determined return scenario throughout the forecast period. However, we can also estimate financial outcomes using stochastic analysis, a simulation tool that generates thousands of possible forward-looking trials to examine the probable impact of market uncertainty on financial outcomes. This simulation method can provide policymakers with vital information on how the volatility of annual returns is likely to impact plan solvency and state budgets.

For example, **Figures 7 and 8** illustrate how future market volatility may affect Pennsylvania’s public plans by comparing results from of stochastic simulations that all reach the long-term rate of return assumed for each plan, but yield returns in any given year that deviate from that assumed rate. Each line in Figure 7 represents a sequence of returns, or trial, that averages to 7.25 percent – the assumed rate of return for SERS and PSERS – over a 20-year forecast period. These trials were selected from the 10,000 simulations produced by Pew’s model and illustrate how the path of lower- and higher-than-expected returns can vary over the forecast period. Trial 3, for example, projects low returns in the first half of the forecast period, while Trial 2 projects low returns in the latter part of the period.<sup>4</sup>

**Figure 7**



**Figure 8**



Note: Based on trials with 7.25 percent returns over a 20-year period.  
Source: The Terry Group and The Pew Charitable Trusts

<sup>4</sup> See Mennis, et al. (2018) for a more detailed discussion of stochastic methods as they apply to stress testing public pensions. See, also, Yin, Y., & Boyd, D. (2018). Analyzing the Interplay Between Public-Pension Finances and Governmental Finances: Lessons from Linking an Economic Model to a Pension Fund Model. Brookings Municipal Finance Conference.



**Figure 8** illustrates the corresponding annual required employer contribution rates for each of those trials, highlighting just how significantly market volatility can impact plan finances. In Trial 3, for example, low returns in the first years of the forecast period slow initial asset growth, and prompt higher-than-expected required contributions throughout the period. Conversely, higher early returns in Trial 2 contribute to a larger-than-expected asset base, resulting in significantly lower-than-anticipated employer contributions during the 20-year forecast period. In all cases, the employer contribution rate is more volatile in the stochastic simulation analysis than when using a fixed, stable rate of return.

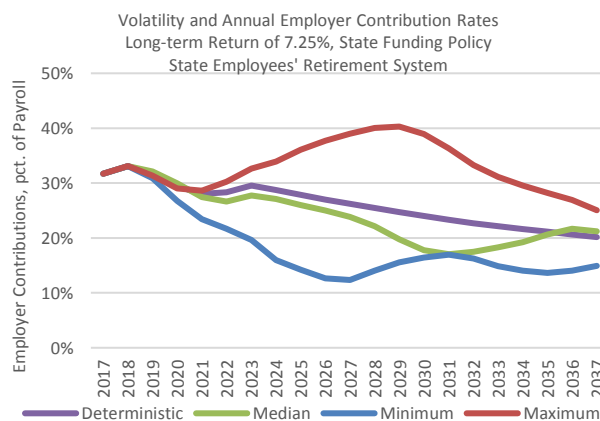
This analysis illustrates the value of stochastic simulation analysis: its capacity to generate a range of probable plan and state budget financial outcomes caused by financial market volatility.

Impact of Market Volatility on Pennsylvania SERS and PSERS

Changes to both pension costs and plan solvency from two primary sources can be estimated for Pennsylvania’s pension plans: the volatility and timing of returns over the forecast period; and the state’s pension contribution policy in response to that volatility. Comparing results for SERS and PSERS also illustrates how the impact of volatility differs based on contribution policy and assumptions.

**Figure 9** below illustrates employer contributions estimated under a deterministic trial in which PA SERS’s expected return of 7.25 percent is met each year; and the range of projected annual employer contribution rates generated by 10 stochastic simulation trials that all yield a 20-year return equal to that target. As shown in **Figure 10**, if the plan meets that target each and every year, employer contributions would equal 25 percent of payroll over the 20-year forecast period, and the funded ratio would reach 89 percent in 2037. However, introducing variability in returns over the same period can produce very different results. Specifically, we find that contributions throughout the forecast period could range from 19 to 33 percent of payroll depending on the sequence of annual returns; and that the funded ratio in 2037 could fall anywhere between 76 and 102 percent.

**Figure 9**



**Figure 10**

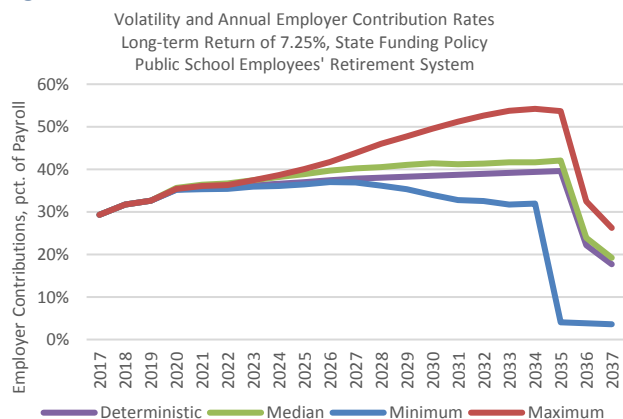
Simulation Analysis of Employer Contributions Percent of Payroll and Plan Funded Ratio State Employees' Retirement System				
10 trials with 7.25% returns	10-Year Contribution Rate	Funded Ratio in 2027	20-Year Contribution Rate	Funded Ratio in 2037
Minimum	21%	52%	19%	76%
Maximum	32%	88%	33%	102%
Median	27%	66%	24%	86%
Deterministic: 7.25% Returns	29%	74%	25%	89%

Note: Similar analyses are included in “Legislative Stress Test Report for Pennsylvania Public Pensions,” Exhibits 9 & 10. Based on trials with 20-year return of 7.25%. Contribution rates represent total present value of contributions over a time period as a share of present value of payroll. Source: The Terry Group and The Pew Charitable Trusts

Similarly, results for PSERS are provided in **Figures 11** and **12**. Note that expected contributions for PSERS are projected to be 35 percent of payroll over the next 20 years if investment returns are 7.25

percent every year—10 percentage points higher than SERS’ contribution rate. However, costs for PSERS are much more predictable. Across the 10 trials examined, the projected costs for PSERS over the next 20 years could range from 32 to 40 percent of payroll – an 8 percentage point spread, in comparison to the 14 point range projected for SERS.

**Figure 11**



**Figure 12**

Simulation Analysis of Employer Contributions Percent of Payroll and Plan Funded Ratio Public School Employees' Retirement System				
10 trials with 7.25% returns	10-Year Contribution Rate	Funded Ratio in 2027	20-Year Contribution Rate	Funded Ratio in 2037
Minimum	34%	51%	32%	84%
Maximum	37%	90%	40%	107%
Median	36%	64%	37%	100%
Deterministic: 7.25% Returns	35%	68%	35%	95%

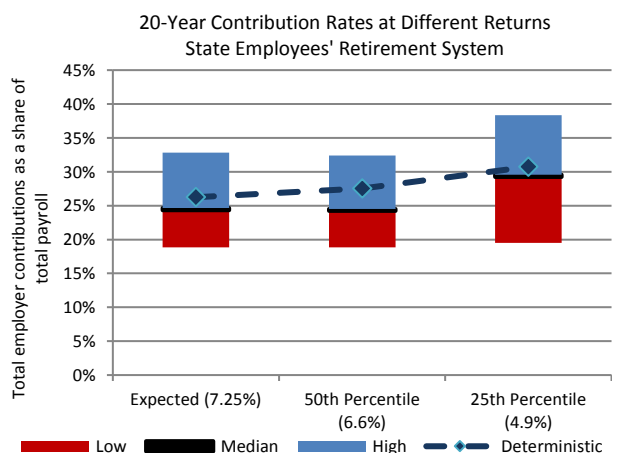
Note: Similar analyses included in “Legislative Stress Test Report for Pennsylvania Public Pensions,” Exhibits 9 & 10. Based on trials with 20-year return of 7.25%. Contribution rates represent total present value of contributions over a time period as a share of total present value of payroll. Source: The Terry Group and The Pew Charitable Trusts

**Lower-Than-Expected Returns with Market Volatility**

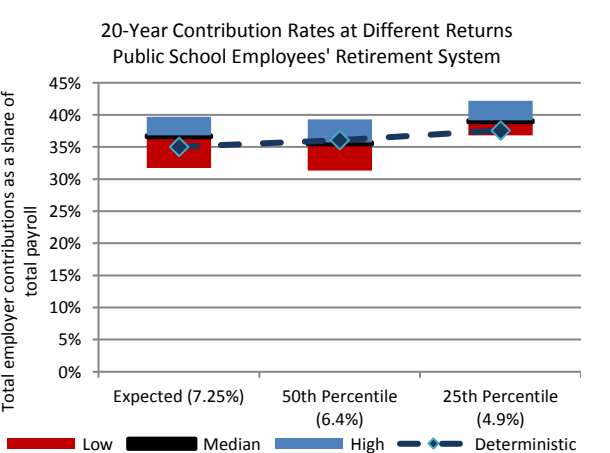
Of course, plans do not always meet their target returns. **Figures 13** and **14** below illustrate the range of 20-year contribution rates for each plan at three rates of return: the plan’s expected return, and the 50<sup>th</sup> and 25<sup>th</sup> percentile returns generated by applying our capital market assumptions to plan asset allocations. For each return, we analyze a deterministic trial, and 10 stochastic trials with the same 20-year performance, to assess the probable range of total required employer contributions over the forecast period.

We find that, over the range of return scenarios, SERS has lower expected costs but is exposed to more cost volatility due to investment volatility and the potential for adverse timing of market downturns.

**Figure 13**



**Figure 14**



Note: Similar analyses are included in “Legislative Stress Test Report for Pennsylvania Public Pensions,” Exhibits 9 & 10. Source: The Terry Group and The Pew Charitable Trusts

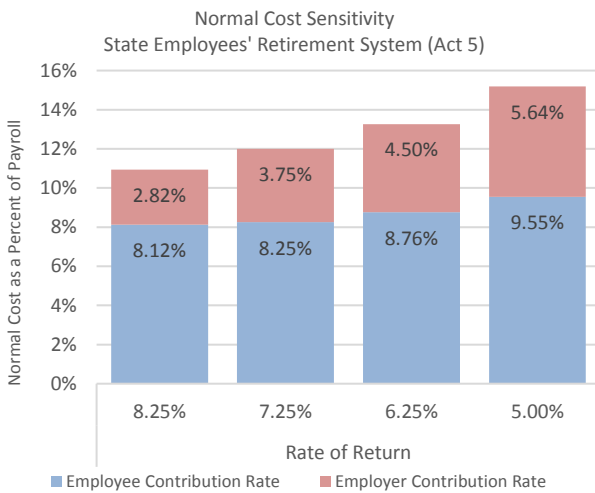
## Section 4: Sensitivity of Costs and Liabilities to Investment Returns

### Employer Service Costs and Net Pension Liabilities

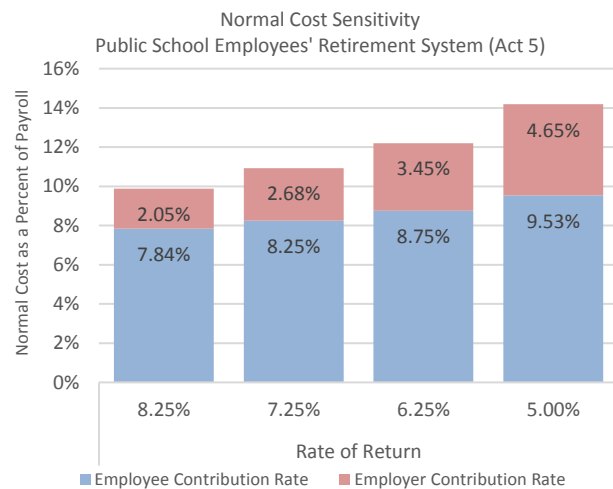
We also estimate the potential range of service costs and net pension liabilities under investment returns 1 percent above and 1 percent below the expected rate of return, and apply the **fixed 5 percent** return assumption.

**Figures 15 and 16** show the range of benefit cost for new hires enrolled in SERS and PSERS, respectively, at four different rates of return: the plan’s assumed rate of return of 7.25 percent, 5 percent returns, and +1/-1 percent of the assumed rate of return. These analyses examine the benefits put in place in Act 5 of 2017. An example analysis comparing the Act 5 benefits to the prior tier of benefits from Act 120 of 2010 is included in Section 5.

**Figure 15**



**Figure 16**



Note: Similar analyses are included in “Legislative Stress Test Report for Pennsylvania Public Pensions,” Exhibits 11 & 12.

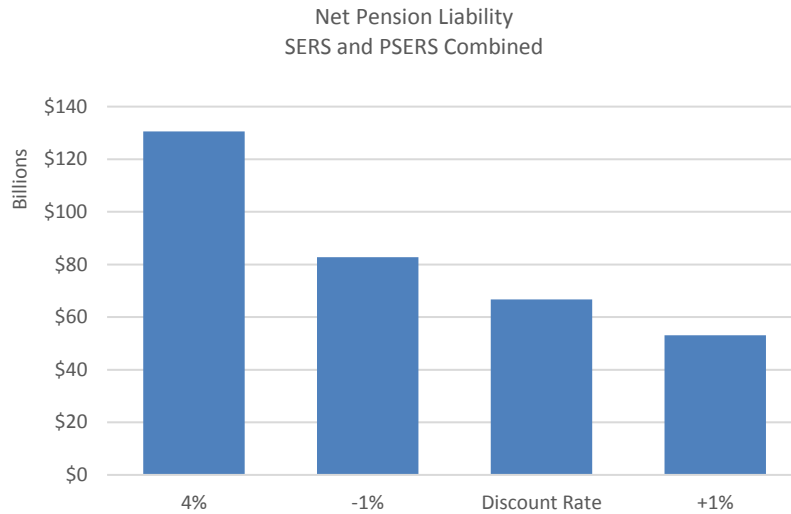
Source: The Terry Group and The Pew Charitable Trusts

Current reporting required by the Government Accounting Standards Board (GASB) includes a calculation of plan net pension liabilities at a range of discount rates 1 percent above and 1 percent below the expected rate of return. In addition, proposed changes to Actuarial Standards of Practice (ASOP) 4 recommends the disclosure of an Investment Risk Defeasement Measure at a lower, near risk-free rate.<sup>5</sup> For the purpose of replicating the Investment Risk Defeasement Measure, we applied a 4% discount rate.

**Figure 17** summarizes the results of these liability sensitivity analyses, highlighting the aggregate unfunded pension liability for SERS and PSERS on a combined basis (see Appendix for more detailed calculations).

<sup>5</sup> Proposed Revision of Actuarial Standard of Practice Number 4, Measuring Pension Obligations and Determining Pension Plan Costs or Contributions, Exposure Draft (March 2018).

**Figure 17**



Source: Plans' comprehensive annual financial reports, FY 2017.

Note: Discount rate for SERS and PSERS was 7.25%. In place of the investment risk defeasement calculation, per the proposed amendment to ASOP 4, a discount rate of 4% was applied to the AAL as reported in plan valuations.

The GASB data provides policymakers and other stakeholders with basic information around the risk associated with investment return assumptions for public plans. These data may be particularly useful for states with plans that are at or near full funding under current actuarial assumptions by highlighting the riskiness of the assets used to prefund liabilities, reinforcing the need to maintain strong funding practices and the potential cost of unfunded benefit increases. Separately, the Investment Risk Defeasement Measure provides an indicator of pension debt that is more comparable to state bond obligations and provides an overall level of risk taken on by plan sponsors.

## Section 5: Applying Stress Testing to Measure the Impact of Policy Changes

### Reform Impact Analysis

---

Sections 1 through 4 of this report are designed to aid budget officials and policymakers in planning for the potential impact of lower investment returns and financial market volatility on pension balance sheets and government budgets. This section provides an example of how the elements of a standardized stress test report can also be used to aid decision-making, by providing a framework to analyze the impact of proposed policy changes.

We have chosen to examine the projected impact on contributions and risk of recent changes to SERS and PSERS pension benefits under a range of investment return scenarios using sensitivity analysis and scenario analysis. These or other elements of the risk reporting framework could be equally useful to assess future decisions about contribution policies, asset allocation, or benefit provisions.

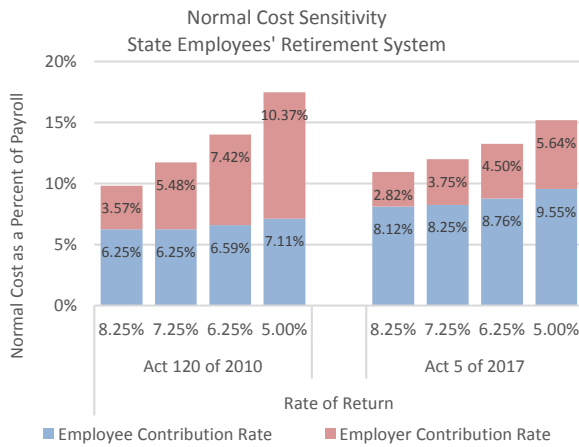
Sensitivity analysis of benefit costs under different assumed rates of return can provide a straightforward and reasonably accurate method to assess the financial impact of proposed changes to benefit plan design. For example, this approach was central to analysis generated by the Independent Fiscal Office (IFO) in Pennsylvania as part of the 2017 reforms.

#### Using Sensitivity Analysis to Assess the Impact of Act 5 Plan Design Changes

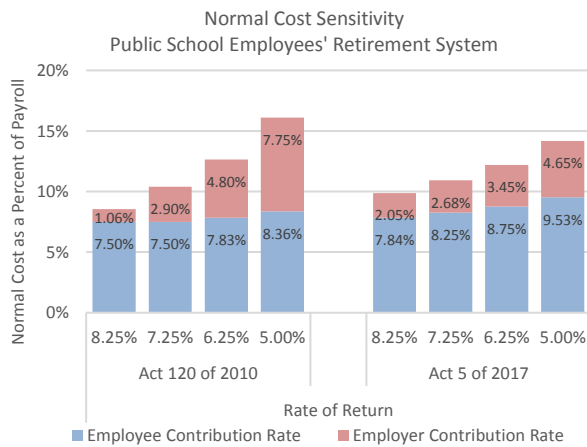
The benefit changes in Act 5 provide new hires with a choice between three plans. Two are “risk-managed” hybrid designs that includes a smaller defined benefit component, an accompanying defined contribution plan, and a risk sharing component that raises contributions if investment returns fall short of the plan target rate. As an alternate option, participants can also choose to join a defined contribution plan.

Using Pew’s stress test model, we can assess the fiscal impact of those changes by comparing the total normal cost and employer share of cost for employees participating in the Act 5 benefits with those who receive benefits under Act 120. As seen in **Figure 18** and **19**, employer normal costs decreased for both SERS and PSERS due to Act 5 reforms. And perhaps more importantly given the objectives of these changes, the risk of unanticipated employer cost increases during market downturns was reduced by more than half. Under the new plan design, the potential for employee contribution increases in periods of lower-than-expected returns is offset during periods of market overperformance, when gains are shared with participants in the form of reduced employee contributions and higher balances in DC accounts.

**Figure 18**



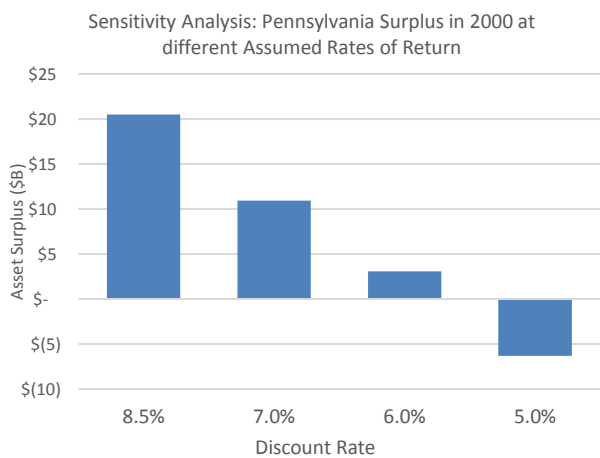
**Figure 19**



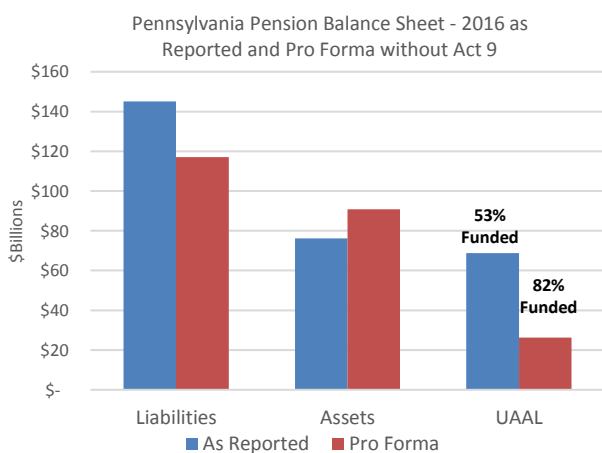
Source: The Terry Group and The Pew Charitable Trusts

Stress test analysis and risk reporting is a powerful tool for assessing potential policy changes while they are being considered and can provide the key information required to avoid decisions that result in adverse long-term fiscal impacts to a state or local government. For example, **Figure 20** shows a sensitivity analysis of Pennsylvania’s public pensions in 2000, prior to Act 9, would have shown the projected pension shortfalls the Commonwealth would face if investment returns fell short of expectations, despite the surplus the retirement system enjoyed at that time. This more complete assessment of pension plan funded status may have prevented adoption of the unfunded benefit enhancements that have added more than \$40 billion to Pennsylvania’s pension debt (see **Figure 21**) and an increase to pension costs of more than \$2 billion annually.

**Figure 20**



**Figure 21**



Note: 2016 annual employer contribution was \$4.8 billion including \$3.3 billion in amortization. The approximately \$43 billion in increased unfunded liabilities from Act 9 represent about two-thirds of the 2016 UAAL.

Sources: The Pew Charitable Trusts analysis of Pennsylvania’s retirement system CAFRs and actuarial valuations and The Terry Group.

# Appendix

## PA COMBINED - 10 YEAR STRESS TEST FORECAST RESULTS UNDER STATE POLICY CONTRIBUTIONS (\$ in Millions)

	2017	Expected Return	Low Return	Asset Shock	Stochastic Baseline	
		Deterministic 7.25%	Deterministic 5%	Economic Scenario	50th Percentile	25th Percentile
<i>Fiscal year ending June 30, 2017</i>	2017	2027	2027	2027	2027	2027
<b>Balance Sheet Measures</b>						
Market Value of Assets (MVA)	\$ 82,682	\$ 125,819	\$ 101,896	\$ 89,660	\$ 115,333	\$ 92,716
Actuarial Accrued Liability (AAL)	150,412	180,525	180,525	177,502	177,477	177,190
Unfunded Actuarial Accrued Liability (UAAL)	67,731	54,706	78,629	87,842	62,144	84,474
Accrued Liability at Defeasement Rate	215,132	258,201	258,201	253,877	253,842	253,431
Unfunded Liability at Defeasement Rate	132,450	132,382	156,305	164,217	138,509	160,715
Funded Ratio	55%	70%	56%	51%	65%	52%
Defeasement Ratio	38%	49%	39%	35%	45%	37%
<b>Cash Flow Measures</b>						
Benefit Payments	\$ 9,911	\$ 13,000	\$ 13,000	\$ 13,000	\$ 13,000	\$ 13,000
Total Contributions	7,092	9,631	10,566	11,184	9,651	10,428
Negative Operating Cash Flow	2,819	3,369	2,434	1,816	3,349	2,572
Operating Cash Flow to Assets Ratio	n.a.	-2.8%	-2.4%	-2.1%	-3.0%	-2.8%
Own Source Revenue (OSR)	55,644	81,023	81,023	77,215	80,998	80,345
Employer Contributions / OSR	10.3%	9.9%	10.9%	12.3%	10.0%	11.0%
<b>Payment and Contribution Measures</b>						
Payroll	\$ 19,018	\$ 23,744	\$ 23,744	\$ 22,508	\$ 22,538	\$ 22,412
Employer Contribution / Payroll	30%	34%	37%	42%	36%	39%
Employee Contribution / Payroll	7.2%	6.6%	7.3%	7.5%	6.9%	7.2%
Total Contributions / Payroll	37%	41%	44%	50%	43%	47%
Net amortization \$	n.a.	2,601	2,036	2,104	2,292	1,697
Minimum Employer Contribution / Payroll (over 10 years)	n.a.	32%	32%	32%	27%	28%
Maximum Employer Contribution / Payroll (over 10 years)	n.a.	34%	37%	42%	44%	47%
<b>Investment Performance</b>						
Compounded Annual Growth - From Start Date	n.a.	7.25%	5.00%	3.58%	6.49%	4.22%
Compounded Annual Growth - Segments	n.a.	7.25%	5.00%	5.10%	6.49%	5.18%

<sup>(1)</sup> See Methodology section for a complete description of economic and behavioral scenarios.

**PA COMBINED - 10 YEAR STRESS TEST FORECAST**  
**RESULTS UNDER REVENUE CONSTRAINED CONTRIBUTIONS**  
(\$ in Millions)

	2017	Expected Return	Low Return	Asset Shock	Stochastic Baseline	
		Deterministic 7.25%	Deterministic 5%	Economic Scenario	50th Percentile	25th Percentile
<i>Fiscal year ending June 30, 2017</i>		2027	2027	2027	2027	2027
<b>Balance Sheet Measures</b>						
Market Value of Assets (MVA)	\$ 82,682	\$ 125,248	\$ 98,432	\$ 75,221	\$ 114,031	\$ 88,699
Actuarial Accrued Liability (AAL)	150,412	180,525	180,525	177,502	177,120	177,163
Unfunded Actuarial Accrued Liability (UAAL)	67,731	55,277	82,093	102,281	63,089	88,464
Accrued Liability at Defeasement Rate	215,132	258,201	258,201	253,877	253,331	253,393
Unfunded Liability at Defeasement Rate	132,450	132,953	159,769	178,656	139,300	164,694
Funded Ratio	55%	69%	55%	42%	64%	50%
Defeasement Ratio	38%	49%	38%	30%	45%	35%
<b>Cash Flow Measures</b>						
Benefit Payments	\$ 9,911	\$ 13,000	\$ 13,000	\$ 13,000	\$ 13,000	\$ 13,000
Total Contributions	7,092	9,911	10,067	9,625	9,804	9,867
Negative Operating Cash Flow	2,819	3,089	2,933	3,375	3,196	3,133
Operating Cash Flow to Assets Ratio	n.a.	-2.6%	-3.0%	-4.5%	-2.9%	-3.5%
Own Source Revenue (OSR)	55,644	81,023	81,023	77,215	80,433	80,271
Employer Contributions / OSR	10.3%	10.3%	10.3%	10.3%	10.3%	10.3%
<b>Payment and Contribution Measures</b>						
Payroll	\$ 19,018	\$ 23,744	\$ 23,744	\$ 22,508	\$ 22,399	\$ 22,397
Employer Contribution / Payroll	30%	35%	35%	35%	37%	37%
Employee Contribution / Payroll	7.2%	6.6%	7.3%	7.5%	6.8%	7.2%
Total Contributions / Payroll	37%	42%	42%	43%	44%	44%
Net amortization \$	n.a.	2,833	1,315	(396)	2,472	881
Minimum Employer Contribution / Payroll (over 10 years)	n.a.	31%	31%	29%	31%	30%
Maximum Employer Contribution / Payroll (over 10 years)	n.a.	35%	35%	35%	38%	38%
<b>Investment Performance</b>						
Compounded Annual Growth - From Start Date	n.a.	7.25%	5.00%	3.58%	6.49%	4.21%
Compounded Annual Growth - Segments	n.a.	7.25%	5.00%	5.10%	6.50%	5.17%

<sup>(1)</sup> See Methodology section for a complete description of economic and behavioral scenarios.





<b>Best Practices Fund II, L.P.</b>	<b>QTD</b>	<b>YTD</b>	<b>Since Inception</b>
	(Oct-15 -	(Jan-15 -	(Feb-07 -
	Dec-15)	Dec-15)	Dec-15)

**A. Capital Account Statement for LP #5**

<b>A.1 NAV Reconciliation and Summary of Fees, Expenses &amp; Incentive Allocation</b>		<b>LP #5's Allocation of Total Fund</b>		
<b>Beginning NAV - Net of Incentive Allocation</b>		<b>\$45,067,000</b>	<b>\$38,196,000</b>	<b>\$0</b>
Contributions - Cash & Non-Cash		0	5,000,000	35,000,000
Distributions - Cash & Non-Cash (input positive values)		1,250,000	5,000,000	19,000,000
<b>Total Cash / Non-Cash Flows (contributions, less distributions)</b>		<b>(1,250,000)</b>	<b>0</b>	<b>16,000,000</b>
Net Operating Income (Expense):				
(Management Fees – Gross of Offsets, Waivers & Rebates):		(187,500)	(750,000)	(6,625,000)
Management Fee Rebate		0	0	0
(Partnership Expenses - Total):		(48,000)	(154,780)	(548,429)
(Partnership Expenses – Accounting, Administration & IT)		(1,000)	(2,500)	(27,000)
(Partnership Expenses – Audit & Tax Preparatory)		(2,000)	(5,000)	(58,000)
(Partnership Expenses – Bank Fees)		0	0	0
(Partnership Expenses – Custody Fees)		(12,500)	(27,500)	(55,000)
(Partnership Expenses – Due Diligence)		(20,000)	(50,000)	(95,000)
(Partnership Expenses – Legal)		0	(37,500)	(250,000)
(Partnership Expenses – Organization Costs)		(10,000)	(25,000)	(50,000)
(Partnership Expenses – Other Travel & Entertainment)		(2,500)	(7,005)	(12,444)
(Partnership Expenses – Other*)		0	(275)	(985)
Total Offsets to Fees & Expenses (applied during period):		82,600	346,500	1,538,521
<b>Offset Categories</b>				
	<b>% Offset to LP #5*</b>			
Advisory Fee Offset	80%	16,000	72,000	185,007
Broken Deal Fee Offset	80%	8,000	32,000	137,007
Transaction & Deal Fee Offset	80%	4,000	12,000	129,007
Directors Fee Offset	100%	600	2,500	37,500
Monitoring Fee Offset	100%	30,000	135,000	675,000
Capital Markets Fee Offset	100%	15,000	68,000	335,000
Organization Cost Offset	80%	8,000	20,000	40,000
Placement Fee Offset	100%	0	0	0
Other Offset*	80%	0	0	0
<b>Reconciliation for Unapplied Offset Balance (Roll-forward)</b>				
Unapplied Offset Balance (Roll-forward) - Beginning Balance		1,000	5,000	0
Plus: Total Offsets to Fees & Expenses (recognized during period)		81,600	341,500	1,538,521
Less: Total Offsets to Fees & Expenses (applied during period)		82,600	346,500	1,538,521
Unapplied Offset Balance (Roll-forward) - Ending Balance		0	0	0
(Total Management Fees & Partnership Expenses, Net of Offsets & Rebates, Gross of Fee Waiver)		(152,900)	(558,280)	(5,634,908)
Fee Waiver		0	7,500	25,000
Interest Income		500	1,000	10,000
Dividend Income		10,000	32,380	233,508
(Interest Expense)		(2,000)	(8,000)	(40,000)
Other Income/(Expense)*		1,000	3,000	20,000
<b>Total Net Operating Income / (Expense)</b>		<b>(143,400)</b>	<b>(522,400)</b>	<b>(5,386,400)</b>
<b>(Placement Fees)</b>		<b>0</b>	<b>0</b>	<b>(40,000)</b>
<b>Realized Gain / (Loss)</b>		<b>1,000,000</b>	<b>3,000,000</b>	<b>15,100,000</b>
<b>Change in Unrealized Gain / (Loss)</b>		<b>1,000,000</b>	<b>5,000,000</b>	<b>20,000,000</b>
<b>Ending NAV - Net of Incentive Allocation</b>		<b>\$45,673,600</b>	<b>\$45,673,600</b>	<b>\$45,673,600</b>
<b>Reconciliation for Accrued Incentive Allocation</b>				
Accrued Incentive Allocation - Starting Period Balance		(4,750,000)	(3,750,000)	0
Incentive Allocation - Paid During the Period		50,000	250,000	1,250,000
Accrued Incentive Allocation - Periodic Change		(300,000)	(1,500,000)	(6,250,000)
Accrued Incentive Allocation - Ending Period Balance		(5,000,000)	(5,000,000)	(5,000,000)
Ending NAV - Gross of Accrued Incentive Allocation		\$50,673,600	\$50,673,600	\$50,673,600



<b>Best Practices Fund II, L.P.</b>	<b>QTD</b> (Oct-15 - Dec-15)	<b>YTD</b> (Jan-15 - Dec-15)	<b>Since Inception</b> (Feb-07 - Dec-15)
-------------------------------------	------------------------------------	------------------------------------	--

<b>A.2 Commitment Reconciliation:</b>	<b>LP #5's Allocation of Total Fund</b>		
<b>Total Commitment</b>	<b>\$50,000,000</b>	<b>\$50,000,000</b>	<b>\$50,000,000</b>
<b>Beginning Unfunded Commitment:</b>	<b>\$18,500,000</b>	<b>\$23,500,000</b>	<b>\$50,000,000</b>
(Less Contributions)	0	(5,000,000)	(35,000,000)
Plus Recalable Distributions	0	0	4,000,000
(Less Expired/Released Commitments)	0	0	0
+/- Other Unfunded Adjustment	0	0	(500,000)
<b>Ending Unfunded Commitment</b>	<b>\$18,500,000</b>	<b>\$18,500,000</b>	<b>\$18,500,000</b>

<b>A.3 Miscellaneous** (input positive values):</b>	<b>LP #5's Allocation of Total Fund</b>		
Incentive Allocation - Earned (period-end balance)****	\$1,250,000	\$1,250,000	\$1,250,000
Incentive Allocation - Amount Held in Escrow (period-end balance)****	\$250,000	\$250,000	\$250,000
Returned Clawback****	\$0	\$0	\$0
Capitalized Transaction Fees & Exp. - Paid to Non-Related Parties****	\$50,000	\$200,000	\$1,000,000
Distributions Relating to Fees & Expenses****	\$2,500	\$10,000	\$58,000
Fund of Funds: Gross Fees, Exp. & Incentive Allocation paid to the Underlying Funds****	\$1,951	\$7,806	\$24,626

**B. Schedule of Fees, Incentive Allocation & Reimbursements Received by the GP & Related Parties, with Respect to the Fund and Portfolio Companies/Invs.**

<b>B.1 Source Allocation:</b>		<b>LP #5's Allocation of Total Fund</b>		
<b>With Respect to the Fund's LPs</b>	Management Fees - Net of Rebates, Gross of Offsets and Waivers	187,500	750,000	6,625,000
	Partnership Expenses - Paid to GP & Related Parties - Gross of Offsets	1,000	4,000	30,000
	(Less Total Offsets to Fees & Expenses - applied during period)	(82,600)	(346,500)	(1,538,521)
	Capitalized Transaction Fees & Exp. - Paid to GP & Related Parties****	0	0	0
	Accrued Incentive Allocation - Periodic Change	300,000	1,500,000	6,250,000
<b>With Respect to the Fund's Portfolio Companies/ Invs.</b>	Total Fees with Respect to Portfolio Companies/Investments:	80,600	350,500	1,611,277
	Advisory Fees****	20,000	90,000	231,259
	Broken Deal Fees****	10,000	40,000	171,259
	Transaction & Deal Fees****	5,000	15,000	161,259
	Directors Fees****	600	2,500	37,500
	Monitoring Fees****	30,000	135,000	675,000
	Capital Markets Fees****	15,000	68,000	335,000
	Other Fees****,*	0	0	0
	Total Reimbursements for Travel & Administrative Expenses****	5,000	15,000	62,200
	<b>Total Received by the GP &amp; Related Parties</b>	<b>\$491,500</b>	<b>\$2,273,000</b>	<b>\$13,039,956</b>

\*Current offset percentages for the specific LP; As offset calculations may change over the life of the Fund, the current offset percentages may not be applicable for calculating the

\*\*Content in A.3 aims to provide users with additional context on the balances provided in other sections; Some of the balances in A.3 represent a sub-total for an amount provided sections may typically be presented as a negative amount; To prevent double-counting, or other miscalculations, users should avoid netting balances in A.3 with amounts in other s

\*\*\*Balances in this section represent fees & reimbursements received by the GP/Manager/Related Parties with respect to the Fund's investments that are not allocable to the Total GP/Manager/Related Party); To avoid double-counting, LP # 5's Allocation of Total Fund should not reflect any pro-rata share of these positions; Balances in this section, plus the t GP/Manager/Related Parties With Respect to the Fund's Portfolio Companies/Invs.

\*\*\*\*Allocation for individual LPs, the Total Fund and all remaining positions may need to be estimated on a pro-rata basis

\*A description should be provided in the footnote section for any amount(s) listed in this row for the year-to-date period

**Shaded/Italicized/Grouped Content Represents Level 2 Data**

**Footnotes for any YTD (Total Fund) expenses, fees & offsets (including any "other" balances)**  
 Partnership Expenses – Other (\$10,500) = Insurance (\$8,000) + Partnership-Level Taxes (\$2,500)

## **Websites of Pension Funds and Investment Boards with Notable Transparency Practices**

1. **Arizona State Retirement System (\$37 billion)** – board materials, comprehensive investment reports  
<https://www.azasrs.gov/>
2. **Los Angeles County Employee Retirement Association (\$53 billion)** – board materials, detailed alternative investment reports with Public Market Equivalent values  
[https://www.lacera.com/about\\_lacera/board\\_investments.html](https://www.lacera.com/about_lacera/board_investments.html)
3. **Los Angeles City Employees Retirement System (\$17 billion)** – board materials, manager score cards  
<https://www.lacers.org/index.html>
4. **Montana Board of Investments (\$11 billion)** – board materials, comprehensive investment reports  
<https://www.ucop.edu/investment-office/>
5. **Nebraska Investment Council (\$26 billion)** – board materials, comprehensive investment reports, manager presentations with proposed fee terms  
<https://nic.nebraska.gov/>
6. **New Jersey Department of Treasury (\$79 billion)** – alternative investment fee terms  
<https://www.nj.gov/treasury/doinvest/alternativeinvestments.shtml>
7. **New Mexico Educational Retirement Board (\$12 billion)** – comprehensive performance reports, including private equity with multiple Public Market Equivalent values  
<http://nmerb.org/Investments.html>
8. **North Dakota State Investment Board (\$13 billion)** – board materials, comprehensive investment reports  
<http://www.nd.gov/rio/SIB/Board/default.htm>
9. **Rhode Island State Investment Commission (\$8 billion)** – interactive investment performance, board materials, manager fee terms  
<http://investments.treasury.ri.gov/>
10. **South Carolina Retirement System Investment Commission (\$32 billion)** – board materials, enhanced fee reporting  
<https://www.rsic.sc.gov/index.html>
11. **UC Regents (\$110 billion)** – itemized fee disclosure for alternatives  
<https://www.ucop.edu/investment-office/>

## Report on SERS and PSERS performance and fees paid

Ludovic Phalippou

University of Oxford

I was only given data on fund vintages, total capital committed, invested, distributed and net asset values. From this information I have inferred performance and fees paid for both funds. Statistics throughout are very coherent and close to what has been observed elsewhere. Assumptions on fees are conservative (i.e. fee estimates should be seen as a lower bound).

I eliminated the funds of years 2016-2018 because their performance is not meaningful and as significant fees are paid upfront, they would look mechanically (and misleadingly) high.

Some likely errors were found in IRRs and some IRRs were missing. This has little impact on results but these IRRs were replaced by that implied from the TVPI and a duration of four years.

The implied duration of each investment was computed from their IRR and TVPI. The formula used assumes no intermediary cash flows. The average duration of investments at PSERS is 4 years while it is 5 years at SERS. Part of the explanation is that SERS has an older portfolio overall. Half of the capital invested in PE by PSERS was after 2007, while it is 25% for SERS.

All the calculations are done as if the portfolio was liquidated today. Consequently, the performance related fee, which is due when investments are exited, would be due today and it is assumed that the sale value would be equal to the reported net asset value for each fund.

PSERS invested a total of 25b for a total return of 38b. With a four years (implied) holding period the return is 10.7% p.a. The return per dollar invested is lower for the more recent investments (2007 on) but holding period is also lower as most of these investments are not exited yet. The estimated rate of return is the same for post 2007: 10.8% p.a.

SERS invested a total of 14b for a total return of 24b. With a five years (implied) holding period the return is virtually identical at 10.6% p.a. Again, returns are similar post-2007 at 10.5%. Again, all these numbers are estimate because I do not have all the required data at hand. These rates of returns are rough proxies. This is the best guess given the information provided.

Over long horizon about any US stock-market indices has returns around 10% p.a. as well. These figures are similar to what is observed for other major US public pension funds and show that these investments have not generated a bad rate of return. Yet, these investments

do not appear to have outperformed public equity returns by a wide magnitude, unlike what is often heard in various marketing pitches. A major debate is on whether their risk and diversification characteristics are such that these returns have been sufficient.

Another major debate is on the fees that have been paid. The exact amount is unknown and I made conservative assumptions. A fee is commonly understood as being the extra amount the investor would have received if all the entities hired in relation to the management of the fund would not have received any income from the fund (and its investments). I follow this definition and therefore include fund expenses (including organizational expenses), portfolio company fees, management fees and carried interest.

The total fees for PSERS are \$7.6 billion, i.e. 30% of the amount invested. These fees reduced the annual rate of return by 5.1%. Similarly, for SERS, the total fees are \$5 billion, representing 34% of the amount invested and a lower reduction in rate of returns (due to the longer implied holding period) of 4.1%. More aggressive (but not implausible) assumptions around fees increase these figure to a 6% p.a. to 7% p.a. (and increase absolute amount as well). Note also that the first academic study on fees, that of Paul Gompers and Josh Lerner in 1999 estimated fees to be about one third of capital invested. Hence the amounts obtained here are consistent with those estimated elsewhere in the academic literature (Per Stromberg in his recent report to the Norwegian government has an estimate that is slightly higher than the conservative one presented here).

I also tried to estimate what the overall fee as a fraction of NAV would be and found similar numbers: 5.3% for PSERS and 4.5% for SERS. What is typically reported by pension funds is only management fees net of any rebates. I estimated that the reported fees should have been 1.7% for SERS and 2.2% for PSERS. Apparently, what the pension funds have reported is still lower than these estimates. There are additional management fee rebates (e.g. waivers which shift management fees to carried interest), which I have not accounted for as there has no estimates in the literature and they may account for the difference. Note also that the higher fees at PSERS compared to SERS are partly (or fully) due to PSERS PE programme being younger overall than that of SERS.

Conclusion: Performance is difficult to assess, but we can conclude that it has been neither bad or great. It is unclear whether it has been sufficiently high to compensate for risk given potential diversification benefits. Not having access to data forces us to make multiple assumptions. I believe I worked with a conservative estimate of fees and come to the conclusion that these pension funds together have paid a total of at the very least \$12 billion over the years, or 4% to 5% of investment value annually.

NB: All the computations (and formulas) are shown in the Excel file on the sheets called PSERS and SERS respectively).



Media/Communication III	1996	25,000,000	23,593,750	38,175,382
New Enterprise Associates VII	1996	30,000,000	30,000,000	102,186,705
OCM Principal Opportunities	1996	25,000,000	25,000,000	36,286,472
Permira UK Venture Fund IV	1996	15,248,000	15,794,739	23,596,190
Polaris Venture Partners	1996	15,000,000	14,520,000	46,594,679
RRZ Private Equity	1996	20,000,000	19,144,687	12,188,287
TL Ventures III	1996	15,000,000	15,000,000	20,773,654
Vestar Capital Partners III	1996	25,000,000	22,286,809	27,748,687
ABRY Broadcast Partners III	1997	25,000,000	20,394,093	28,932,345
APAX Germany II	1997	8,737,262	8,455,477	17,367,332
APAX UK Ventures VI	1997	6,918,899	6,918,899	13,274,906
Apollo Investment Fund IV	1997	75,000,000	72,079,063	124,814,033
Blackstone Capital III	1997	75,000,000	74,295,009	155,123,498
Charterhouse Equity Partners III	1997	50,000,000	52,598,202	76,093,084
Code Hennessy & Simmons III	1997	40,000,000	38,423,990	56,551,057
Fairview II	1997	10,000,000	9,869,194	4,047,645
Frontenac VII	1997	40,000,000	40,000,000	55,957,155
GTCR V	1997	11,400,000	11,400,000	20,777,730
Halpern Denny Fund II	1997	25,000,000	24,999,991	5,307,874
Harbourvest IPEP II	1997	25,000,000	24,500,000	34,075,106
Healthcare Ventures V	1997	25,000,000	25,000,000	52,714,973
J.H. Whitney Equity Fund III	1997	20,000,000	19,971,316	50,875,134
Keystone V	1997	25,000,000	25,000,000	2,320,252
Madison Dearborn Capital Partners II	1997	40,000,000	39,472,443	93,274,048
Mid-Atlantic Venture Fund III	1997	20,008,308	20,000,000	5,654,702
OCM Opportunities Fund II	1997	40,000,000	40,000,000	60,368,957
P/A Fund III	1997	100,000,000	99,366,750	161,607,393
Permira European Fund	1997	33,494,536	32,159,947	84,005,717
TA/Advent VIII	1997	30,000,000	29,400,000	67,141,158
TPG Partners II	1997	75,000,000	71,335,785	127,821,076
Clayton Dubilier & Rice VI	1998	50,000,000	33,699,959	57,754,625
Grotech Partners V	1998	25,000,000	25,000,000	24,590,624
GTCR VI	1998	50,000,000	49,520,987	44,453,905
HarbourVest IPEP III	1998	40,000,000	39,400,000	60,828,829
JP Morgan Venture Capital Investors	1998	100,000,000	93,284,186	70,128,287
Kelso VI	1998	75,000,000	64,061,730	92,977,515
Lexington Capital Partners II	1998	40,000,000	39,538,000	52,511,592
Media/Communications IV	1998	25,000,000	23,125,000	17,340,500
Polaris Venture Partners II	1998	25,000,000	24,750,000	40,761,283
Summit V	1998	37,500,000	36,187,500	49,997,247
Thomas H. Lee Equity Fund IV	1998	70,000,000	60,512,410	52,506,686
Weston Presidio III	1998	35,000,000	31,989,586	36,399,850
ABS Capital Partners III	1999	35,000,000	27,764,683	18,757,336
Adams Capital Management II	1999	30,000,000	30,000,000	4,117,043
APAX Europe IV	1999	32,424,000	29,909,800	40,876,051
APEX Investment Fund IV	1999	25,000,000	25,000,000	5,661,282
Asia Pacific Growth Fund III	1999	15,000,000	14,627,000	16,708,736
Atlas Venture Fund IV	1999	26,000,000	21,630,650	8,556,942
Cerberus Institutional Partners	1999	35,000,000	35,000,000	79,906,454
Code Hennessy & Simmons IV	1999	100,000,000	97,230,000	156,773,531

Cross Atlantic Technology Fund	1999	20,000,000	19,965,000	23,742,240
Draper Fisher Jurvetson Fund VI	1999	8,000,000	8,000,000	5,347,835
Draper Triangle Ventures	1999	20,000,000	16,394,757	11,357,493
Frazier Healthcare III	1999	30,000,000	30,000,000	13,051,047
Great Hill Equity Partners	1999	30,000,000	27,858,676	31,339,243
Gryphon Partners II	1999	35,000,000	32,173,416	41,953,023
HarbourVest Partners VI	1999	200,000,000	196,000,000	235,595,889
Hellman & Friedman Capital Partners IV	1999	75,000,000	84,681,459	189,025,929
Invemed Catalyst Fund	1999	25,000,000	13,695,639	11,020,758
J.H. Whitney IV	1999	20,000,000	17,858,772	7,529,485
Lexington Capital Partners III	1999	35,000,000	34,516,449	43,383,378
LLR Equity Partners	1999	25,000,000	24,500,000	52,596,658
Madison Dearborn Capital Partners III	1999	75,000,000	74,852,182	114,509,416
New Enterprise Associates IX	1999	20,000,000	19,600,000	6,787,282
Newbridge Asia II	1999	15,000,000	14,756,943	14,567,191
Oakhill Capital Partners	1999	50,000,000	50,156,830	93,999,577
Palamon European Equity	1999	29,779,989	33,537,469	67,773,811
Summit Accelerator Fund	1999	8,000,000	7,560,000	13,302,985
TL Ventures IV	1999	35,000,000	35,000,000	26,810,892
TPG Partners III	1999	75,000,000	61,238,756	165,383,087
US Venture Partners VII	1999	13,750,000	13,750,000	4,800,279
Vestar Capital Partners IV	1999	100,000,000	90,331,274	172,192,260
ABACUS Fund Partners	2000	15,000,000	15,000,000	8,949,405
ABRY Partners IV	2000	35,000,000	22,500,122	74,633,973
ABS Capital Partners IV	2000	35,000,000	28,789,304	68,253,149
Adams Capital Management III	2000	30,000,000	30,000,000	7,011,905
Advanced Technology Ventures VI	2000	10,000,000	10,000,000	4,498,689
Alloy Ventures 2000	2000	20,000,000	20,000,000	5,964,401
APAX Europe V	2000	53,262,000	68,764,274	150,017,403
Apax Excelcor VI	2000	35,000,000	33,957,540	56,527,379
Apollo Investment Fund V	2000	50,000,000	42,484,039	122,268,807
Atlas Venture Fund V	2000	37,200,000	34,699,263	40,751,899
Audax Private Equity Fund	2000	35,000,000	33,157,787	55,936,816
Bain Capital Fund VII	2000	25,000,000	23,562,500	47,998,008
BC European Capital VII	2000	32,658,500	37,740,202	96,576,440
Blackstone Communications Partners I	2000	25,000,000	22,873,931	30,998,189
Charles River Partnership XI	2000	11,032,259	11,032,259	14,422,548
DLJ Merchant Banking Fund III	2000	85,000,000	82,782,001	188,607,421
Draper Fisher Jurvetson Fund VII	2000	20,000,000	20,000,000	9,781,991
Francisco Partners	2000	50,000,000	46,788,932	61,163,230
Great Hill Equity Partners II	2000	35,000,000	33,224,137	78,337,666
GTCR VII	2000	55,000,000	47,987,500	121,878,298
Halpern Denny Fund III	2000	25,000,000	22,446,273	28,562,555
Healthcare Ventures VI	2000	35,000,000	35,000,000	6,534,943
InterWest Partners VIII	2000	25,000,000	24,850,000	12,953,647
J.H. Whitney V	2000	20,000,000	22,559,318	44,904,355
JP Morgan Venture Capital Investors II	2000	100,000,000	98,029,678	116,082,449
Kline Hawkes Pacific	2000	15,000,000	15,000,000	7,024,280
Madison Dearborn Capital Partners IV	2000	90,000,000	87,106,109	167,519,294
Media/Communications Ventures Fund V	2000	35,000,000	33,781,095	56,014,639



Meritech Capital Partners II	2000	26,475,166	24,842,529	37,926,932
Mid-Atlantic Venture Fund IV	2000	30,000,000	30,000,000	9,177,849
New Enterprise Associates X	2000	35,000,000	35,000,000	32,493,542
Newbridge Asia III	2000	15,000,000	12,743,920	55,728,660
Novo Vita	2000	11,616,498	11,328,462	5,382,912
OCM Opportunities Fund III	2000	60,000,000	60,000,000	90,237,385
Pemira European Fund II	2000	48,000,000	45,672,612	91,464,087
Polaris Venture Partners III	2000	50,000,000	49,500,000	35,229,712
Providence Equity Partners IV	2000	25,000,000	21,894,740	56,040,746
SCP Private Equity Partners II	2000	25,000,000	23,026,869	8,534,307
TA IX	2000	45,000,000	43,850,000	105,863,474
Thomas H. Lee Equity Fund V	2000	100,000,000	97,772,983	175,615,745
Three Arch Capital	2000	20,000,000	19,500,000	16,330,214
TL Ventures V	2000	40,000,000	40,000,000	16,100,247
US Venture Partners VIII	2000	26,250,000	25,830,000	31,214,948
Weston Presidio IV	2000	35,000,000	34,451,015	39,417,544
Worldview Technology Partners IV	2000	18,130,023	16,951,175	7,883,559
ABRY Mezzanine Partners	2001	30,000,000	24,857,300	49,707,116
Accel Europe	2001	15,000,000	11,350,000	16,931,665
Advanced Technology Ventures VII	2001	27,000,000	26,797,500	28,185,753
AG Capital Recovery Partners II	2001	17,600,000	17,600,000	27,534,983
APEX Investment Fund V	2001	20,000,000	20,122,702	7,739,736
Atlas Venture Fund VI	2001	24,800,000	23,283,720	16,191,410
Austin Ventures VIII	2001	20,932,140	20,932,140	33,689,094
BC European Capital VII Top Up	2001	10,046,300	12,278,596	32,386,202
Blackstone Capital IV	2001	75,000,000	67,747,508	184,306,060
Cerberus Institutional Partners Series Two	2001	35,000,000	30,100,793	93,674,154
Cross Atlantic Technology Fund II	2001	32,900,000	31,815,285	33,327,455
Frazier Healthcare IV	2001	30,000,000	28,257,985	24,821,191
Harbourvest IPEP IV	2001	40,000,000	39,000,000	66,958,354
Highland Capital Partners VI	2001	25,000,000	25,000,000	37,031,136
IVP II	2001	8,600,000	8,564,472	2,799,296
Lexington Capital Partners V	2001	75,000,000	74,322,207	122,032,804
Matlin Patterson Global Opportunities Partners	2001	35,000,000	30,007,727	56,709,189
Morgenthaler Partners VII	2001	35,000,000	35,000,000	28,717,913
OCM Opportunities Fund IV	2001	70,000,000	70,000,000	115,665,253
OCM Principal Opportunities II	2001	25,000,000	25,000,000	43,894,166
Parthenon Investors II	2001	20,000,000	19,771,146	35,780,448
Polaris Venture Partners IV	2001	50,000,000	49,750,000	44,081,207
Summit Ventures VI	2001	62,000,000	62,000,000	124,366,643
AG Capital Recovery Partners III	2002	20,000,000	16,000,000	25,183,359
Alloy Ventures 2002	2002	25,000,000	24,832,999	15,448,474
Alpha Private Equity Fund 4	2002	26,508,000	35,605,050	77,986,040
Avenue Special Situations Fund III	2002	50,000,000	37,387,969	62,626,424
Berkshire Fund VI	2002	20,000,000	17,260,685	44,220,291
Charterhouse Capital Partners VII	2002	55,482,500	52,250,090	109,645,407
GTCR VIII	2002	75,000,000	69,393,599	114,671,436
Healthcare Ventures VII	2002	35,000,000	35,000,000	22,026,107
J.W. Childs Equity Partners III	2002	40,000,000	38,233,446	76,553,620
JP Morgan US Corp Finance Investors II	2002	50,000,000	47,843,124	83,158,875

Leeds Equity Partners IV	2002	20,000,000	18,540,214	22,913,831
Nordic Capital V	2002	34,998,500	42,214,178	131,708,708
Sterling Capital Partners I	2002	15,000,000	14,148,729	30,923,385
Abingworth Bioventures IV	2003	20,000,000	19,700,000	23,712,133
AG Capital Recovery Partners IV	2003	50,000,000	35,415,216	55,993,470
Alloy Annex I	2003	5,000,000	5,000,000	1,958,747
Cerberus Institutional Partners Series Three	2003	35,000,000	22,321,354	48,003,987
HarbourVest Partners VII	2003	75,000,000	73,887,500	90,232,312
Keelo VII	2003	40,000,000	38,453,157	65,700,825
New Enterprise Associates 11	2003	25,000,000	25,000,000	53,967,678
Novitas Capital III	2003	10,000,000	8,337,867	3,924,047
Permira European Fund III	2003	115,960,000	123,774,404	214,320,293
Quaker BioVentures	2003	20,000,000	19,757,627	5,472,501
ShoreView Capital Partners	2003	38,000,000	26,859,811	56,043,792
Three Arch Partners IV	2003	20,000,000	19,050,000	19,732,734
TPG Partners IV	2003	30,000,000	27,502,731	56,716,528
ABRY Partners V	2004	45,000,000	36,658,306	81,985,980
Apax Europe VI	2004	76,349,190	74,145,979	134,550,076
AXA Secondary Fund III	2004	26,000,000	21,733,291	37,244,706
AXA Secondary Fund III-2	2004	14,000,000	11,677,210	19,062,784
Bain Capital Fund VIII-E	2004	12,144,000	12,299,670	19,831,405
Clearstone Venture Partners III-A	2004	25,000,000	24,250,000	12,828,843
Draper Triangle Ventures II	2004	12,000,000	11,490,032	13,724,504
Elevation Partners	2004	35,000,000	27,052,500	49,826,210
Energy Spectrum Partners IV	2004	50,000,000	47,543,899	86,714,979
First Reserve Fund X	2004	30,000,000	29,215,295	54,728,700
Gryphon Partners III	2004	30,000,000	34,094,131	51,691,321
Hellman & Friedman Capital Partners V	2004	80,000,000	70,568,846	191,936,442
InterWest Partners IX	2004	20,000,000	19,430,000	20,323,462
IVP III	2004	10,500,000	9,555,000	12,920,296
Knightsbridge Venture Capital VI	2004	20,000,000	18,266,667	13,807,280
Lime Rock Partners III	2004	15,000,000	13,833,501	7,379,936
LLR Equity Partners II	2004	25,000,000	25,000,000	40,778,924
Matlin Patterson Global Opportunities Partners II	2004	30,000,000	29,982,912	10,578,309
Oak Investment Partners XI	2004	35,000,000	35,000,000	20,884,742
Oaktree Capital Management	2004	40,000,000	39,999,995	117,367,238
OCM Opportunities Fund V	2004	40,000,000	40,000,000	64,930,528
Pitango Venture Capital Fund IV	2004	20,000,000	20,266,266	16,748,087
Providence Equity Partners V	2004	45,000,000	41,090,834	49,459,242
UMS Partners Fund I	2004	5,000,000	5,000,000	3,004,752
Versa Capital Partners	2004	20,000,000	22,868,000	15,988,714
ABS Capital Partners V	2005	20,000,000	19,404,254	48,986,604
AG Capital Recovery Partners V	2005	20,000,000	20,000,000	21,834,353
Alloy Ventures 2005	2005	25,000,000	25,000,000	8,242,217
Apollo Investment Fund VI	2005	40,000,000	38,289,202	52,606,408
Audax Private Equity Fund II	2005	25,000,000	25,506,073	45,110,929
Austin Ventures IX	2005	15,000,000	15,127,754	16,396,495
Avenue Special Situations Fund IV	2005	50,000,000	49,911,855	69,076,799
BC European Capital VIII	2005	98,107,500	97,137,090	104,856,917
Birchmere Ventures III	2005	10,000,000	9,082,885	8,692,184

Brynwood Partners V	2005	10,000,000	9,646,565	18,886,569
Code Hennessy & Simmons V	2005	50,000,000	52,664,489	91,608,248
Frazier Healthcare V	2005	30,000,000	27,254,471	44,861,311
Healthcare Ventures VIII	2005	30,000,000	29,775,000	20,617,021
HIPEP V-Asia Pacific & Rest of World	2005	30,000,000	28,200,000	31,465,405
InterMedia Partners VII	2005	15,000,000	14,749,398	16,403,677
J.H. Whitney VI	2005	50,000,000	46,555,172	40,539,938
JMI Equity Fund V	2005	24,000,000	21,891,322	122,661,437
JP Morgan Venture Capital Investors III	2005	100,000,000	99,249,283	80,029,395
Lexington Capital Partners VI	2005	50,000,000	52,232,143	61,408,551
Lightspeed Venture Partners VII	2005	18,000,000	15,057,658	29,801,929
Lime Rock Resources	2005	20,000,000	17,129,968	25,286,779
Meridian Venture Partners II	2005	10,000,000	10,000,000	21,939,244
Morgenthaler Partners VIII	2005	35,000,000	35,046,903	39,451,350
Motion II B	2005	48,204,998	41,261,710	38,726,742
New York Life Capital Partners III	2005	50,000,000	50,454,371	42,068,297
Newbridge Asia IV	2005	40,000,000	37,967,906	82,887,170
Nordic Capital VI	2005	54,369,000	59,249,208	92,734,157
OCM Opportunities Fund VI	2005	40,000,000	40,000,000	63,171,009
OCM/GFI Power Opportunities Fund II	2005	25,000,000	13,110,559	41,644,215
Palamon European Equity II	2005	36,113,990	37,311,083	60,699,188
Sterling Capital Partners II	2005	30,000,000	27,224,698	27,662,225
Summit Partners Private Equity Fund VII	2005	97,134,500	97,134,505	141,097,097
Summit Partners Venture Capital Fund II	2005	15,000,000	15,000,000	28,086,917
Templeton Strategic Emerging Markets Fund II	2005	100,000,000	74,742,190	149,972,520
Vestar Capital Partners V	2005	50,000,000	48,164,752	55,571,508
Weston Presidio V	2005	50,000,000	43,269,290	104,257,463
ABRY Senior Equity II	2006	30,000,000	25,405,779	44,684,848
Alpha Private Equity Fund 5	2006	57,796,800	62,184,152	82,402,625
Artiman Ventures II	2006	25,000,000	20,967,427	13,141,575
Asia Alternatives Capital Partners	2006	50,000,000	23,406,269	34,732,699
Avenue Asia Special Situations Fund IV	2006	50,000,000	31,897,973	33,606,114
AXA Secondary Fund IV	2006	80,000,000	66,908,452	82,302,114
Bain Capital Fund IX	2006	75,000,000	72,937,500	107,913,972
Bain Capital IX Coinvestment Fund	2006	15,000,000	14,456,250	21,969,013
Berkshire Fund VII	2006	32,000,000	29,159,510	44,446,671
Blackstone Capital Partners V	2006	150,000,000	141,252,710	228,895,260
Brait IV	2006	25,000,000	15,396,613	2,873,282
Care Capital Investments III	2006	25,000,000	19,990,191	11,268,961
Centerbridge Capital Partners I	2006	50,000,000	51,804,352	107,910,945
Cerberus Institutional Partners Series Four	2006	75,000,000	68,695,715	99,407,294
Charterhouse Capital Partners VIII	2006	63,826,976	67,961,522	70,399,353
Chequers Capital XV	2006	31,133,996	28,814,337	55,670,090
Devon Park Bioventures	2006	10,842,897	8,417,877	25,366,934
Eureka II	2006	20,000,000	16,539,093	17,061,767
First Reserve Fund XI	2006	60,000,000	61,497,082	39,196,915
Francisco Partners II	2006	30,000,000	29,186,046	40,261,907
Great Hill Equity Partners III	2006	35,000,000	31,191,526	40,355,000
GTCR IX	2006	50,000,000	46,134,343	79,736,269
HarbourVest Partners VIII	2006	100,000,000	98,000,000	95,315,924

Hellman & Friedman Capital Partners VI	2008	125,000,000	112,971,649	195,637,870
Highland Capital Partners VII	2008	35,000,000	35,000,000	27,335,325
Lime Rock Partners IV	2006	25,000,000	23,650,060	19,382,889
Madison Dearborn Capital Partners V	2006	75,000,000	66,925,260	98,078,137
Meritech Capital Partners III	2006	35,000,000	35,000,000	179,717,500
New Enterprise Associates 12	2006	35,000,000	35,626,297	40,514,815
NewSpring Growth Capital II	2006	10,000,000	8,757,900	13,815,193
Oak Investment Partners XII	2006	40,000,000	39,214,554	28,177,778
OCM Principal Opportunities Fund IV	2006	20,000,000	20,400,000	32,981,381
Permira IV	2008	127,779,198	123,910,382	186,107,259
PNC Equity Partners II	2008	15,000,000	12,151,978	24,020,354
Polaris Venture Partners V	2006	50,000,000	49,000,000	37,304,560
Siguler Guff BRIC Opportunities Fund	2006	10,000,000	9,500,000	8,684,042
Sofinnova Venture Partners VII	2006	20,000,000	19,204,944	28,074,291
TA X	2006	70,000,000	67,550,000	88,457,009
Thomas H. Lee Equity Fund VI	2006	50,000,000	49,635,152	53,898,962
TPG Partners V	2006	95,756,241	89,664,515	101,412,222
Abingworth Bioventures V	2007	33,775,000	26,267,424	37,245,978
ABRY Advanced Securities Fund	2007	25,000,000	20,239,583	38,682,209
Advent Latin American Private Equity Fund IV	2007	30,000,000	29,810,236	32,090,921
Apax Europe VII	2007	132,170,235	131,963,257	145,865,152
Asia Alternatives Capital Partners II	2007	50,000,000	26,583,918	20,136,025
Audax Private Equity Fund III	2007	37,000,000	39,579,527	73,271,872
Avenue Special Situations Fund V	2007	70,000,000	69,901,575	92,690,854
Bain Capital Asia Fund	2007	12,000,000	11,020,944	15,143,534
Bain Capital Fund X	2007	90,000,000	86,374,239	100,560,312
Bain Capital X Coinvestment Fund	2007	5,000,000	1,225,000	1,061,774
Baring Vostok Private Equity Fund IV	2007	30,000,000	27,455,543	14,782,880
Battery Ventures VIII, L.P.	2007	25,000,000	25,000,000	44,528,658
CID Greater China Venture Capital Fund II	2007	20,000,000	15,642,417	20,748,420
CVI Global Value Fund	2007	60,000,000	57,000,000	82,038,032
Dover Street VII	2007	30,000,000	28,725,000	34,158,237
Energy Spectrum Partners V	2007	30,000,000	24,365,520	51,487,729
Excelsior Capital Asia Partners III	2007	25,000,000	19,930,971	12,585,480
Highland Consumer Fund I	2007	25,000,000	25,000,000	7,358,806
Insight Venture Partners VI	2007	30,000,000	28,895,502	61,968,071
IVP IV	2007	14,000,000	13,300,000	11,104,733
JMI Equity Fund VI	2007	40,000,000	38,591,240	66,063,810
Kelso VIII	2007	150,000,000	127,406,578	110,435,972
Nordic Capital VII	2007	92,519,165	88,584,871	74,215,867
OCM Opportunities Fund VII	2007	40,000,000	40,000,000	51,627,682
OCM Opportunities Fund VII b	2007	40,000,000	36,000,000	59,059,393
Pitango Venture Capital Fund V	2007	30,000,000	27,917,626	16,866,840
Providence Equity Partners VI	2007	50,000,000	50,589,518	51,180,127
Quaker BioVentures II	2007	25,000,000	22,108,833	16,355,865
Sankaty Credit Opportunities III	2007	50,000,000	50,000,000	50,615,310
SFC Energy Partners I	2007	25,000,000	22,291,498	22,575,508
Siguler Guff BRIC Opportunities Fund II	2007	25,000,000	24,500,000	12,920,918
Sterling Capital Partners III	2007	32,000,000	29,792,891	30,703,208
TPG Asia V	2007	22,500,000	19,733,774	20,736,313

W Capital Partners II	2007	40,000,000	38,333,987	51,953,047
Weathergagge Venture Capital	2007	25,000,000	22,875,000	21,431,174
ABRY Partners VI	2008	50,000,000	54,962,201	105,219,960
Advent International GPE VI-A	2008	35,000,000	34,034,207	52,362,090
Avenue Europe Special Situations Fund	2008	38,832,500	25,306,863	37,899,419
Bain Capital Europe III	2008	72,432,276	62,972,190	112,389,602
Baring India Private Equity Fund III Limited	2008	5,000,000	4,829,380	3,515,232
Battery Ventures VIII Side Car Fund	2008	9,000,000	6,768,000	17,412,210
Brynwood Partners VI	2008	10,000,000	10,586,341	20,942,840
Cleesidra Capital Partners II	2008	25,631,168	14,880,732	20,490,598
First Reserve Fund XII	2008	50,000,000	50,054,842	24,077,391
Great Hill Equity Partners IV	2008	25,000,000	21,827,798	32,871,394
Guggenheim Technology Ventures I	2008	2,000,000	2,000,000	585,422
H.I.G. Bayside Debt & LBO Fund II	2008	30,000,000	30,010,001	24,818,134
InterWest Partners X	2008	30,000,000	25,894,500	2,300,138
Lightspeed Venture Partners VIII	2008	15,000,000	12,661,838	18,809,443
<b>Lime Rock Partners V</b>	2008	42,500,000	39,651,821	23,057,932
LLR Equity Partners III	2008	30,000,000	28,374,310	30,522,651
Madison Dearborn Capital Partners VI	2008	50,000,000	44,757,002	72,677,386
Morgenthaler Partners IX	2008	20,000,000	19,200,000	29,175,846
New York Life Capital Partners IV	2008	50,000,000	49,547,519	79,691,371
Patriot Financial Partners	2008	25,000,000	25,000,000	44,342,334
Sankaty Credit Opportunities IV	2008	40,000,000	38,000,000	49,701,946
Segulah IV	2008	16,705,847	14,633,586	9,819,161
ShoreView Capital Partners II	2008	40,000,000	32,902,497	53,927,004
Templeton Strategic Emerging Markets Fund III	2008	100,000,000	92,498,137	59,967,965
TPG Partners VI	2008	45,000,000	46,395,784	49,654,685
Versa Capital Partners II	2008	15,000,000	15,943,385	5,867,313
Yucaipa American Alliance Fund II	2008	25,000,000	26,820,365	15,650,108
ABS Capital Partners VI	2009	40,000,000	35,589,138	17,444,057
Charterhouse Capital Partners IX	2009	66,385,000	54,638,144	65,564,824
Advent Latin American Private Equity Fund V	2010	15,000,000	13,058,177	2,670,000
Artiman Ventures III	2010	20,000,000	18,910,000	
Avenue Special Situations Fund VI	2010	20,000,000	19,977,798	17,801,933
J.H. Whitney VII	2010	25,000,000	20,808,196	29,754,045
Oaktree Power Opportunities Fund III	2010	25,000,000	15,501,637	13,173,469
OCM Opportunities Fund VIII	2010	12,500,000	12,500,000	14,429,583
OCM Opportunities Fund VIIIb	2010	12,500,000	12,500,000	6,973,114
Weathergagge Venture Capital II	2010	25,000,000	20,814,084	4,917,827
ABRY Partners VII	2011	30,000,000	34,226,469	39,156,084
Asia Alternatives Korea Buyout Investors (Hahn & Co)	2011	7,000,000	8,017,051	4,096,324
BC European Capital IX	2011	26,472,535	23,406,153	12,246,295
Berkshire Fund VIII	2011	30,000,000	24,660,545	5,306,179
Francisco Partners III	2011	20,000,000	17,426,150	15,323,189
H.I.G. Growth Buyouts & Equity Fund II	2011	15,000,000	6,784,132	2,654,945
Insight Venture Partners VII	2011	20,000,000	19,141,600	13,716,040
JMI Equity Fund VII	2011	10,000,000	8,988,735	4,802,885
Meritech Capital Partners IV	2011	20,000,000	19,100,000	11,914,133
SFC Energy Partners II	2011	25,000,000	17,772,960	2,222,349
Advent International GPE VII-B	2012	40,000,000	34,073,050	15,159,752



Asia Alternatives Capital Partners III	2012	50,000,000	45,804,166	16,768,065
AXA Secondary Fund V B	2012	75,000,000	57,721,809	58,318,874
Carlyle Energy Mezzanine Opportunities Fund	2012	50,000,000	52,755,986	19,937,821
Denham Commodity Partners VI	2012	50,000,000	40,178,653	17,649,777
NewSpring Growth Capital III	2012	25,000,000	21,204,827	2,218,985
Penn Asia Investors	2012	83,000,000	61,805,442	12,168,422
Eureka Growth Capital III	2013	20,000,000	9,977,250	9,600,134
FSN Capital IV L.P.	2013	46,049,703	35,124,589	11,830,703
H.I.G. Bayside Loan Opp. Fund III	2013	50,000,000	34,494,601	9,000,884
Incline Equity Partners III	2013	15,000,000	11,421,071	12,841,882
Insight Venture Partners VIII	2013	50,000,000	46,424,000	6,688,134
LBC Credit Partners III	2013	50,000,000	47,500,000	31,189,050
LLR Equity Partners IV	2013	50,000,000	40,069,497	10,736,842
Oaktree Opportunities Fund IX	2013	50,000,000	50,000,000	7,483,912
Platinum Equity Capital Partners III, L.P.	2013	50,000,000	43,439,580	40,481,570
Capvis Equity IV	2014	49,855,591	25,151,017	11,046,958
GTCR Fund XI, LP	2014	25,000,000	13,551,655	3,692,041
H.I.G. Europe Capital Partners II	2014	27,544,586	2,854,281	
Hahn & Company II	2014	50,000,000	18,908,645	129
Horizon Impact Fund	2014	50,000,000	24,935,644	2,444,290
Horizon Strategic Fund - Carlyle Group	2014	100,000,000	71,801,469	11,489,662
KPS Special Situations Fund IV	2014	25,000,000	5,009,898	5,384,244
Meritech Capital Partners V	2014	23,000,000	14,317,500	
Sentinel Capital Partners V, L.P.	2014	10,000,000	5,976,411	371,539
ABRY Partners VIII	2015	25,000,000	21,020,610	3,599,240
ADV Opportunities Fund I, L.P.	2015	50,000,000	36,078,170	(138,445)
Advent Latin American Private Equity Fund VI	2015	25,000,000	4,521,483	375,000
Audax Private Equity Fund V	2015	50,000,000	10,928,119	280,051
Blackstone Capital Partners VII, L.P.	2015	50,000,000	6,245,583	17,717
Centerbridge Capital Partners III	2015	30,000,000	7,268,621	404,701
Clearlake Capital Partners IV, L.P.	2015	15,000,000	10,452,661	1,075,857
Draper Triangle Ventures III, LP	2015	10,000,000	4,886,204	
Francisco Partners IV	2015	25,000,000	14,185,199	
H.I.G. Bayside Loan Opp. Fund IV	2015	25,000,000	8,183,672	3,410,636
H.I.G. Brazil and Latin America Partners	2015	50,000,000	804,392	
Helman & Friedman Capital Partners VIII	2015	50,000,000	2,850,985	804,914
Insight Venture Partners IX	2015	50,000,000	32,170,605	1,339,968
JMI Equity Fund VIII	2015	25,000,000	9,092,487	
Lightspeed India Partners I	2015	15,000,000	6,109,500	
Primavera Capital Fund II	2015	50,000,000	24,191,322	783,010
Ridgemont Equity Partners II	2015	50,000,000	22,691,497	5,851,833
RRJ Capital Master Fund III	2015	50,000,000	15,929,917	244,415
Sterling Group Partners IV, L.P.	2015	20,000,000	5,228,329	342,813
		15,813.58	14,303.92	20,037.86
		4,602.17	3,636.48	3,171.03

Funds highlighted in yellow had its IRR corrected as it was inconsistent with its TVPI (same if IRR was missing; assumed 4 years HP)

Assumptions

If this portfolio is liquidated today

Only keep pre 2015 inv (no dist for more recent)

Mngt fees commitment period

1.8%

Mngt fees post commitment period	1.5%
Carry always 20%, hurdle 8%, US style	
PC fees (% inv)	4%
% rebated	80%
Fund expenses (% Kcom)	1.5%
PC fees only if	

1 Assumed always charged hence reduce rate

Results	From inception			From 2007 vintage		
Weighted average implied inv duration	5.10			4.24		
TVPI	1.67			1.53		
RoR using weighted average implied inv duration	10.6%			10.5%		
TVPI gross of fees	2.02			1.82		
Impact of fees on RoR	4.1%			4.6%		
RoR gross of fees	14.8%			15.1%		
Total Invested (billion)	14.3			3.6		
Total value (billion)	23.9			5.6		
Total Fees Paid (billion)	4.9	34%	6.7%	1.1	29%	6.8%
Estimate of reported fees per year (billion)	0.4			0.1		
Estimate of average NAV	22			5		
Estimate of reported annual TER	1.7%			2.1%		
Estimate of actual annual TER	4.5%			4.9%		

PSERS

Fund (original)	Vintage Year	Strategy	Commitment	Contributions	Distributions	NAV	Since Inception IRR	TVPI	Mngt fees year 1-5	Mngt fees year 10-6	Fund expenses	PC fees	Carry	Implied Duration	Net total management fees	
NEPA Venture Fund I	1985	#N/A	1,000,000	1,000,000	6,080,528		17.08%	6.08	0.09	0.08	0.02	-	1.27	11.45	11447287.2	0.17
Commonwealth Capital Ventures, L.P.	1986	#N/A	20,000,000	20,000,000	20,584,156		0.30%	1.03	1.80	1.50	0.30	-	-	9.61	192216950.7	3.30
APA/Fostin Venture Fund I, L.P.	1987		20,000,000	20,000,000	77,132,193		19.88%	3.86	1.80	1.50	0.30	-	14.28	7.44	148883808.1	3.30
CEO Venture Fund I, L.P.	1987		1,000,000	1,000,000	1,101,749		1.43%	1.10	0.09	0.08	0.02	-	-	6.82	6824482.854	0.17
Genesis Seed Fund	1987		2,000,000	2,000,000	815,687		-12.43%	0.41	0.18	0.15	0.03	-	-	6.76	13514053.88	0.33
Loyalhanna Venture Fund	1987		15,000,000	15,000,000	21,446,203		3.58%	1.43	1.35	1.13	0.23	-	-	10.16	152454931.2	2.48
CIGNA	1988	Private Equity	4,566,946	4,566,946	6,645,349		9.21%	1.46	0.41	0.34	0.07	0.05	0.52	4.26	19442545.51	0.53
CEO Venture Fund II, L.P.	1989		15,000,000	15,000,000	10,651,730		-4.17%	0.71	1.35	1.13	0.23	-	-	8.04	120553840.4	2.48
Edison II-PA Venture Fund	1991		10,000,000	10,000,000	25,972,603		22.19%	2.60	0.90	0.75	0.15	-	3.99	4.76	47625933.36	1.65
Commonwealth Capital Ventures II, L.P.	1992		10,000,000	10,000,000	15,214,766		15.10%	1.52	0.90	0.75	0.15	-	1.30	2.98	29842703.49	1.65
Landmark Equity Partners II, L.P.	1992		25,000,000	25,000,000	39,042,318		24.34%	1.56	2.25	1.88	0.38	-	3.51	2.05	51155749.88	4.13
NEPA Venture Fund II	1992		5,000,000	5,000,000	23,252,576	1,102,463	38.03%	4.87	0.45	0.38	0.08	-	4.84	4.91	24562466.61	0.83
Technology Leaders, L.P.	1992		10,000,000	10,000,000	22,111,898		23.24%	2.21	0.90	0.75	0.15	-	3.03	3.80	37974612.23	1.65
Grotech Capital Partners IV, L.P.	1993		25,000,000	25,000,000	44,210,693		15.67%	1.77	2.25	1.88	0.38	-	4.80	3.92	97905897.31	4.13
Keystone Venture Fund IV, L.P.	1993		7,766,667	7,766,666	5,904,516		-8.41%	0.76	0.70	0.58	0.12	-	-	3.12	24235309.91	1.28
Landmark Equity Partners III, LP	1993	Private Equity	27,085,010	27,085,010	76,454,209		33.81%	2.82	2.44	2.03	0.41	0.33	12.34	3.56	96502524.86	3.17
P/A Fund	1993		30,000,000	30,000,000	66,835,233		18.83%	2.23	2.70	2.25	0.45	-	9.21	4.64	139290938	4.95
TDH III, L.P.	1993		7,350,750	7,350,750	4,874,316		-5.23%	0.66	0.66	0.55	0.11	-	-	7.65	56217548.73	1.21
TPG Partners, L.P.	1993	Private Equity	24,194,356	24,465,437	89,300,776		36.55%	3.65	2.18	1.83	0.36	0.29	16.21	4.16	101683768.8	2.84
Bastion Capital Fund, LP	1994	Private Equity	12,500,000	12,246,895	24,148,319		18.93%	1.97	1.13	0.92	0.19	0.15	2.98	3.92	47962047.42	1.46
Edison Venture Fund III, L.P.	1994		14,807,690	14,807,690	28,785,013		18.19%	1.94	1.33	1.11	0.22	-	3.49	3.98	58895394.19	2.44
Green Equity Investors II, L.P.	1994	Private Equity	25,000,000	24,151,005	50,916,127		14.40%	2.11	2.25	1.81	0.38	0.29	6.69	5.54	133895765	2.90
Heritage Fund I, L.P.	1994	Private Equity	25,000,000	24,999,999	24,755,484		-0.46%	0.99	2.25	1.87	0.38	0.30	-	2.13	53294134.59	2.92
Keystone Minority Capital Fund	1994		114,865	114,865	15,365		-15.91%	0.13	0.01	0.01	0.00	-	-	11.61	1333486.62	0.02
Landmark Equity Partners IV, LP	1994	Private Equity	10,533,687	10,254,032	15,424,239		16.66%	1.50	0.95	0.77	0.16	0.12	1.29	2.65	27167952.45	1.22
Spectrum Equity Investors, L.P.	1994		25,000,000	25,000,000	52,261,392		23.59%	2.09	2.25	1.88	0.38	-	6.82	3.48	87037769.96	4.13
Bruckmann, Rosser, Sherrill & Co. L.P.	1995	Private Equity	25,000,000	24,465,163	44,580,173		10.37%	1.82	2.25	1.83	0.38	0.29	5.03	6.08	148782045.9	2.91
Franklin Capital Associates III, L.P.	1995		15,000,000	15,000,000	14,558,465		-0.33%	0.97	1.35	1.13	0.23	-	-	9.04	135583020.6	2.48
Landmark Equity Partners V, L.P.	1995		49,060,283	48,481,948	59,280,814	558,511	8.33%	1.23	4.42	3.64	0.74	-	2.84	2.63	127531841.9	8.05
Landmark Mezzanine Partners	1995	Private Equity	75,000,000	59,315,512	107,968,551		28.73%	1.82	6.75	4.45	1.13	0.71	12.16	2.37	140679400.6	8.35
ABS Capital Partners II, L.P.	1996	Private Equity	40,000,000	39,291,734	45,555,770	262,157	6.71%	1.17	3.60	2.95	0.60	0.47	-	2.37	92965534	4.66
GS Mezzanine Partners, LP	1996	Private Equity	30,000,000	26,883,828	39,260,072		8.82%	1.46	2.70	2.02	0.45	0.32	3.09	4.48	120443146	3.43
Lexington Capital Partners I, L.P.	1996	Private Equity	50,000,000	49,613,120	62,975,030	26,896	13.16%	1.27	4.50	3.72	0.75	0.60	3.35	1.93	95873365.29	5.84
SCP Private Equity Partners I, L.P.	1996		62,500,000	6,285,918	43,172,864	76,262	61.96%	6.88	5.63	0.47	0.94	-	9.24	4.00	25143672	6.10
U.S. Equity Partners, L.P.	1996	Private Equity	75,000,000	76,336,235	69,738,856		-1.56%	0.91	6.75	5.73	1.13	0.92	-	5.75	438851141.4	8.81
Willis Stein & Partners, L.P.	1996	Private Equity	25,000,000	25,004,635	53,581,016		20.65%	2.14	2.25	1.88	0.38	0.30	7.14	4.06	101515591.7	2.93
Adams Capital Management, L.P.	1997		12,500,000	12,500,000	22,671,838	229,585	44.80%	1.83	1.13	0.94	0.19	-	2.60	1.64	20444953.01	2.06
BG Media International Investors	1997		25,000,000	24,729,264	21,119,037		-2.40%	0.85	2.25	1.85	0.38	0.30	-	6.50	160648554.6	2.92
Credit Suisse First Boston Intl. Equity Part	1997	Private Equity	100,000,000	76,663,758	95,813,877		5.22%	1.25	9.00	5.75	1.50	0.92	-	4.38	335952972.8	11.07
Lehman Brothers Merchant Banking Partn	1997	Private Equity	158,552,133	168,556,341	220,371,513		5.72%	1.31	14.27	12.64	2.38	2.02	-	4.82	812252290.9	18.82
TL Ventures III, L.P.	1997		50,000,000	50,000,000	69,245,707		24.67%	1.38	4.50	3.75	0.75	-	4.81	1.48	73840828.98	8.25
TPG Partners II, L.P.	1997	Private Equity	50,000,000	53,854,393	91,361,723		9.93%	1.70	4.50	4.04	0.75	0.65	9.38	5.58	300657609.2	5.95
Bridgepoint Capital II (Secondary)	1998	Private Equity	84,714,906	81,290,641	166,312,361	368,128	18.65%	2.05	7.62	6.10	1.27	0.98	21.35	4.20	341332797.9	9.82
Bridgepoint Europe I	1998	Private Equity	79,622,624	75,126,567	135,823,089	222,058	12.43%	1.81	7.17	5.63	1.19	0.90	15.23	5.07	380768707.6	9.19
Credit Suisse First Boston Equity Partners,	1998	Private Equity	137,172,500	114,737,213	32,970,843		-16.26%	0.29	12.35	8.61	2.06	1.38	-	7.03	806294321.8	15.44



Edgewater Private Equity Fund III	1998	Private Equity	39,000,000	39,000,000	23,129,095	-7.85%	0.59	3.51	2.93	0.59	0.47	-	6.39	249244257.1	4.56	
Furman Selz Investors II, L.P.	1998	Private Equity	56,250,000	55,816,077	96,375,368	11.53%	1.73	5.06	4.19	0.84	0.67	10.14	5.01	279372739.6	6.57	
Greenwich Street Capital Partners II, L.P.	1998	Private Equity	200,000,000	216,105,302	214,588,348	-0.13%	0.99	18.00	16.21	3.00	2.59	-	5.42	1170241134	23.83	
Morgan Stanley DW Capital Partners IV, L.P.	1998	Private Equity	300,000,000	236,925,618	477,873,353	263,255	16.87%	2.02	27.00	17.77	4.50	2.84	60.30	4.50	1067132104	33.40
Novitas Capital, L.P.	1998	Venture Capital	30,000,000	29,952,000	34,686,498	979,388	9.26%	1.19	2.70	2.25	0.45	-	1.43	1.97	59051101.41	4.95
Sunnrise Capital Partners, L.P.	1998	Private Equity	57,388,755	57,104,502	20,834,805	-15.59%	0.36	5.16	4.28	0.86	0.69	-	5.95	339713302.3	6.71	
Cross Atlantic Technology Fund, L.P.	1999	Venture Capital	30,141,666	30,357,584	35,781,536	1,557,812	2.78%	1.23	2.71	2.28	0.45	-	7.55	229172977.4	4.99	
Deutsche European Partners IV	1999	Private Equity	200,000,000	180,960,550	224,577,100	6.41%	1.24	18.00	13.57	3.00	2.17	-	3.48	628955758.2	22.89	
Graham Partners	1999	Private Equity	56,671,214	61,946,457	82,648,447	5.47%	1.33	5.10	4.65	0.85	0.74	-	5.41	335373060.4	6.77	
Halifax Capital Partners	1999	Private Equity	50,000,000	39,967,488	63,972,891	11.77%	1.60	4.50	3.00	0.75	0.48	6.00	4.23	168957697.3	5.58	
KBL Partnership, L.P.	1999	Venture Capital	13,743,333	13,711,864	6,919,745	3,580,033	-3.37%	0.77	1.24	1.03	0.21	-	7.79	106758964.1	2.27	
KRG Capital Partners I, L.P.	1999	Private Equity	50,000,000	43,261,578	91,634,458	17.75%	2.12	4.50	3.24	0.75	0.52	12.09	4.59	198720529.6	5.67	
Lehman Brothers Communications Partne	1999	Venture Capital	12,500,000	11,442,260	5,210,205	-13.81%	0.46	1.13	0.86	0.19	-	-	5.29	60569248.51	1.98	
LLR Equity Partners, L.P.	1999	Venture Capital	62,500,000	61,344,870	131,553,825	53,649	21.74%	2.15	5.63	4.60	0.94	17.57	3.88	238033252.9	10.23	
New York Life Capital Partners I, L.P.	1999	Private Equity	200,000,000	205,005,869	226,525,069	2,092,489	1.85%	1.12	18.00	15.38	3.00	2.46	5.95	1219144714	23.54	
StarVest	1999	Venture Capital	67,500,000	65,659,367	113,383,601	503,562	7.38%	1.73	6.08	4.92	1.01	-	7.73	507844600.5	11.00	
Wicks Communications and Media Partne	1999	Private Equity	87,500,000	88,993,376	115,304,727	8.57%	1.30	7.88	6.67	1.31	1.07	6.58	3.15	280337708.5	10.28	
Avenue Special Situations Fund II, L.P.	2000	Special Situations	125,000,000	126,838,089	199,775,750	19.22%	1.58	11.25	9.51	1.88	-	18.23	2.58	327761184.6	20.76	
Clarity Partners L.P.	2000	Private Equity	203,590,000	204,760,392	150,711,218	-6.93%	0.74	18.32	15.36	3.05	2.46	-	4.27	873787576	23.85	
Co-Investment 2000 Fund, L.P.	2000	Venture Capital	135,000,000	135,000,000	200,274,616	16,562,657	7.82%	1.61	12.15	10.13	2.03	-	6.29	849651196.5	22.28	
DLJ Merchant Banking Partners III, L.P.	2000	Private Equity	300,000,000	310,668,837	671,148,994	20.27%	2.16	27.00	23.30	4.50	3.73	90.12	4.17	1296517149	35.39	
Dubin Clark Fund II, L.P.	2000	Private Equity	24,083,333	23,706,041	27,060,085	1.99%	1.14	2.17	1.78	0.36	0.28	-	6.72	159202399.5	2.81	
Furman Selz Investors III, L.P.	2000	Private Equity	100,000,000	95,025,051	206,864,610	22.58%	2.18	9.00	7.13	1.50	1.14	27.96	3.82	363087206.4	11.57	
GSC Recovery II, L.P.	2000	Special Situations	280,000,000	279,170,771	430,042,246	364,060	10.14%	1.54	25.20	20.94	4.20	-	37.81	4.48	1251315718	46.14
Irving Place Capital MB-PSERS II, L.P.	2000	Private Equity	300,000,000	285,338,979	461,742,652	7,197,845	12.54%	1.64	27.00	21.40	4.50	3.42	45.90	4.21	1199912008	34.70
New Mountain Partners, L.P.	2000	Private Equity	192,509,033	161,121,249	243,188,690	13.69%	1.51	17.33	12.08	2.89	1.93	20.52	3.21	516973897.5	21.68	
Novitas Capital II, L.P.	2000	Venture Capital	75,000,000	74,775,000	16,507,112	1,646,649	-15.71%	0.24	6.75	5.61	1.13	-	8.28	619354134.1	12.36	
Palladium Equity Partners II-A, L.P.	2000	Private Equity	57,750,000	65,063,804	84,652,715	57,705,135	8.79%	2.19	5.20	4.88	0.87	0.78	19.32	9.29	604674577	6.95
SCP Private Equity Partners II, L.P.	2000	Venture Capital	125,000,000	129,745,343	41,010,860	18,964,221	-8.14%	0.46	11.25	9.73	1.88	-	9.09	1179175050	20.98	
Sterling Venture Partners I, L.P.	2000	Venture Capital	33,986,000	36,115,022	39,138,810	223,913	1.61%	1.09	3.06	2.71	0.51	-	5.39	194710875.3	5.77	
Avenue Asia Special Situations Fund II, L.P.	2001	Special Situations	220,000,000	220,000,000	413,276,527	21.47%	1.88	19.80	16.50	3.30	-	48.32	3.24	713160454	36.30	
Blue Point Capital Partners I, L.P.	2001	Private Equity	103,750,000	91,140,153	143,028,571	216,686	12.08%	1.57	9.34	6.84	1.56	1.09	13.03	3.96	361355051.9	11.80
Bridgepoint Europe II, L.P.	2001	Private Equity	317,885,713	313,199,355	607,586,316	6,122,484	29.41%	1.96	28.61	23.49	4.77	3.76	75.13	2.61	817185801.3	37.07
Cerberus Institutional Partners L.P. (Series	2001	Special Situations	200,000,000	173,047,901	539,461,950	586,369	27.08%	3.12	18.00	12.98	3.00	-	91.75	4.75	821810518.6	30.98
Cross Atlantic Technology Fund II, L.P.	2001	Venture Capital	21,119,734	21,119,734	21,394,134	340,247	0.47%	1.03	1.90	1.58	0.32	-	6.12	129211806.8	3.48	
Edgewater Growth Capital Partners, L.P.	2001	Private Equity	59,196,500	59,196,500	77,379,658	6.58%	1.31	5.33	4.44	0.89	0.71	-	4.20	248823727.4	6.93	
Gleacher Mezzanine Fund I, L.P.	2001	Special Situations	75,000,000	63,450,304	95,943,900	20.30%	1.51	6.75	4.76	1.13	-	8.12	2.24	141961612.3	11.51	
GSC Partners CDO Investors III, L.P.	2001	Special Situations	80,000,000	80,000,000	146,903,688	18.58%	1.84	7.20	6.00	1.20	-	16.73	3.57	285299343.4	13.20	
KRG Capital Fund II (PA) L.P.	2001	Private Equity	100,000,000	79,636,623	119,983,431	22.08%	1.51	9.00	5.97	1.50	0.96	10.09	2.05	163610936.1	11.15	
New York Life Capital Partners II, L.P.	2001	Private Equity	200,000,000	194,688,538	550,331,205	3,057,195	32.47%	2.84	18.00	14.60	3.00	2.34	89.67	3.72	723304618.9	23.26
PAI Europe III	2001	Private Equity	333,547,528	335,956,000	1,112,343,391	38.15%	3.31	30.02	25.20	5.00	4.03	194.10	3.70	1244612693	39.09	
Perseus-Soros BioPharmaceutical Fund, L.	2001	Venture Capital	112,206,666	124,112,299	202,156,748	337,000	20.27%	1.63	10.10	9.31	1.68	-	19.60	2.65	329176180	19.41
PNC Equity Partners, L.P.	2001	Private Equity	43,154,458	39,619,636	77,501,909	141,300	21.11%	1.96	3.88	2.97	0.65	0.48	9.51	3.51	139175036.6	4.95
Quadrangle Capital Partners, L.P.	2001	Private Equity	270,422,415	225,438,094	386,739,733	11.07%	1.72	24.34	16.91	4.06	2.71	40.33	5.14	1158870867	30.42	
Strategic Feeder, L.P.	2001	Private Equity	200,000,000	194,687,388	308,973,117	16.81%	1.59	18.00	14.60	3.00	2.34	28.57	2.97	578703946.2	23.26	
Avenue Special Situations III, L.P.	2002	Special Situations	205,156,000	152,853,651	259,715,762	18.53%	1.70	18.46	11.46	3.08	-	26.72	3.12	476651307.4	29.93	
Lindsay Goldberg & Bessemer, L.P.	2002	Private Equity	300,000,000	312,986,446	732,620,207	109,344	34.18%	2.34	27.00	23.47	4.50	3.76	104.94	2.89	905512456	35.45
Sterling Capital Partners, L.P.	2002	Private Equity	75,000,000	84,393,474	163,071,264	8,450,469	18.04%	2.03	6.75	6.33	1.13	1.01	21.78	4.28	360882228.5	9.03
U.S. Equity Partners II, L.P.	2002	Private Equity	300,000,000	222,858,123	400,784,550	14.12%	1.80	27.00	16.71	4.50	2.67	44.48	4.44	990252622.1	33.02	

Avenue Asia Special Situations Fund III, L.P.	2003	Special Situations	100,000,000	76,892,230	114,952,589		8.41%	1.49	9.00	5.77	1.50	-	9.52	4.98	382903496.5	14.77
Cerberus Institutional Partners, L.P. - Series A	2003	Special Situations	100,000,000	81,055,777	155,809,765	5,847,414	12.88%	1.99	9.00	6.08	1.50	-	20.15	5.70	461854819.6	15.08
GSC Partners CDO Investors IV, L.P.	2003	Special Situations	80,000,000	80,000,000	114,506,209		7.17%	1.43	7.20	6.00	1.20	-	-	5.18	414292833.5	13.20
Jefferson Partners Fund IV, L.P.	2003	Venture Capital	24,389,194	24,581,511	219,088		-54.80%	0.01	2.20	1.84	0.37	-	-	5.94	146136377.7	4.04
NYLIM Mezzanine Partners (Parallel Fund) I, L.P.	2003	Special Situations	75,000,000	69,106,090	91,497,156	1,489,132	9.90%	1.35	6.75	5.18	1.13	-	5.97	3.14	217279398.8	11.93
Quaker Bio-Ventures, L.P.	2003	Venture Capital	69,350,000	69,458,692	27,445,322	577,854	-13.65%	0.40	6.24	5.21	1.04	-	-	6.18	429593107.8	11.45
Strategic Partners Fund II, L.P.	2003	Private Equity	300,000,000	264,923,968	471,221,398	1,811,826	34.15%	1.79	27.00	19.87	4.50	3.18	52.03	1.97	522765560.1	34.15
Tenaya Capital IV-P, L.P.	2003	Venture Capital	75,000,000	72,679,657	82,032,212	36,545,447	7.72%	1.63	6.75	5.45	1.13	-	-	6.58	478412298	12.20
Allegheny New Mountain Partners, L.P.	2004	Private Equity	100,000,000	84,637,408	171,742,050	1,783,626	14.23%	2.05	9.00	6.35	1.50	1.02	22.22	5.40	456732099.9	11.29
Catterton Partners V, L.P.	2004	Private Equity	100,000,000	101,386,111	135,110,453	9,501,709	5.77%	1.43	9.00	7.60	1.50	1.22	-	6.33	641822780.8	11.74
Gold Hill Venture Lending O3, L.P.	2004	Special Situations	50,000,000	50,000,000	80,272,865	1,380,094	10.75%	1.63	4.50	3.75	0.75	-	7.91	4.80	240171383.6	8.25
LLR Equity Partners II, L.P.	2004	Venture Capital	75,000,000	75,003,401	122,831,303	12,753,401	12.48%	1.81	6.75	5.63	1.13	-	15.15	5.03	377591558.8	12.38
Milestone Partners II, L.P.	2004	Private Equity	29,890,000	27,844,247	42,050,676	2,323,258	17.28%	1.59	2.69	2.09	0.45	0.33	4.13	2.92	81409178.85	3.44
Platinum Equity Capital Partners, L.P.	2004	Private Equity	125,000,000	97,797,352	250,768,934	8,577,160	59.96%	2.65	11.25	7.33	1.88	1.17	40.39	2.08	203039267.3	13.89
Baring Asia Private Equity Fund III, L.P.	2005	Private Equity	122,500,000	142,650,592	291,823,625	56,923,551	52.38%	2.44	11.03	10.70	1.84	1.71	51.52	2.12	302754441.6	14.88
Bridgepoint Europe III, L.P.	2005	Private Equity	269,841,089	249,204,792	161,569,387	139,972,984	2.64%	1.21	24.29	18.69	4.05	2.99	-	7.32	1823168897	31.01
Crestview Capital Partners	2005	Private Equity	150,000,000	154,361,773	226,159,577	17,807,227	7.36%	1.58	13.50	11.58	2.25	1.85	-	6.45	994916920.3	17.67
Evergreen Pacific Partners, L.P.	2005	Private Equity	50,000,000	39,104,137	5,292,828		-99.99%	0.14	4.50	2.93	0.75	0.47	-	0.22	8490827.171	5.56
GSC Recovery III (Parallel Fund), L.P.	2005	Special Situations	200,000,000	201,932,340	252,992,547	10,592,499	6.45%	1.31	18.00	15.14	3.00	-	-	4.26	860784873.3	33.14
Jefferies Capital Partners IV, L.P.	2005	Private Equity	100,000,000	95,270,050	108,935,198		2.85%	1.14	9.00	7.15	1.50	1.14	-	4.77	454417388.7	11.57
KRG Capital Fund III, (PA) L.P.	2005	Private Equity	88,000,000	88,076,832	77,248,244		-2.67%	0.88	7.92	6.61	1.32	1.06	-	4.85	426945406.3	10.30
New York Life Capital Partners III-A, L.P.	2005	Private Equity	200,000,000	218,620,077	168,329,133	34,937,593	-1.11%	0.93	18.00	16.40	3.00	2.62	-	6.52	1426180768	23.90
PAI Europe IV	2005	Private Equity	128,401,669	131,323,378	178,840,213	14,243,218	9.15%	1.47	11.56	9.85	1.93	1.58	15.44	4.40	578163074.6	15.10
Quadrangle Capital Partners II, L.P.	2005	Private Equity	250,000,000	227,201,835	296,569,830		5.70%	1.31	22.50	17.04	3.75	2.73	-	4.81	1092033418	28.63
Strategic Partners Fund III VC, L.P.	2005	Venture Capital	50,000,000	56,312,951	61,676,335	13,213,686	6.28%	1.33	4.50	4.22	0.75	-	-	4.68	263592365.9	8.72
Strategic Partners Fund III-B, L.P.	2005	Private Equity	200,000,000	218,355,603	260,001,884	34,969,200	6.39%	1.35	18.00	16.38	3.00	2.62	-	4.86	1060211233	23.90
Versa Capital Fund I, L.P.	2005	Special Situations	75,000,000	88,545,177	61,946,810	42,734,408	3.85%	1.18	6.75	6.64	1.13	-	-	4.43	392379576.5	13.39
Aisling Capital II, L.P.	2006	Venture Capital	50,000,000	58,965,264	45,112,590	12,421,943	-0.46%	0.98	4.50	4.42	0.75	-	-	5.33	314139297.3	8.92
Avenue Asia Special Situations Fund IV, L.P.	2006	Special Situations	300,000,000	225,070,059	239,670,405	6,571,185	1.96%	1.09	27.00	16.88	4.50	-	-	4.63	1042437053	43.88
Avenue Special Situations Fund IV, L.P.	2006	Special Situations	115,000,000	144,782,669	189,601,502	434,870	8.39%	1.31	10.35	10.86	1.73	-	11.31	3.38	488772048.3	21.21
Catterton Partners VI, L.P.	2006	Private Equity	130,000,000	147,418,375	180,226,813	88,929,010	12.14%	1.83	11.70	11.06	1.95	1.77	30.43	5.25	774566423.5	15.68
Cerberus Institutional Partners, L.P. (Series B)	2006	Special Situations	400,000,000	369,661,873	530,150,585	108,202,068	8.85%	1.73	36.00	27.72	6.00	-	67.17	6.44	2381434458	63.72
Co-Investment Fund II, L.P.	2006	Venture Capital	135,000,000	134,325,000	41,241,732	109,352,855	1.72%	1.12	12.15	10.07	2.03	-	-	6.70	900520822.4	22.22
First Reserve Fund XI, L.P.	2006	Private Equity	200,000,000	213,209,232	140,355,363		-9.68%	0.66	18.00	15.99	3.00	2.56	-	4.11	875561543.6	23.76
Irving Place Capital III SPV, L.P.	2006	Private Equity	150,000,000	153,479,615	113,640,309	100,442,305	5.99%	1.39	13.50	11.51	2.25	1.84	-	5.72	877997646.9	17.64
KKR 2006 Fund, L.P.	2006	Private Equity	300,000,000	299,054,703	408,221,889		6.52%	1.37	27.00	22.43	4.50	3.59	-	4.93	1473358981	35.07
Landmark Equity Partners XIII, L.P.	2006	Private Equity	100,000,000	96,088,084	94,349,668	27,715,720	5.13%	1.27	9.00	7.21	1.50	1.15	-	4.78	459608616.6	11.59
NYLIM Mezzanine Partners II (Parallel Fund) I, L.P.	2006	Special Situations	150,000,000	166,079,837	204,550,868	5,149,973	6.88%	1.26	13.50	12.46	2.25	-	-	3.51	582116852.5	25.96
Permira IV, L.P.	2006	Private Equity	169,966,588	167,234,080	231,025,324	37,078,287	8.68%	1.60	15.30	12.54	2.55	2.01	25.22	5.67	948261077.5	19.81
TPG Partners V, L.P.	2006	Private Equity	250,000,000	261,876,873	307,855,529		3.11%	1.18	22.50	19.64	3.75	3.14	-	5.28	1383136285	29.57
Windjammer Senior Equity Fund III, L.P.	2006	Special Situations	50,000,000	45,230,610	87,739,336	13,470,335	19.01%	2.24	4.50	3.39	0.75	-	13.99	4.63	209320882.5	7.89
Actis Emerging Markets 3, L.P.	2007	Private Equity	200,000,000	221,002,062	190,013,443	49,115,000	1.92%	1.08	18.00	16.58	3.00	2.65	-	4.14	916043785.7	23.97
Apax Europe VII-A, L.P.	2007	Private Equity	277,238,578	289,821,881	304,041,648	99,244,392	6.40%	1.39	24.95	21.74	4.16	3.48	-	5.33	1543493528	32.78
Avenue Special Situations Fund V, L.P.	2007	Special Situations	300,000,000	301,785,852	399,310,776	391,076	11.07%	1.32	27.00	22.63	4.50	-	24.48	2.68	807713450.9	49.63
Baring Asia Private Equity Fund IV, L.P.	2007	Private Equity	300,000,000	299,036,096	209,373,609	286,998,748	8.90%	1.66	27.00	22.43	4.50	3.59	49.33	5.94	1777391863	35.07
Blue Point Capital Partners II, L.P.	2007	Private Equity	100,000,000	92,540,501	166,930,524	47,239,573	18.90%	2.31	9.00	6.94	1.50	1.11	30.41	4.85	448569087.9	11.50
Capital International Private Equity Fund V, L.P.	2007	Private Equity	200,000,000	204,785,901	182,602,895	11,504,837	-1.48%	0.95	18.00	15.36	3.00	2.46	-	3.59	735492105	23.53
Cinven Fourth Fund	2007	Private Equity	201,482,814	206,669,064	270,786,940	20,964,850	7.00%	1.41	18.13	15.50	3.02	2.48	-	5.10	1053173774	23.71
Gleacher Mezzanine Fund II, L.P.	2007	Special Situations	100,000,000	91,977,798	121,870,338	681,218	10.61%	1.33	9.00	6.90	1.50	-	7.64	2.85	261762472.7	15.90



KRG Capital Fund IV, L.P.	2007	Private Equity	300,000,000	287,028,332	337,445,210		6.26%	1.18	27.00	21.53	4.50	3.44	-	2.67	764962644.2	34.75
Navis Asia Fund V, L.P.	2007	Private Equity	100,000,000	121,024,807	181,335,725		8.83%	1.50	9.00	9.08	1.50	1.45	15.08	4.78	578335646.7	12.27
New Mountain Partners III, L.P.	2007	Private Equity	300,000,000	303,474,150	332,455,016	246,208,764	13.79%	1.91	27.00	22.76	4.50	3.64	68.80	5.00	1516202968	35.19
OCM Opportunities Fund VII, L.P.	2007	Special Situations	75,000,000	75,000,000	96,363,822	6,760,731	7.49%	1.37	6.75	5.63	1.13	-	-	4.41	330672672.2	12.38
Partners Group Secondary 2008 S.C.A., SK	2007	Private Equity	200,772,150	178,459,488	219,934,855	42,969,268	8.87%	1.47	18.07	13.38	3.01	2.14	21.11	4.56	813563762.1	22.89
Platinum Equity Capital Partners II, L.P.	2007	Private Equity	300,000,000	282,375,537	385,761,971	112,308,446	14.70%	1.76	27.00	21.18	4.50	3.39	53.92	4.14	1168423770	34.62
PNC Equity Partners II, L.P.	2007	Private Equity	68,065,386	59,157,106	108,317,934	10,105,863	14.07%	2.00	6.13	4.44	1.02	0.71	14.82	5.27	311901326	7.72
Providence Equity Partners VI, L.P.	2007	Private Equity	300,000,000	316,291,227	403,436,046		5.69%	1.28	27.00	23.72	4.50	3.80	-	4.40	1390870755	35.54
Psilos Group Partners III, L.P.	2007	Venture Capital	62,500,000	64,471,078	32,146,734	52,906,930	4.90%	1.32	5.63	4.84	0.94	-	-	5.79	373405521.9	10.46
Quaker BioVentures II, L.P.	2007	Venture Capital	100,000,000	95,153,932	68,423,489	39,283,050	3.14%	1.13	9.00	7.14	1.50	-	-	4.01	381372751.6	16.14
StarVest Partners II (Parallel), L.P.	2007	Venture Capital	50,000,000	49,143,950	10,263,263	36,732,459	-0.83%	0.96	4.50	3.69	0.75	-	-	5.36	263550236.3	8.19
StepStone International Investors III L.P.	2007	Private Equity	139,654,310	137,023,257	96,302,048	22,277,120	-2.89%	0.87	12.57	10.28	2.09	1.64	-	4.93	675494331.9	16.27
Tenaya Capital V-P, L.P.	2007	Venture Capital	75,000,000	68,800,806	88,826,978	43,210,941	17.21%	1.92	6.75	5.16	1.13	-	15.81	4.11	282432487.5	11.91
Trilantic Capital Partners IV L.P.	2007	Private Equity	76,752,676	79,140,339	110,980,173	17,296,178	14.53%	1.62	6.91	5.94	1.15	0.95	12.28	3.56	281734399.1	9.04
Aisling Capital III, L.P.	2008	Venture Capital	50,000,000	55,758,405	65,148,673	38,709,917	23.77%	1.86	4.50	4.18	0.75	-	12.03	2.92	162631003.1	8.68
Avenue Europe Special Situations Fund, L.P.	2008	Special Situations	203,579,414	260,544,517	362,645,255		12.18%	1.39	18.32	19.54	3.05	-	25.53	2.88	749551878.8	37.86
Bridgepoint Europe IV, L.P.	2008	Private Equity	400,647,075	370,761,035	376,288,428	211,748,659	11.59%	1.59	36.06	27.81	6.01	4.45	54.32	4.21	1559410903	46.07
Catterton Growth Partners, L.P.	2008	Private Equity	75,000,000	92,996,496	78,123,852	63,716,303	9.52%	1.53	6.75	6.97	1.13	1.12	12.21	4.64	431699356.3	9.26
Clarity PSERS II, L.P.	2008	Private Equity	17,386,250	12,225,121	2,451,273		-28.86%	0.20	1.56	0.92	0.26	0.15	-	4.72	57689254.32	1.89
CVC Capital Partners Asia Pacific III, L.P.	2008	Private Equity	300,000,000	295,760,392	407,869,886	72,613,080	13.87%	1.62	27.00	22.18	4.50	3.55	46.18	3.74	1104922868	34.99
CVC European Equity Partners V, L.P.	2008	Private Equity	393,205,903	432,823,008	548,539,546	181,322,392	14.79%	1.69	35.39	32.46	5.90	5.19	74.26	3.79	1639633359	47.07
Evergreen Pacific Partners II, L.P.	2008	Private Equity	80,954,545	69,295,755	112,366,281	22,192,997	20.04%	1.94	7.29	5.20	1.21	0.83	16.32	3.63	251765199.2	9.16
First Reserve Fund XII, L.P.	2008	Private Equity	250,000,000	271,961,621	120,621,735	71,283,066	-8.74%	0.71	22.50	20.40	3.75	3.26	-	3.81	1036792412	29.84
Headland Private Equity Fund 6 Ltd.	2008	Private Equity	200,000,000	187,330,868	215,392,572		5.08%	1.15	18.00	14.05	3.00	2.25	-	2.82	527705450.5	23.06
Landmark Equity Partners XIV, L.P.	2008	Private Equity	150,000,000	141,169,667	129,718,251	57,619,167	10.56%	1.33	13.50	10.59	2.25	1.69	11.54	2.82	397893481.3	17.31
LLR Equity Partners III, L.P.	2008	Venture Capital	187,500,000	168,296,850	193,061,392	94,707,366	14.66%	1.71	16.88	12.62	2.81	-	29.87	3.92	659930044	29.50
Milestone Partners III, L.P.	2008	Private Equity	60,000,000	61,078,376	53,308,563	7,994,934	0.07%	1.00	5.40	4.58	0.90	0.73	-	5.26	321122546.5	7.05
New York Life Capital Partners IV-A L.P.	2008	Private Equity	100,000,000	109,029,901	159,311,262	41,681,091	13.80%	1.84	9.00	8.18	1.50	1.31	22.99	4.73	515868769.5	11.94
Nordic Capital VII Beta, L.P.	2008	Private Equity	166,973,378	187,621,305	230,587,380		5.34%	1.23	15.03	14.07	2.50	2.25	-	3.96	743676755.7	20.09
OCM Opportunities Fund VII-B, L.P.	2008	Special Situations	225,500,000	202,500,000	332,209,087	16,890,781	16.64%	1.72	20.25	15.19	3.38	-	36.65	3.54	716500021.5	35.44
PAI Europe V	2008	Private Equity	135,590,427	127,523,536	145,455,466	54,252,127	8.03%	1.57	12.20	9.56	2.03	1.53	18.05	5.81	740574941.2	15.65
Strategic Partners Fund IV VC, L.P.	2008	Venture Capital	50,000,000	57,690,876	62,085,664	16,873,812	7.76%	1.37	4.50	4.33	0.75	-	-	4.20	242257735.3	8.83
Strategic Partners Fund IV, L.P.	2008	Private Equity	100,000,000	95,277,862	128,399,284	23,591,114	13.45%	1.60	9.00	7.15	1.50	1.14	14.18	3.70	352610665.3	11.57
TPG Partners VI, L.P.	2008	Private Equity	360,000,000	364,618,439	486,773,394		10.75%	1.34	32.40	27.35	5.40	4.38	30.54	2.83	1031832650	42.24
Versa Capital Fund II, L.P.	2008	Special Situations	150,000,000	166,533,012	61,987,088	115,015,414	1.74%	1.06	13.50	12.49	2.25	-	-	3.53	588600639	25.99
Crestview Partners II, L.P.	2009	Private Equity	200,000,000	223,862,451	208,740,494	184,043,441	15.54%	1.75	18.00	13.43	3.00	2.69	42.23	3.89	871337266.4	20.69
Avenue Special Situations Fund VI, L.P.	2010	Special Situations	75,000,000	76,892,726	65,419,325	15,155,266	1.15%	1.05	6.75	3.46	1.13	-	-	4.09	314528003.3	10.21
Baring Asia Private Equity Fund V, L.P.	2011	Private Equity	200,000,000	258,860,880	115,909,119	212,474,816	9.25%	1.27	18.00	7.77	3.00	3.11	17.38	2.69	696078335.4	13.34
Capital International Private Equity Fund V	2011	Private Equity	100,000,000	85,968,947	8,836,449	67,436,396	-4.09%	0.89	9.00	2.58	1.50	1.03	-	2.87	246356536	7.45
Coller International Partners VI, L.P.	2011	Private Equity	100,000,000	70,276,733	41,954,887	62,581,134	15.55%	1.49	9.00	2.11	1.50	0.84	8.56	2.75	193078566.3	7.74
Denham Commodity Partners Fund VI, L.F.	2011	Private Equity	75,000,000	67,984,011	26,474,674	54,574,900	9.56%	1.19	6.75	2.04	1.13	0.82	3.27	1.93	130892893.7	5.53
Incline Equity Partners III, L.P.	2011	Private Equity	65,000,000	52,705,864	58,196,745	33,978,835	30.25%	1.75	5.85	1.58	0.98	0.63	9.87	2.12	111473838.6	4.90
Milestone Partners IV, L.P.	2011	Private Equity	70,000,000	62,854,885	3,266,308	90,951,315	12.74%	1.50	6.30	1.89	1.05	0.75	7.84	3.38	212171148.4	5.17
Orchid Asia V, L.P.	2011	Private Equity	40,000,000	35,382,635	49,714,052	10,812,512	28.41%	1.71	3.60	1.06	0.60	0.42	6.29	2.15	75964603.44	2.96
Partners Group Secondary 2011 (USD), L.F.	2011	Private Equity	100,000,000	63,330,430	41,850,806	62,481,175	19.62%	1.65	9.00	1.90	1.50	0.76	10.25	2.79	176474096.1	7.86
Strategic Partners Fund V, L.P.	2011	Private Equity	150,000,000	117,397,311	134,562,779	56,146,102	21.10%	1.62	13.50	3.52	2.25	1.41	18.33	2.53	297520805.1	11.39
Actis Global 4, L.P.	2012	Private Equity	100,000,000	77,926,914	12,381,782	71,482,000	3.74%	1.08	9.00	1.17	1.50	0.94	-	2.00	155826845.5	6.43
Bain Capital Asia Fund II, L.P.	2012	Private Equity	100,000,000	97,500,000	68,580,185	102,766,489	23.46%	1.76	9.00	1.46	1.50	1.17	18.46	2.68	260853282.5	5.78
Catterton Partners VII, L.P.	2012	Private Equity	100,000,000	101,585,643	8,493,428	118,727,973	10.74%	1.25	9.00	1.52	1.50	1.22	6.41	2.21	224079747.3	5.65

Cerberus Institutional Partners V, L.P.	2012	Special Situations	200,000,000	212,359,277	111,375,046	219,522,197	14.24%	1.56	18.00	3.19	3.00	-	29.63	3.33	707477119.8	21.19
Cinven Fifth Fund, L.P.	2012	Private Equity	119,649,271	122,334,803	72,661,077	93,966,171	16.52%	1.36	10.77	1.84	1.79	1.47	11.07	2.02	247239802.6	6.73
GoldPoint Partners Co-Investment V, L.P.	2012	Private Equity	50,000,000	51,765,238	16,513,419	54,160,775	21.01%	1.37	4.50	0.78	0.75	0.62	4.73	1.63	84517339.38	2.79
NGP Natural Resources X, L.P.	2012	Private Equity	100,000,000	98,372,962	64,538,857	46,403,477	4.80%	1.13	9.00	1.48	1.50	1.18	-	2.56	252301815.1	5.75
Palladium Equity Partners IV, L.P.	2012	Private Equity	75,000,000	50,254,240	4,462,353	55,334,196	9.56%	1.19	6.75	0.75	1.13	0.60	2.39	1.90	95691624.22	5.09
PEIP #1	2012	PSERS Private Eq	14,999,081	6,188,176	18,877,139	6,809,914	50.86%	4.15	-	-	0.22	-	-	3.46	21420973.01	-
PEIP #2	2012	PSERS Private Eq	13,878,761	13,878,761	33,036,817	-	44.43%	2.38	-	-	0.21	-	-	2.36	32741359.15	-
PEIP #3	2012	PSERS Private Eq	10,000,000	10,000,000	3,651,097	14,528,692	15.43%	1.82	-	-	0.15	-	-	4.17	41655050	-
PEIP #4	2012	PSERS Private Eq	10,000,000	7,500,000	4,459,782	10,564,521	16.33%	2.00	-	-	0.15	-	-	4.59	34448751.65	-
Platinum Equity Capital Partners III, L.P.	2012	Private Equity	200,000,000	167,530,424	149,308,859	151,547,157	33.65%	1.80	18.00	2.51	3.00	2.01	33.33	2.02	338155719.6	12.47
Summit Partners Growth Equity Fund VIII,	2012	Venture Capital	100,000,000	106,235,469	48,159,118	117,493,379	21.72%	1.56	9.00	1.59	1.50	-	14.85	2.26	240105170.8	10.59
Summit Partners Venture Capital Fund III,	2012	Venture Capital	25,000,000	25,000,000	7,085,788	33,337,056	16.15%	1.62	2.25	0.38	0.38	-	3.86	3.21	80240456.49	2.63
Tenaya Capital VI, L.P.	2012	Venture Capital	50,000,000	43,133,075	-	41,867,627	-0.91%	0.97	4.50	0.65	0.75	-	-	3.26	140497737.3	5.15
Windjammer Senior Equity Fund IV, L.P.	2012	Special Situations	100,000,000	75,012,533	4,237,899	70,473,498	-0.19%	1.00	9.00	1.13	1.50	-	-	2.12	158660699.1	10.13
Apollo Investment Fund VIII, L.P.	2013	Special Situations	220,000,000	145,126,637	22,937,079	152,637,529	13.72%	1.21	19.80	-	3.30	-	7.61	1.48	214985050.5	19.80
Catterton Growth Partners II, L.P.	2013	Private Equity	75,000,000	73,853,446	-	88,759,019	7.90%	1.20	6.75	-	1.13	0.89	-	2.42	178568409.1	3.21
DCPF VI Oil and Gas Coinvestment Fund L	2013	Private Equity	25,000,000	21,522,070	4,625,060	30,446,000	32.23%	1.63	2.25	-	0.38	0.26	3.39	1.75	37617033.57	1.22
HgCapital 7, L.P.	2013	Private Equity	109,710,728	95,999,656	19,290,702	100,607,871	12.13%	1.25	9.87	-	1.65	1.15	5.97	1.94	186401519.2	5.27
LLR Equity Partners IV, L.P.	2013	Venture Capital	200,000,000	164,000,000	45,151,535	183,486,148	22.74%	1.39	18.00	-	3.00	-	16.16	1.62	265949904.3	18.00
New Mountain Partners IV, L.P.	2013	Private Equity	100,000,000	73,369,240	7,319,605	89,138,660	22.63%	1.31	9.00	-	1.50	0.88	5.77	1.34	98402405.33	5.48
North Haven Private Equity Asia IV, L.P.	2013	Private Equity	100,000,000	74,236,550	8,532,727	80,597,678	9.28%	1.20	9.00	-	1.50	0.89	3.72	2.06	152954809.3	5.44
PEIP #10	2013	PSERS Private Eq	14,982,607	6,854,911	4,664,047	7,148,244	17.23%	1.72	-	-	0.22	-	-	3.42	23465613.83	-
PEIP #6	2013	PSERS Private Eq	11,785,993	10,161,101	13,012,891	16,254,136	29.74%	2.88	-	-	0.18	-	-	4.06	41286225.73	-
PEIP #7	2013	PSERS Private Eq	12,007,603	12,281,374	8,507,605	19,135,971	24.43%	2.25	-	-	0.18	-	-	3.71	45586557.21	-
PEIP #8	2013	PSERS Private Eq	12,187,352	11,506,417	1,256,611	32,642,284	32.53%	2.95	-	-	0.18	-	-	3.84	44143147.02	-
PS-PEIP #1	2013	PSERS Private Eq	2,500,000	2,500,000	-	4,601,596	15.22%	1.84	-	-	0.04	-	-	4.31	10766197.27	-
Trilantic Capital Partners V (North Americ.	2013	Private Equity	100,000,000	74,813,685	22,014,866	81,124,764	16.03%	1.38	9.00	-	1.50	0.90	7.08	2.16	161565918.4	5.41
Bain Capital Fund XI, L.P.	2014	Private Equity	100,000,000	62,500,000	18,366,696	72,314,042	26.54%	1.45	7.20	-	1.50	0.75	7.05	1.58	98820343.5	4.20
Blue Point Capital Partners III, L.P.	2014	Private Equity	60,000,000	34,337,578	8,727,093	43,750,426	24.88%	1.53	4.32	-	0.90	0.41	4.53	1.91	65549976.8	2.67
HGGC Fund II, L.P.	2014	Private Equity	100,000,000	83,652,424	15,475,646	84,145,198	15.39%	1.19	7.20	-	1.50	1.00	3.99	1.22	102091635.8	3.18
NGP Natural Resources XI, L.P.	2014	Private Equity	100,000,000	58,487,190	11,573,665	62,337,562	30.45%	1.26	7.20	-	1.50	0.70	3.86	0.88	51498548.49	4.39
Odyssey Investment Partners Fund V, L.P.	2014	Private Equity	100,000,000	38,455,987	13	32,670,930	-13.48%	0.85	7.20	-	1.50	0.46	-	1.13	43298679.32	5.35
Orchid Asia Fund VI, L.P.	2014	Private Equity	75,000,000	27,428,542	3,455,297	27,431,376	11.60%	1.13	5.40	-	1.13	0.33	0.86	1.08	29675236.14	4.08
PEIP #12	2014	PSERS Private Eq	15,000,000	12,086,263	-	42,224,684	46.85%	3.49	-	-	0.23	-	-	3.26	39348004.02	-
PEIP #13	2014	PSERS Private Eq	13,000,000	13,035,722	26,587,857	64,747,800	94.17%	7.01	-	-	0.20	-	-	2.93	38245853.71	-
PEIP #14	2014	PSERS Private Eq	13,000,000	10,000,000	-	19,611,570	25.20%	1.96	-	-	0.20	-	-	3.00	29969199.7	-
PEIP #15	2014	PSERS Private Eq	6,000,000	6,000,000	-	6,000,000	0.00%	1.00	-	-	0.09	-	-	4.00	24000000	-
PEIP #16	2014	PSERS Private Eq	16,448,766	7,550,757	3,434,089	9,680,904	24.09%	1.74	-	-	0.25	-	-	2.56	19314745.73	-
PEIP #17	2014	PSERS Private Eq	10,000,000	10,000,000	-	22,499,800	34.29%	2.25	-	-	0.15	-	-	2.75	27504573.02	-
PEIP #18	2014	PSERS Private Eq	15,000,000	10,886,435	2,781,354	10,817,333	10.76%	1.25	-	-	0.23	-	-	2.18	23697222.49	-
Strategic Partners Fund VI, L.P.	2014	Private Equity	150,000,000	92,484,023	42,099,775	86,840,695	23.88%	1.39	10.80	-	2.25	1.11	9.11	1.55	143519967.5	6.36
The Energy & Minerals Group Fund III, L.P.	2014	Private Equity	100,000,000	93,705,930	2,441,014	79,693,746	-5.76%	0.88	7.20	-	1.50	1.12	-	2.22	208181368.1	2.70
Baring Asia Private Equity Fund VI, L.P.	2015	Private Equity	100,000,000	45,633,060	150,451	53,138,190	13.64%	1.17	5.40	-	1.50	0.55	1.91	1.21	55349349.06	3.21
Bridgepoint Europe V, L.P.	2015	Private Equity	167,930,277	76,298,263	15,406,708	76,927,280	27.23%	1.21	9.07	-	2.52	0.92	4.01	0.79	60437005.39	5.41
Cerberus Institutional Partners VI, L.P.	2015	Special Situations	200,000,000	35,028,933	872,857	46,879,670	26.86%	1.36	10.80	-	3.00	-	3.18	1.30	45621462.54	10.80
Clearlake Capital Partners IV, L.P.	2015	Special Situations	57,500,000	42,635,479	4,124,120	55,599,295	42.85%	1.40	3.11	-	0.86	-	4.27	0.95	40293736.05	3.11
Coller International Partners VII, L.P.	2015	Private Equity	100,000,000	5,017,808	-	8,479,603	57.12%	1.69	5.40	-	1.50	0.06	0.87	1.16	5826614.64	5.16
Crestview Partners III, L.P.	2015	Private Equity	150,000,000	45,988,366	758,272	46,505,019	1.73%	1.03	8.10	-	2.25	0.55	-	1.59	73319055	5.89
Equistone Partners Europe Fund V, L.P.	2015	Private Equity	73,107,454	49,103,483	-	61,470,418	21.28%	1.25	3.95	-	1.10	0.59	3.09	1.16	57170081.11	1.59

PAI Europe VI	2015	Private Equity	114,969,556	45,926,301	4,515,851	56,504,039	16.76%	1.33	6.21	-	1.72	0.55	3.77	1.83	84223784.56	4.00
Partners Group Secondary 2015 (USD) A,	2015	Private Equity	100,000,000	14,961,090	625,079	17,106,441	20.23%	1.19	5.40	-	1.50	0.18	0.69	0.92	13796160.43	4.68
PEIP #19	2015	PSERS Private Eq	15,000,000	15,175,000		9,408,795	-19.14%	0.62	-	-	0.23	-	-	2.25	34143026.63	-
PEIP #20	2015	PSERS Private Eq	15,000,000	12,362,967	709,159	14,578,876	10.42%	1.24	-	-	0.23	-	-	2.14	26487418.24	-
PEIP #21	2015	PSERS Private Eq	15,000,000	15,012,260		17,013,777	7.34%	1.13	-	-	0.23	-	-	1.77	26526140.05	-
PEIP #22	2015	PSERS Private Eq	14,617,943	14,758,714	4,208,263	15,028,254	18.54%	1.30	-	-	0.22	-	-	1.56	22993351.88	-
Searchlight Capital Partners II, L.P.	2015	Special Situations	74,000,000	22,307,040	1,638,201	26,133,896	22.42%	1.24	4.00	-	1.11	-	1.37	1.08	24164264.1	4.00
Summit Partners Growth Equity Fund IX, I	2015	Venture Capital	100,000,000	6,000,000		9,176,221	52.94%	1.53	5.40	-	1.50	-	0.79	1.00	5999724.53	5.40
Summit Partners Venture Capital Fund IV,	2015	Venture Capital	50,000,000	12,481,575		14,069,196	15.97%	1.13	2.70	-	0.75	-	0.40	0.81	10086780.46	2.70
Tenaya Capital VII, L.P.	2015	Venture Capital	100,000,000	35,366,880	5,845,583	29,366,723	-0.35%	1.00	5.40	-	1.50	-	-	1.25	44183291.77	5.40
Venor Special Situations Fund II, L.P.	2015	Special Situations	100,000,000	90,392,327	1,428	96,762,940	5.72%	1.07	5.40	-	1.50	-	-	1.22	110698359	5.40
Versa Capital Fund III, L.P.	2015	Special Situations	150,000,000	67,500,000	1,875,000	29,790,321	-59.07%	0.47	8.10	-	2.25	-	-	0.85	57193245.54	8.10
Woodstream	2015	PSERS Private Eq	8,682,106	8,682,106		14,741,967	35.81%	1.70	-	-	0.13	-	-	1.73	15017327.99	-
			27,474.19	25,246.54	30,377.20	7,637.72		1.51							4.01	3.142
			13,588.26	11,924.52	10,305.00	6,546.06		1.41							3.37	1.316

Funds highlighted in yellow had its IRR corrected as it was inconsistent with its TVPI (same if IRR was missing; assumed 4 years HP)

#### Assumptions

If this portfolio is liquidated today

Only keep pre 2015 inv (no dist for more recent)

Mngt fees commitment period 1.8%

Mngt fees post commitment period 1.5%

Carry always 20%, hurdle 8%, US style

PC fees (% inv) 6%

% rebated 80%

Fund expenses (% Kcom) 1.5%

PC fees only if Private Equity 1

No fee paid if PSERS Private Equity Internal 1

Results	From inception	From 2007 vintage
Weighted average implied inv duration	4.01	3.37
TVPI	1.51	1.41
RoR using weighted average implied inv d	10.7%	10.8%
TVPI gross of fees	1.80	1.61
Impact of fees on RoR	5.1%	4.5%
RoR gross of fees	15.8%	15.3%
Total Invested (billion)	25.2	11.9
Total value (billion)	38.0	16.9
Total Fees Paid (billion)	7.5	2.4
	30%	20%
	7.4%	6.0%

Estimate of reported fees per year (billion)	0.8	0.4
Estimate of average NAV	35	16
Estimate of reported annual TER	2.2%	2.5%
Estimate of actual annual TER	5.3%	4.6%



Fund (original)	Vintage Year	Strategy	Commitment	Contributions	Distributions	NAV	Since Inception IRR	TVPI	Mngt fees year 1-5	Mngt fees year 10-6	Fund expenses	PC fees	Carry	Implied Duration	Net total management fees	
NEPA Venture Fund I	1985	#N/A	Venture Capital	1,000,000	1,000,000	6,080,528	17.08%	6.08	0.09	0.08	0.02	-	1.27	11.45	11447287.2	0.17
Commonwealth Capital Ventures, L.P.	1986	#N/A	Venture Capital	20,000,000	20,000,000	20,584,156	0.30%	1.03	1.80	1.50	0.30	-	-	9.61	192216950.7	3.30
APA/Fostin Venture Fund I, L.P.	1987		Venture Capital	20,000,000	20,000,000	77,132,193	19.88%	3.86	1.80	1.50	0.30	-	14.28	7.44	148883808.1	3.30
CEO Venture Fund I, L.P.	1987		Venture Capital	1,000,000	1,000,000	1,101,749	1.43%	1.10	0.09	0.08	0.02	-	-	6.82	6824482.854	0.17
Genesis Seed Fund	1987		Venture Capital	2,000,000	2,000,000	815,687	-12.43%	0.41	0.18	0.15	0.03	-	-	6.76	13514053.88	0.33
Loyalhanna Venture Fund	1987		Venture Capital	15,000,000	15,000,000	21,446,203	3.58%	1.43	1.35	1.13	0.23	-	-	10.16	152454931.2	2.48
CIGNA	1988		Private Equity	4,566,946	4,566,946	6,645,349	9.21%	1.46	0.41	0.34	0.07	0.05	0.52	4.26	19442545.51	0.53
CEO Venture Fund II, L.P.	1989		Venture Capital	15,000,000	15,000,000	10,651,730	-4.17%	0.71	1.35	1.13	0.23	-	-	8.04	120553840.4	2.48
Edison II-PA Venture Fund	1991		Venture Capital	10,000,000	10,000,000	25,972,603	22.19%	2.60	0.90	0.75	0.15	-	3.99	4.76	47625933.36	1.65
Commonwealth Capital Ventures II, L.P.	1992		Venture Capital	10,000,000	10,000,000	15,214,766	15.10%	1.52	0.90	0.75	0.15	-	1.30	2.98	29842703.49	1.65
Landmark Equity Partners II, L.P.	1992		Venture Capital	25,000,000	25,000,000	39,042,318	24.34%	1.56	2.25	1.88	0.38	-	3.51	2.05	51155749.88	4.13
NEPA Venture Fund II	1992		Venture Capital	5,000,000	5,000,000	23,252,576	38.03%	5.87	0.45	0.38	0.08	-	4.84	4.91	24562466.61	0.83
Technology Leaders, L.P.	1992		Venture Capital	10,000,000	10,000,000	22,111,898	23.24%	2.21	0.90	0.75	0.15	-	3.03	3.80	37974612.23	1.65
Grotech Capital Partners IV, L.P.	1993		Venture Capital	25,000,000	25,000,000	44,210,693	15.67%	1.77	2.25	1.88	0.38	-	4.80	3.92	97905897.31	4.13
Keystone Venture Fund IV, L.P.	1993		Venture Capital	7,766,667	7,766,666	5,904,516	-8.41%	0.76	0.70	0.58	0.12	-	-	3.12	24235309.91	1.28
Landmark Equity Partners III, LP	1993		Private Equity	27,085,010	27,085,010	76,454,209	33.81%	2.82	2.44	2.03	0.41	0.33	12.34	3.56	96502524.86	3.17
P/A Fund	1993		Venture Capital	30,000,000	30,000,000	66,835,233	18.83%	2.23	2.70	2.25	0.45	-	9.21	4.64	139290938	4.95
TDH III, L.P.	1993		Venture Capital	7,350,750	7,350,750	4,874,316	-5.23%	0.66	0.66	0.55	0.11	-	-	7.65	56217548.73	1.21
TPG Partners, L.P.	1993		Private Equity	24,194,356	24,465,437	89,300,776	36.55%	3.65	2.18	1.83	0.36	0.29	16.21	4.16	101683768.8	2.84
Bastion Capital Fund, LP	1994		Private Equity	12,500,000	12,246,895	24,148,319	18.93%	1.97	1.13	0.92	0.19	0.15	2.98	3.92	47962047.42	1.46
Edison Venture Fund III, L.P.	1994		Venture Capital	14,807,690	14,807,690	28,785,013	18.19%	1.94	1.33	1.11	0.22	-	3.49	3.98	58895394.19	2.44
Green Equity Investors II, L.P.	1994		Private Equity	25,000,000	24,151,005	50,916,127	14.40%	2.11	2.25	1.81	0.38	0.29	6.69	5.54	133895765	2.90
Heritage Fund I, L.P.	1994		Private Equity	25,000,000	24,999,999	24,755,484	-0.46%	0.99	2.25	1.87	0.38	0.30	-	2.13	53294134.59	2.92
Keystone Minority Capital Fund	1994		Venture Capital	114,865	114,865	15,365	-15.91%	0.13	0.01	0.01	0.00	-	-	11.61	1333486.62	0.02
Landmark Equity Partners IV, LP	1994		Private Equity	10,533,687	10,254,032	15,424,239	16.66%	1.50	0.95	0.77	0.16	0.12	1.29	2.65	27167952.45	1.22
Spectrum Equity Investors, L.P.	1994		Venture Capital	25,000,000	25,000,000	52,261,392	23.59%	2.09	2.25	1.88	0.38	-	6.82	3.48	87037769.96	4.13
Bruckmann, Rosser, Sherrill & Co. L.P.	1995		Private Equity	25,000,000	24,465,163	44,580,173	10.37%	1.82	2.25	1.83	0.38	0.29	5.03	6.08	148782045.9	2.91
Franklin Capital Associates III, L.P.	1995		Venture Capital	15,000,000	15,000,000	14,558,465	-0.33%	0.97	1.35	1.13	0.23	-	-	9.04	135583020.6	2.48
Landmark Equity Partners V, L.P.	1995		Venture Capital	49,060,283	48,481,948	59,280,814	8.33%	1.23	4.42	3.64	0.74	-	2.84	2.63	127531841.9	8.05
Landmark Mezzanine Partners	1995		Private Equity	75,000,000	59,315,512	107,968,551	28.73%	1.82	6.75	4.45	1.13	0.71	12.16	2.37	140679400.6	8.35
ABS Capital Partners II, L.P.	1996		Private Equity	40,000,000	39,291,734	45,555,770	6.71%	1.17	3.60	2.95	0.60	0.47	-	2.37	92965534	4.66
GS Mezzanine Partners, LP	1996		Private Equity	30,000,000	26,883,828	39,260,072	8.82%	1.46	2.70	2.02	0.45	0.32	3.09	4.48	120443146	3.43
Lexington Capital Partners I, L.P.	1996		Private Equity	50,000,000	49,613,120	62,975,030	13.16%	1.27	4.50	3.72	0.75	0.60	3.35	1.93	95873365.29	5.84
SCP Private Equity Partners I, L.P.	1996		Venture Capital	62,500,000	6,285,918	43,172,864	61.96%	6.88	5.63	0.47	0.94	-	9.24	4.00	25143672	6.10
U.S. Equity Partners, L.P.	1996		Private Equity	75,000,000	76,336,235	69,738,856	-1.56%	0.91	6.75	5.73	1.13	0.92	-	5.75	438851141.4	8.81
Willis Stein & Partners, L.P.	1996		Private Equity	25,000,000	25,004,635	53,581,016	20.65%	2.14	2.25	1.88	0.38	0.30	7.14	4.06	101515591.7	2.93
Adams Capital Management, L.P.	1997		Venture Capital	12,500,000	12,500,000	22,671,838	44.80%	1.83	1.13	0.94	0.19	-	2.60	1.64	20444953.01	2.06
BG Media International Investors	1997		Private Equity	25,000,000	24,729,264	21,119,037	-2.40%	0.85	2.25	1.85	0.38	0.30	-	6.50	160648554.6	2.92
Credit Suisse First Boston Intl. Equity Partn	1997		Private Equity	100,000,000	76,663,758	95,813,877	5.22%	1.25	9.00	5.75	1.50	0.92	-	4.38	335952972.8	11.07
Lehman Brothers Merchant Banking Partn	1997		Private Equity	158,552,133	168,556,341	220,371,513	5.72%	1.31	14.27	12.64	2.38	2.02	-	4.82	812252290.9	18.82
TL Ventures III, L.P.	1997		Venture Capital	50,000,000	50,000,000	69,245,707	24.67%	1.38	4.50	3.75	0.75	-	4.81	1.48	73840828.98	8.25
TPG Partners II, L.P.	1997		Private Equity	50,000,000	53,854,393	91,361,723	9.93%	1.70	4.50	4.04	0.75	0.65	9.38	5.58	300657609.2	5.95
Bridgepoint Capital II (Secondary)	1998		Private Equity	84,714,906	81,290,641	166,312,361	18.65%	2.05	7.62	6.10	1.27	0.98	21.35	4.20	341332797.9	9.82
Bridgepoint Europe I	1998		Private Equity	79,622,624	75,126,567	135,823,089	12.43%	1.81	7.17	5.63	1.19	0.90	15.23	5.07	380768707.6	9.19
Credit Suisse First Boston Equity Partners,	1998		Private Equity	137,172,500	114,737,213	32,970,843	-16.26%	0.29	12.35	8.61	2.06	1.38	-	7.03	806294321.8	15.44

Edgewater Private Equity Fund III	1998	Private Equity	39,000,000	39,000,000	23,129,095	-7.85%	0.59	3.51	2.93	0.59	0.47	-	6.39	249244257.1	4.56
Furman Seiz Investors II, L.P.	1998	Private Equity	56,250,000	55,816,077	96,375,368	11.53%	1.73	5.06	4.19	0.84	0.67	10.14	5.01	279372739.6	6.57
Greenwich Street Capital Partners II, L.P.	1998	Private Equity	200,000,000	216,105,302	214,588,348	-0.13%	0.99	18.00	16.21	3.00	2.59	-	5.42	1170241134	23.83
Morgan Stanley DW Capital Partners IV, L.P.	1998	Private Equity	300,000,000	236,925,618	477,873,353	16.87%	2.02	27.00	17.77	4.50	2.84	60.30	4.50	1067132104	33.40
Novitas Capital, L.P.	1998	Venture Capital	30,000,000	29,952,000	34,686,498	9.26%	1.19	2.70	2.25	0.45	-	1.43	1.97	59051101.41	4.95
Sunrise Capital Partners, L.P.	1998	Private Equity	57,388,755	57,104,502	20,834,805	-15.59%	0.36	5.16	4.28	0.86	0.69	-	5.95	339713302.3	6.71
Cross Atlantic Technology Fund, L.P.	1999	Venture Capital	30,141,666	30,357,584	35,781,536	2.78%	1.23	2.71	2.28	0.45	-	-	7.55	229172977.4	4.99
Deutsche European Partners IV	1999	Private Equity	200,000,000	180,960,550	224,577,100	6.41%	1.24	18.00	13.57	3.00	2.17	-	3.48	628955758.2	22.89
Graham Partners	1999	Private Equity	56,671,214	61,946,457	82,648,447	5.47%	1.33	5.10	4.65	0.85	0.74	-	5.41	335373060.4	6.77
Halifax Capital Partners	1999	Private Equity	50,000,000	39,967,488	63,972,891	11.77%	1.60	4.50	3.00	0.75	0.48	6.00	4.23	168957697.3	5.58
KBL Partnership, L.P.	1999	Venture Capital	13,743,333	13,711,864	6,919,745	-3.37%	0.77	1.24	1.03	0.21	-	-	7.79	106758964.1	2.27
KRG Capital Partners I, L.P.	1999	Private Equity	50,000,000	43,261,578	91,634,458	17.75%	2.12	4.50	3.24	0.75	0.52	12.09	4.59	198720529.6	5.67
Lehman Brothers Communications Partne	1999	Venture Capital	12,500,000	11,442,260	5,210,205	-13.81%	0.46	1.13	0.86	0.19	-	-	5.29	60569248.51	1.98
LLR Equity Partners, L.P.	1999	Venture Capital	62,500,000	61,344,870	131,553,825	21.74%	2.15	5.63	4.60	0.94	-	17.57	3.88	238033252.9	10.23
New York Life Capital Partners I, L.P.	1999	Private Equity	200,000,000	205,005,869	226,525,069	1.85%	1.12	18.00	15.38	3.00	2.46	-	5.95	1219144714	23.54
StarVest	1999	Venture Capital	67,500,000	65,659,367	113,383,601	7.38%	1.73	6.08	4.92	1.01	-	-	7.73	507844600.5	11.00
Wicks Communications and Media Partne	1999	Private Equity	87,500,000	88,993,376	115,304,727	8.57%	1.30	7.88	6.67	1.31	1.07	6.58	3.15	280337708.5	10.28
Avenue Special Situations Fund II, L.P.	2000	Special Situations	125,000,000	126,838,089	199,775,750	19.22%	1.58	11.25	9.51	1.88	-	18.23	2.58	327761184.6	20.76
Clarity Partners L.P.	2000	Private Equity	203,590,000	204,760,392	150,711,218	-6.93%	0.74	18.32	15.36	3.05	2.46	-	4.27	873787576	23.85
Co-Investment 2000 Fund, L.P.	2000	Venture Capital	135,000,000	135,000,000	200,274,616	7.82%	1.61	12.15	10.13	2.03	-	-	6.29	849651196.5	22.28
DLJ Merchant Banking Partners III, L.P.	2000	Private Equity	300,000,000	310,668,837	671,148,994	20.27%	2.16	27.00	23.30	4.50	3.73	90.12	4.17	1296517149	35.39
Dubin Clark Fund II, L.P.	2000	Private Equity	24,083,333	23,706,041	27,060,085	1.99%	1.14	2.17	1.78	0.36	0.28	-	6.72	159202399.5	2.81
Furman Seiz Investors III, L.P.	2000	Private Equity	100,000,000	95,025,051	206,864,610	22.58%	2.18	9.00	7.13	1.50	1.14	27.96	3.82	363087206.4	11.57
GSC Recovery II, L.P.	2000	Special Situations	280,000,000	279,170,771	430,042,246	10.14%	1.54	25.20	20.94	4.20	-	37.81	4.48	1251315718	46.14
Irving Place Capital MB-PSERS II, L.P.	2000	Private Equity	300,000,000	285,338,979	461,742,652	12.54%	1.64	27.00	21.40	4.50	3.42	45.90	4.21	1199912008	34.70
New Mountain Partners, L.P.	2000	Private Equity	192,509,033	161,121,249	243,188,690	13.69%	1.51	17.33	12.08	2.89	1.93	20.52	3.21	516973897.5	21.68
Novitas Capital II, L.P.	2000	Venture Capital	75,000,000	74,775,000	16,507,112	-15.71%	0.24	6.75	5.61	1.13	-	-	8.28	619354134.1	12.36
Palladium Equity Partners II-A, L.P.	2000	Private Equity	57,750,000	65,063,804	84,652,715	8.79%	2.19	5.20	4.88	0.87	0.78	19.32	9.29	604674577	6.95
SCP Private Equity Partners II, L.P.	2000	Venture Capital	125,000,000	129,745,343	41,010,860	-8.14%	0.46	11.25	9.73	1.88	-	-	9.09	1179175050	20.98
Sterling Venture Partners I, L.P.	2000	Venture Capital	33,986,000	36,115,022	39,138,810	1.61%	1.09	3.06	2.71	0.51	-	-	5.39	194710875.3	5.77
Avenue Asia Special Situations Fund II, L.P.	2001	Special Situations	220,000,000	220,000,000	413,276,527	21.47%	1.88	19.80	16.50	3.30	-	48.32	3.24	713160454	36.30
Blue Point Capital Partners I, L.P.	2001	Private Equity	103,750,000	91,140,153	143,028,571	12.08%	1.57	9.34	6.84	1.56	1.09	13.03	3.96	361355051.9	11.80
Bridgepoint Europe II, L.P.	2001	Private Equity	317,885,713	313,199,355	607,586,316	29.41%	1.96	28.61	23.49	4.77	3.76	75.13	2.61	817185801.3	37.07
Cerberus Institutional Partners L.P. (Series	2001	Special Situations	200,000,000	173,047,901	539,461,950	27.08%	3.12	18.00	12.98	3.00	-	91.75	4.75	821810518.6	30.98
Cross Atlantic Technology Fund II, L.P.	2001	Venture Capital	21,119,734	21,119,734	21,394,134	0.47%	1.03	1.90	1.58	0.32	-	-	6.12	129211806.8	3.48
Edgewater Growth Capital Partners, L.P.	2001	Private Equity	59,196,500	59,196,500	77,379,658	6.58%	1.31	5.33	4.44	0.89	0.71	-	4.20	248823727.4	6.93
Gleacher Mezzanine Fund I, L.P.	2001	Special Situations	75,000,000	63,450,304	95,943,900	20.30%	1.51	6.75	4.76	1.13	-	8.12	2.24	141961612.3	11.51
GSC Partners CDO Investors III, L.P.	2001	Special Situations	80,000,000	80,000,000	146,903,688	18.58%	1.84	7.20	6.00	1.20	-	16.73	3.57	285299343.4	13.20
KRG Capital Fund II (PA) L.P.	2001	Private Equity	100,000,000	79,636,623	119,983,431	22.08%	1.51	9.00	5.97	1.50	0.96	10.09	2.05	163610936.1	11.15
New York Life Capital Partners II, L.P.	2001	Private Equity	200,000,000	194,688,538	550,331,205	32.47%	2.84	18.00	14.60	3.00	2.34	89.67	3.72	723304618.9	23.26
PAI Europe III	2001	Private Equity	333,547,528	335,956,000	1,112,343,391	38.15%	3.31	30.02	25.20	5.00	4.03	194.10	3.70	1244612693	39.09
Perseus-Soros BioPharmaceutical Fund, L.	2001	Venture Capital	112,206,666	124,112,299	202,156,748	20.27%	1.63	10.10	9.31	1.68	-	19.60	2.65	329176180	19.41
PNC Equity Partners, L.P.	2001	Private Equity	43,154,458	39,619,636	77,501,909	21.11%	1.96	3.88	2.97	0.65	0.48	9.51	3.51	139175036.6	4.95
Quadrangle Capital Partners, L.P.	2001	Private Equity	270,422,415	225,438,094	386,739,733	11.07%	1.72	24.34	16.91	4.06	2.71	40.33	5.14	1158870867	30.42
Strategic Feeder, L.P.	2001	Private Equity	200,000,000	194,687,388	308,973,117	16.81%	1.59	18.00	14.60	3.00	2.34	28.57	2.97	578703946.2	23.26
Avenue Special Situations III, L.P.	2002	Special Situations	205,156,000	152,853,651	259,715,762	18.53%	1.70	18.46	11.46	3.08	-	26.72	3.12	476651307.4	29.93
Lindsay Goldberg & Bessemer, L.P.	2002	Private Equity	300,000,000	312,986,446	732,620,207	34.18%	2.34	27.00	23.47	4.50	3.76	104.94	2.89	905512456	35.45
Sterling Capital Partners, L.P.	2002	Private Equity	75,000,000	84,393,474	163,071,264	18.04%	2.03	6.75	6.33	1.13	1.01	21.78	4.28	360882228.5	9.03
U.S. Equity Partners II, L.P.	2002	Private Equity	300,000,000	222,858,123	400,784,550	14.12%	1.80	27.00	16.71	4.50	2.67	44.48	4.44	990252622.1	33.02



Avenue Asia Special Situations Fund III, L.P.	2003	Special Situations	100,000,000	76,892,230	114,952,589		8.41%	1.49	9.00	5.77	1.50	-	9.52	4.98	382903496.5	14.77
Cerberus Institutional Partners, L.P. - Series	2003	Special Situations	100,000,000	81,055,777	155,809,765	5,847,414	12.88%	1.99	9.00	6.08	1.50	-	20.15	5.70	461854819.6	15.08
GSC Partners CDO Investors IV, L.P.	2003	Special Situations	80,000,000	80,000,000	114,506,209		7.17%	1.43	7.20	6.00	1.20	-	-	5.18	414292833.5	13.20
Jefferson Partners Fund IV, L.P.	2003	Venture Capital	24,389,194	24,583,511	219,088		-54.80%	0.01	2.20	1.84	0.37	-	-	5.94	146136377.7	4.04
NYLJM Mezzanine Partners (Parallel Fund)	2003	Special Situations	75,000,000	69,106,090	91,497,156	1,489,132	9.90%	1.35	6.75	5.18	1.13	-	5.97	3.14	217279398.8	11.93
Quaker Bio-Ventures, L.P.	2003	Venture Capital	69,350,000	69,458,692	27,445,322	577,854	-13.65%	0.40	6.24	5.21	1.04	-	-	6.18	429593107.8	11.45
Strategic Partners Fund II, L.P.	2003	Private Equity	300,000,000	264,923,968	471,221,398	1,811,826	34.15%	1.79	27.00	19.87	4.50	3.18	52.03	1.97	522765560.1	34.15
Tenaya Capital IV-P, L.P.	2003	Venture Capital	75,000,000	72,679,657	82,032,212	36,545,447	7.72%	1.63	6.75	5.45	1.13	-	-	6.58	478412298	12.20
Allegheny New Mountain Partners, L.P.	2004	Private Equity	100,000,000	84,637,408	171,742,050	1,783,626	14.23%	2.05	9.00	6.35	1.50	1.02	22.22	5.40	456732099.9	11.29
Catterton Partners V, L.P.	2004	Private Equity	100,000,000	101,386,111	135,110,453	9,501,709	5.77%	1.43	9.00	7.60	1.50	1.22	-	6.33	641822780.8	11.74
Gold Hill Venture Lending 03, L.P.	2004	Special Situations	50,000,000	50,000,000	80,272,865	1,380,094	10.75%	1.63	4.50	3.75	0.75	-	7.91	4.80	140171383.6	8.25
LLR Equity Partners II, L.P.	2004	Venture Capital	75,000,000	75,003,401	122,831,303	12,753,401	12.48%	1.81	6.75	5.63	1.13	-	15.15	5.03	377591558.8	12.38
Milestone Partners II, L.P.	2004	Private Equity	29,890,000	27,844,247	42,050,676	2,323,258	17.28%	1.59	2.69	2.09	0.45	0.33	4.13	2.92	81409178.85	3.44
Platinum Equity Capital Partners, L.P.	2004	Private Equity	125,000,000	97,797,352	250,768,934	8,577,160	59.96%	2.65	11.25	7.33	1.88	1.17	40.39	2.08	203039267.3	13.89
Baring Asia Private Equity Fund III, L.P.	2005	Private Equity	122,500,000	142,650,592	291,823,625	56,923,551	52.38%	2.44	11.03	10.70	1.84	1.71	51.52	2.12	302754441.6	14.88
Bridgepoint Europe III, L.P.	2005	Private Equity	269,841,089	249,204,792	161,569,387	139,972,984	2.64%	1.21	24.29	18.69	4.05	2.99	-	7.32	1823168897	31.01
Crestview Capital Partners	2005	Private Equity	150,000,000	154,361,773	226,159,577	17,807,227	7.36%	1.58	13.50	11.58	2.25	1.85	-	6.45	994916920.3	17.67
Evergreen Pacific Partners, L.P.	2005	Private Equity	50,000,000	39,104,137	5,292,828		-99.99%	0.14	4.50	2.93	0.75	0.47	-	0.22	8490827.171	5.56
GSC Recovery III (Parallel Fund), L.P.	2005	Special Situations	200,000,000	201,932,340	252,992,547	10,592,499	6.45%	1.31	18.00	15.14	3.00	-	-	4.26	860784873.3	33.14
Jefferies Capital Partners IV, L.P.	2005	Private Equity	100,000,000	95,270,050	108,935,198		2.85%	1.14	9.00	7.15	1.50	1.14	-	4.77	454417388.7	11.57
KRG Capital Fund III, (PA) L.P.	2005	Private Equity	88,000,000	88,076,832	77,248,244		-2.67%	0.88	7.92	6.61	1.32	1.06	-	4.85	426945406.3	10.30
New York Life Capital Partners III-A, L.P.	2005	Private Equity	200,000,000	218,620,077	168,329,133	34,937,593	-1.11%	0.93	18.00	16.40	3.00	2.62	-	6.52	1426180768	23.90
PAI Europe IV	2005	Private Equity	128,401,669	131,323,378	178,840,213	14,243,218	9.15%	1.47	11.56	9.85	1.93	1.58	15.44	4.40	578163074.6	15.10
Quadrangle Capital Partners II, L.P.	2005	Private Equity	250,000,000	227,201,835	296,569,830		5.70%	1.31	22.50	17.04	3.75	2.73	-	4.81	1092033418	28.63
Strategic Partners Fund III VC, L.P.	2005	Venture Capital	50,000,000	56,312,951	61,676,335	13,213,686	6.28%	1.33	4.50	4.22	0.75	-	-	4.68	263592365.9	8.72
Strategic Partners Fund III-B, L.P.	2005	Private Equity	200,000,000	218,355,603	260,001,884	34,969,200	6.39%	1.35	18.00	16.38	3.00	2.62	-	4.86	1060211233	23.90
Versa Capital Fund I, L.P.	2005	Special Situations	75,000,000	88,545,177	61,946,810	42,734,408	3.85%	1.18	6.75	6.64	1.13	-	-	4.43	392379576.5	13.39
Aisling Capital II, L.P.	2006	Venture Capital	50,000,000	58,965,264	45,112,590	12,421,943	-0.46%	0.98	4.50	4.42	0.75	-	-	5.33	314139297.3	8.92
Avenue Asia Special Situations Fund IV, L.P.	2006	Special Situations	300,000,000	225,070,059	239,670,405	6,571,185	1.96%	1.09	27.00	16.88	4.50	-	-	4.63	1042437053	43.88
Avenue Special Situations Fund IV, L.P.	2006	Special Situations	115,000,000	144,782,669	189,601,502	434,870	8.39%	1.31	10.35	10.86	1.73	-	11.31	3.38	488772048.3	21.21
Catterton Partners VI, L.P.	2006	Private Equity	130,000,000	147,418,375	180,226,813	88,929,010	12.14%	1.83	11.70	11.06	1.95	1.77	30.43	5.25	774566423.5	15.68
Cerberus Institutional Partners, L.P. (Series	2006	Special Situations	400,000,000	369,661,873	530,150,585	108,202,068	8.85%	1.73	36.00	27.72	6.00	-	67.17	6.44	2381434458	63.72
Co-Investment Fund II, L.P.	2006	Venture Capital	135,000,000	134,325,000	41,241,732	109,352,855	1.72%	1.12	12.15	10.07	2.03	-	-	6.70	900520822.4	22.22
First Reserve Fund XI, L.P.	2006	Private Equity	200,000,000	213,209,232	140,355,363		-9.68%	0.66	18.00	15.99	3.00	2.56	-	4.11	875561543.6	23.76
Irving Place Capital III SPV, L.P.	2006	Private Equity	150,000,000	153,479,615	113,640,309	100,442,305	5.99%	1.39	13.50	11.51	2.25	1.84	-	5.72	877997646.9	17.64
KKR 2006 Fund, L.P.	2006	Private Equity	300,000,000	299,054,703	408,221,889		6.52%	1.37	27.00	22.43	4.50	3.59	-	4.93	1473358981	35.07
Landmark Equity Partners XIII, L.P.	2006	Private Equity	100,000,000	96,088,084	94,349,668	27,715,720	5.13%	1.27	9.00	7.21	1.50	1.15	-	4.78	459608616.6	11.59
NYLJM Mezzanine Partners II (Parallel Fund)	2006	Special Situations	150,000,000	166,079,837	204,550,868	5,149,973	6.88%	1.26	13.50	12.46	2.25	-	-	3.51	582116852.5	25.96
Permira IV, L.P.	2006	Private Equity	169,966,588	167,234,080	231,025,324	37,078,287	8.68%	1.60	15.30	12.54	2.55	2.01	25.22	5.67	948261077.5	19.81
TPG Partners V, L.P.	2006	Private Equity	250,000,000	261,876,873	307,855,529		3.11%	1.18	22.50	19.64	3.75	3.14	-	5.28	1383136285	29.57
Windjammer Senior Equity Fund III, L.P.	2006	Special Situations	50,000,000	45,230,610	87,739,336	13,470,335	19.01%	2.24	4.50	3.39	0.75	-	13.99	4.63	209320882.5	7.89
Actis Emerging Markets 3, L.P.	2007	Private Equity	200,000,000	221,002,062	190,013,443	49,115,000	1.92%	1.08	18.00	16.58	3.00	2.65	-	4.14	916043785.7	23.97
Apax Europe VII-A, L.P.	2007	Private Equity	277,238,578	289,821,881	304,041,648	99,244,392	6.40%	1.39	24.95	21.74	4.16	3.48	-	5.33	1543493528	32.78
Avenue Special Situations Fund V, L.P.	2007	Special Situations	300,000,000	301,785,852	399,310,776	391,076	11.07%	1.32	27.00	22.63	4.50	-	24.48	2.68	807713450.9	49.63
Baring Asia Private Equity Fund IV, L.P.	2007	Private Equity	300,000,000	299,036,096	209,373,609	286,998,748	8.90%	1.66	27.00	22.43	4.50	3.59	49.33	5.94	1777391863	35.07
Blue Point Capital Partners II, L.P.	2007	Private Equity	100,000,000	92,540,501	166,930,524	47,239,573	18.90%	2.31	9.00	6.94	1.50	1.11	30.41	4.85	448569087.9	11.50
Capital International Private Equity Fund \	2007	Private Equity	200,000,000	204,785,901	182,602,895	11,504,837	-1.48%	0.95	18.00	15.36	3.00	2.46	-	3.59	735492105	23.53
Cinven Fourth Fund	2007	Private Equity	201,482,814	206,669,064	270,786,940	20,964,850	7.00%	1.41	18.13	15.50	3.02	2.48	-	5.10	1053173774	23.71
Gleacher Mezzanine Fund II, L.P.	2007	Special Situations	100,000,000	91,977,798	121,870,338	681,218	10.61%	1.33	9.00	6.90	1.50	-	7.64	2.85	261762472.7	15.90



KRG Capital Fund IV, L.P.	2007	Private Equity	300,000,000	287,028,332	337,445,210		6.26%	1.18	27.00	21.53	4.50	3.44	-	2.67	764962644.2	34.75
Navis Asia Fund V, L.P.	2007	Private Equity	100,000,000	121,024,807	181,335,725		8.83%	1.50	9.00	9.08	1.50	1.45	15.08	4.78	578335646.7	12.27
New Mountain Partners III, L.P.	2007	Private Equity	300,000,000	303,474,150	332,455,016	246,208,764	13.79%	1.91	27.00	22.76	4.50	3.64	68.80	5.00	1516202968	35.19
OCM Opportunities Fund VII, L.P.	2007	Special Situations	75,000,000	75,000,000	96,363,822	6,760,731	7.49%	1.37	6.75	5.63	1.13	-	-	4.41	330672672.2	12.38
Partners Group Secondary 2008 S.C.A., Sit	2007	Private Equity	200,772,150	178,459,488	219,934,855	42,969,268	8.87%	1.47	18.07	13.38	3.01	2.14	21.11	4.56	813563762.1	22.89
Platinum Equity Capital Partners II, L.P.	2007	Private Equity	300,000,000	282,375,537	385,761,971	112,308,446	14.70%	1.76	27.00	21.18	4.50	3.39	53.92	4.14	1168423770	34.62
PNC Equity Partners II, L.P.	2007	Private Equity	68,065,386	59,157,106	108,317,934	10,105,863	14.07%	2.00	6.13	4.44	1.02	0.71	14.82	5.27	311901326	7.72
Providence Equity Partners VI, L.P.	2007	Private Equity	300,000,000	316,291,227	403,436,046		5.69%	1.28	27.00	23.72	4.50	3.80	-	4.40	1390870755	35.54
Psilos Group Partners III, L.P.	2007	Venture Capital	62,500,000	64,471,078	32,146,734	52,906,930	4.90%	1.32	5.63	4.84	0.94	-	-	5.79	373405521.9	10.46
Quaker BioVentures II, L.P.	2007	Venture Capital	100,000,000	95,153,932	68,423,489	39,283,050	3.14%	1.13	9.00	7.14	1.50	-	-	4.01	381372751.6	16.14
StarVest Partners II (Parallel), L.P.	2007	Venture Capital	50,000,000	49,143,950	10,263,263	36,732,459	-0.83%	0.96	4.50	3.69	0.75	-	-	5.36	263550236.3	8.19
StepStone International Investors III L.P.	2007	Private Equity	139,654,310	137,023,257	96,302,048	22,277,120	-2.89%	0.87	12.57	10.28	2.09	1.64	-	4.93	675494331.9	16.27
Tenaya Capital V-P, L.P.	2007	Venture Capital	75,000,000	68,800,806	88,826,978	43,210,941	17.21%	1.92	6.75	5.16	1.13	-	15.81	4.11	282432487.5	11.91
Trilantic Capital Partners IV L.P.	2007	Private Equity	76,752,676	79,140,339	110,980,173	17,296,178	14.53%	1.62	6.91	5.94	1.15	0.95	12.28	3.56	281734399.1	9.04
Aisling Capital III, L.P.	2008	Venture Capital	50,000,000	55,758,405	65,148,673	38,709,917	23.77%	1.86	4.50	4.18	0.75	-	12.03	2.92	162631003.1	8.68
Avenue Europe Special Situations Fund, L.P.	2008	Special Situations	203,579,414	260,544,517	362,645,255		12.18%	1.39	18.32	19.54	3.05	-	25.53	2.88	749551878.8	37.86
Bridgepoint Europe IV, L.P.	2008	Private Equity	400,647,075	370,761,035	376,288,428	211,748,659	11.59%	1.59	36.06	27.81	6.01	4.45	54.32	4.21	1559410903	46.07
Catterton Growth Partners, L.P.	2008	Private Equity	75,000,000	92,996,496	78,123,852	63,716,303	9.52%	1.53	6.75	6.97	1.13	1.12	12.21	4.64	431699356.3	9.26
Clarity PSERS II, L.P.	2008	Private Equity	17,386,250	12,225,121	2,451,273		-28.86%	0.20	1.56	0.92	0.26	0.15	-	4.72	57689254.32	1.89
CVC Capital Partners Asia Pacific III, L.P.	2008	Private Equity	300,000,000	295,760,392	407,869,886	72,613,080	13.87%	1.62	27.00	22.18	4.50	3.55	46.18	3.74	1104922868	34.99
CVC European Equity Partners V, L.P.	2008	Private Equity	393,205,903	432,823,008	548,539,546	181,322,392	14.79%	1.69	35.39	32.46	5.90	5.19	74.26	3.79	1639633359	47.07
Evergreen Pacific Partners II, L.P.	2008	Private Equity	80,954,545	69,295,755	112,366,281	22,192,997	20.04%	1.94	7.29	5.20	1.21	0.83	16.32	3.63	251765199.2	9.16
First Reserve Fund XII, L.P.	2008	Private Equity	250,000,000	271,961,621	120,621,735	71,283,066	-8.74%	0.71	22.50	20.40	3.75	3.26	-	3.81	1036792412	29.84
Headland Private Equity Fund 6 Ltd.	2008	Private Equity	200,000,000	187,330,868	215,392,572		5.08%	1.15	18.00	14.05	3.00	2.25	-	2.82	527705450.5	23.06
Landmark Equity Partners XIV, L.P.	2008	Private Equity	150,000,000	141,169,667	129,718,251	57,619,167	10.56%	1.33	13.50	10.59	2.25	1.69	11.54	2.82	397893481.3	17.31
LLR Equity Partners III, L.P.	2008	Venture Capital	187,500,000	168,296,850	193,061,392	94,707,366	14.66%	1.71	16.88	12.62	2.81	-	29.87	3.92	659930044	29.50
Milestone Partners III, L.P.	2008	Private Equity	60,000,000	61,078,376	53,308,563	7,994,934	0.07%	1.00	5.40	4.58	0.90	0.73	-	5.26	321122546.5	7.05
New York Life Capital Partners IV-A L.P.	2008	Private Equity	100,000,000	109,029,901	159,311,262	41,681,091	13.80%	1.84	9.00	8.18	1.50	1.31	22.99	4.73	515868769.5	11.94
Nordic Capital VII Beta, L.P.	2008	Private Equity	166,973,378	187,621,305	230,587,380		5.34%	1.23	15.03	14.07	2.50	2.25	-	3.96	743676755.7	20.09
OCM Opportunities Fund VII-B, L.P.	2008	Special Situations	225,000,000	202,500,000	332,209,087	16,890,781	16.64%	1.72	20.25	15.19	3.38	-	36.65	3.54	716500021.5	35.44
PAI Europe V	2008	Private Equity	135,590,427	127,523,536	145,455,466	54,252,127	8.03%	1.57	12.20	9.56	2.03	1.53	18.05	5.81	740574941.2	15.65
Strategic Partners Fund IV VC, L.P.	2008	Venture Capital	50,000,000	57,690,876	62,085,664	16,873,812	7.76%	1.37	4.50	4.33	0.75	-	-	4.20	242257735.3	8.83
Strategic Partners Fund IV, L.P.	2008	Private Equity	100,000,000	95,277,862	128,399,284	23,591,114	13.45%	1.60	9.00	7.15	1.50	1.14	14.18	3.70	352610665.3	11.57
TPG Partners VI, L.P.	2008	Private Equity	360,000,000	364,618,439	486,773,394		10.75%	1.34	32.40	27.35	5.40	4.38	30.54	2.83	1031832650	42.24
Versa Capital Fund II, L.P.	2008	Special Situations	150,000,000	166,533,012	61,987,088	115,015,414	1.74%	1.06	13.50	12.49	2.25	-	-	3.53	588600639	25.99
Crestview Partners II, L.P.	2009	Private Equity	200,000,000	223,862,451	208,740,494	184,043,441	15.54%	1.75	18.00	13.43	3.00	2.69	42.23	3.89	871337266.4	20.69
Avenue Special Situations Fund VI, L.P.	2010	Special Situations	75,000,000	76,892,726	65,419,325	15,155,266	1.15%	1.05	6.75	3.46	1.13	-	-	4.09	314528003.3	10.21
Baring Asia Private Equity Fund V, L.P.	2011	Private Equity	200,000,000	258,860,880	115,909,119	212,474,816	9.25%	1.27	18.00	7.77	3.00	3.11	17.38	2.69	696078335.4	13.34
Capital International Private Equity Fund V	2011	Private Equity	100,000,000	85,968,947	8,836,449	67,436,396	-4.09%	0.89	9.00	2.58	1.50	1.03	-	2.87	246356536	7.45
Coller International Partners VI, L.P.	2011	Private Equity	100,000,000	70,276,733	41,954,887	62,581,134	15.55%	1.49	9.00	2.11	1.50	0.84	8.56	2.75	193078566.3	7.74
Denham Commodity Partners Fund VI, L.F.	2011	Private Equity	75,000,000	67,984,011	26,474,674	54,574,900	9.56%	1.19	6.75	2.04	1.13	0.82	3.27	1.93	130892893.7	5.53
Incline Equity Partners III, L.P.	2011	Private Equity	65,000,000	52,705,864	58,196,745	33,978,835	30.25%	1.75	5.85	1.58	0.98	0.63	9.87	2.12	111473838.6	4.90
Milestone Partners IV, L.P.	2011	Private Equity	70,000,000	62,854,885	3,266,308	90,951,315	12.74%	1.50	6.30	1.89	1.05	0.75	7.84	3.38	212171148.4	5.17
Orchid Asia V, L.P.	2011	Private Equity	40,000,000	35,382,635	49,714,052	10,812,512	28.41%	1.71	3.60	1.06	0.60	0.42	6.29	2.15	75964603.44	2.96
Partners Group Secondary 2011 (USD), L.F.	2011	Private Equity	100,000,000	63,330,430	41,850,806	62,481,175	19.62%	1.65	9.00	1.90	1.50	0.76	10.25	2.79	176474096.1	7.86
Strategic Partners Fund V, L.P.	2011	Private Equity	150,000,000	117,397,311	134,562,779	56,146,102	21.10%	1.62	13.50	3.52	2.25	1.41	18.33	2.53	297520805.1	11.39
Actis Global 4, L.P.	2012	Private Equity	100,000,000	77,926,914	12,381,782	71,482,000	3.74%	1.08	9.00	1.17	1.50	0.94	-	2.00	155826845.5	6.43
Bain Capital Asia Fund II, L.P.	2012	Private Equity	100,000,000	97,500,000	68,580,185	102,766,489	23.46%	1.76	9.00	1.46	1.50	1.17	18.46	2.68	260853282.5	5.78
Catterton Partners VII, L.P.	2012	Private Equity	100,000,000	101,585,643	8,493,428	118,727,973	10.74%	1.25	9.00	1.52	1.50	1.22	6.41	2.21	224079747.3	5.65

Cerberus Institutional Partners V, L.P.	2012	Special Situations	200,000,000	212,359,277	111,375,046	219,522,197	14.24%	1.56	18.00	3.19	3.00	-	29.63	3.33	707477119.8	21.19
Cinven Fifth Fund, L.P.	2012	Private Equity	119,649,271	122,334,803	72,661,077	93,966,171	16.52%	1.36	10.77	1.84	1.79	1.47	11.07	2.02	247239802.6	6.73
GoldPoint Partners Co-Investment V, L.P.	2012	Private Equity	50,000,000	51,765,238	16,513,419	54,160,775	21.01%	1.37	4.50	0.78	0.75	0.62	4.73	1.63	84517339.38	2.79
NGP Natural Resources X, L.P.	2012	Private Equity	100,000,000	98,372,962	64,538,857	46,403,477	4.80%	1.13	9.00	1.48	1.50	1.18	-	2.56	252301815.1	5.75
Palladium Equity Partners IV, L.P.	2012	Private Equity	75,000,000	50,254,240	4,462,353	55,334,196	9.56%	1.19	6.75	0.75	1.13	0.60	2.39	1.90	95691624.22	5.09
PEIP #1	2012	PSERS Private Eq	14,999,081	6,188,176	18,877,139	6,809,914	50.86%	4.15	-	-	0.22	-	-	3.46	21420973.01	-
PEIP #2	2012	PSERS Private Eq	13,878,761	13,878,761	33,036,817	-	44.43%	2.38	-	-	0.21	-	-	2.36	32741359.15	-
PEIP #3	2012	PSERS Private Eq	10,000,000	10,000,000	3,651,097	14,528,692	15.43%	1.82	-	-	0.15	-	-	4.17	41655050	-
PEIP #4	2012	PSERS Private Eq	10,000,000	7,500,000	4,459,782	10,564,521	16.33%	2.00	-	-	0.15	-	-	4.59	34448751.65	-
Platinum Equity Capital Partners III, L.P.	2012	Private Equity	200,000,000	167,530,424	149,308,859	151,547,157	33.65%	1.80	18.00	2.51	3.00	2.01	33.33	2.02	338155719.6	12.47
Summit Partners Growth Equity Fund VIII,	2012	Venture Capital	100,000,000	106,235,469	48,159,118	117,493,379	21.72%	1.56	9.00	1.59	1.50	-	14.85	2.26	240105170.8	10.59
Summit Partners Venture Capital Fund III,	2012	Venture Capital	25,000,000	25,000,000	7,085,788	33,337,056	16.15%	1.62	2.25	0.38	0.38	-	3.86	3.21	80240456.49	2.63
Tenaya Capital VI, L.P.	2012	Venture Capital	50,000,000	43,133,075	-	41,867,627	-0.91%	0.97	4.50	0.65	0.75	-	-	3.26	140497737.3	5.15
Windjammer Senior Equity Fund IV, L.P.	2012	Special Situations	100,000,000	75,012,533	4,237,899	70,473,498	-0.19%	1.00	9.00	1.13	1.50	-	-	2.12	158660699.1	10.13
Apollo Investment Fund VIII, L.P.	2013	Special Situations	220,000,000	145,126,637	22,937,079	152,637,529	13.72%	1.21	19.80	-	3.30	-	7.61	1.48	214985050.5	19.80
Catterton Growth Partners II, L.P.	2013	Private Equity	75,000,000	73,853,446	-	88,759,019	7.90%	1.20	6.75	-	1.13	0.89	-	2.42	178568409.1	3.21
DCPF VI Oil and Gas Coinvestment Fund L	2013	Private Equity	25,000,000	21,522,070	4,625,060	30,446,000	32.23%	1.63	2.25	-	0.38	0.26	3.39	1.75	37617033.57	1.22
HgCapital 7, L.P.	2013	Private Equity	109,710,728	95,999,656	19,290,702	100,607,871	12.13%	1.25	9.87	-	1.65	1.15	5.97	1.94	186401519.2	5.27
LLR Equity Partners IV, L.P.	2013	Venture Capital	200,000,000	164,000,000	45,151,535	183,486,148	22.74%	1.39	18.00	-	3.00	-	16.16	1.62	265949904.3	18.00
New Mountain Partners IV, L.P.	2013	Private Equity	100,000,000	73,369,240	7,319,605	89,138,660	22.63%	1.31	9.00	-	1.50	0.88	5.77	1.34	98402405.33	5.48
North Haven Private Equity Asia IV, L.P.	2013	Private Equity	100,000,000	74,236,550	8,532,727	80,597,678	9.28%	1.20	9.00	-	1.50	0.89	3.72	2.06	152954809.3	5.44
PEIP #10	2013	PSERS Private Eq	14,982,607	6,854,911	4,664,047	7,148,244	17.23%	1.72	-	-	0.22	-	-	3.42	23465613.83	-
PEIP #6	2013	PSERS Private Eq	11,785,993	10,161,101	13,012,891	16,254,136	29.74%	2.88	-	-	0.18	-	-	4.06	41286225.73	-
PEIP #7	2013	PSERS Private Eq	12,007,603	12,281,374	8,507,605	19,135,971	24.43%	2.25	-	-	0.18	-	-	3.71	45586557.21	-
PEIP #8	2013	PSERS Private Eq	12,187,352	11,506,417	1,256,611	32,642,284	32.53%	2.95	-	-	0.18	-	-	3.84	44143147.02	-
PS-PEIP #1	2013	PSERS Private Eq	2,500,000	2,500,000	-	4,601,596	15.22%	1.84	-	-	0.04	-	-	4.31	10766197.27	-
Trilantic Capital Partners V (North Americ	2013	Private Equity	100,000,000	74,813,685	22,014,866	81,124,764	16.03%	1.38	9.00	-	1.50	0.90	7.08	2.16	161565918.4	5.41
Bain Capital Fund XI, L.P.	2014	Private Equity	100,000,000	62,500,000	18,366,696	72,314,042	26.54%	1.45	7.20	-	1.50	0.75	7.05	1.58	98820343.5	4.20
Blue Point Capital Partners III, L.P.	2014	Private Equity	60,000,000	34,337,578	8,727,093	43,750,426	24.88%	1.53	4.32	-	0.90	0.41	4.53	1.91	65549976.8	2.67
HGGC Fund II, L.P.	2014	Private Equity	100,000,000	83,652,424	15,475,646	84,145,198	15.39%	1.19	7.20	-	1.50	1.00	3.99	1.22	102091635.8	3.18
NGP Natural Resources XI, L.P.	2014	Private Equity	100,000,000	58,487,190	11,573,665	62,337,562	30.45%	1.26	7.20	-	1.50	0.70	3.86	0.88	51498548.49	4.39
Odyssey Investment Partners Fund V, L.P.	2014	Private Equity	100,000,000	38,455,987	13	32,670,930	-13.48%	0.85	7.20	-	1.50	0.46	-	1.13	43298679.32	5.35
Orchid Asia Fund VI, L.P.	2014	Private Equity	75,000,000	27,428,542	3,455,297	27,431,376	11.60%	1.13	5.40	-	1.13	0.33	0.86	1.08	29675236.14	4.08
PEIP #12	2014	PSERS Private Eq	15,000,000	12,086,263	-	42,224,684	46.85%	3.49	-	-	0.23	-	-	3.26	39348004.02	-
PEIP #13	2014	PSERS Private Eq	13,000,000	13,035,722	26,587,857	64,747,800	94.17%	7.01	-	-	0.20	-	-	2.93	38245853.71	-
PEIP #14	2014	PSERS Private Eq	13,000,000	10,000,000	-	19,611,570	25.20%	1.96	-	-	0.20	-	-	3.00	29969199.7	-
PEIP #15	2014	PSERS Private Eq	6,000,000	6,000,000	-	6,000,000	0.00%	1.00	-	-	0.09	-	-	4.00	24000000	-
PEIP #16	2014	PSERS Private Eq	16,448,766	7,550,757	3,434,089	9,680,904	24.09%	1.74	-	-	0.25	-	-	2.56	19314745.73	-
PEIP #17	2014	PSERS Private Eq	10,000,000	10,000,000	-	22,499,800	34.29%	2.25	-	-	0.15	-	-	2.75	27504573.02	-
PEIP #18	2014	PSERS Private Eq	15,000,000	10,886,435	2,781,354	10,817,333	10.76%	1.25	-	-	0.23	-	-	2.18	23697222.49	-
Strategic Partners Fund VI, L.P.	2014	Private Equity	150,000,000	92,484,023	42,099,775	86,840,695	23.88%	1.39	10.80	-	2.25	1.11	9.11	1.55	143519967.5	6.36
The Energy & Minerals Group Fund III, L.P.	2014	Private Equity	100,000,000	93,705,930	2,441,014	79,693,746	-5.76%	0.88	7.20	-	1.50	1.12	-	2.22	208181368.1	2.70
Baring Asia Private Equity Fund VI, L.P.	2015	Private Equity	100,000,000	45,633,060	150,451	53,138,190	13.64%	1.17	5.40	-	1.50	0.55	1.91	1.21	55349349.06	3.21
Bridgepoint Europe V, L.P.	2015	Private Equity	167,930,277	76,298,263	15,406,708	76,927,280	27.23%	1.21	9.07	-	2.52	0.92	4.01	0.79	60437005.39	5.41
Cerberus Institutional Partners VI, L.P.	2015	Special Situations	200,000,000	35,028,933	872,857	46,879,670	26.86%	1.36	10.80	-	3.00	-	3.18	1.30	45621462.54	10.80
Clearlake Capital Partners IV, L.P.	2015	Special Situations	57,500,000	42,635,479	4,124,120	55,599,295	42.85%	1.40	3.11	-	0.86	-	4.27	0.95	40293736.05	3.11
Collier International Partners VII, L.P.	2015	Private Equity	100,000,000	5,017,808	-	8,479,603	57.12%	1.69	5.40	-	1.50	0.06	0.87	1.16	5826614.64	5.16
Crestview Partners III, L.P.	2015	Private Equity	150,000,000	45,988,366	758,272	46,505,019	1.73%	1.03	8.10	-	2.25	0.55	-	1.59	73319055	5.89
Equistone Partners Europe Fund V, L.P.	2015	Private Equity	73,107,454	49,103,483	-	61,470,418	21.28%	1.25	3.95	-	1.10	0.59	3.09	1.16	57170081.11	1.59

PAI Europe VI	2015	Private Equity	114,969,556	45,926,301	4,515,851	56,504,039	16.76%	1.33	6.21	-	1.72	0.55	3.77	1.83	84223784.56	4.00	
Partners Group Secondary 2015 (USD) A,	2015	Private Equity	100,000,000	14,961,090	625,079	17,106,441	20.23%	1.19	5.40	-	1.50	0.18	0.69	0.92	13796160.43	4.68	
PEIP #19	2015	PSERS Private Eq	15,000,000	15,175,000		9,408,795	-19.14%	0.62			0.23			2.25	34143026.63	-	
PEIP #20	2015	PSERS Private Eq	15,000,000	12,362,967	709,159	14,578,876	10.42%	1.24			0.23	-		2.14	26487418.24	-	
PEIP #21	2015	PSERS Private Eq	15,000,000	15,012,260		17,013,777	7.34%	1.13			0.23	-		1.77	26526140.05	-	
PEIP #22	2015	PSERS Private Eq	14,617,943	14,758,714	4,208,263	15,028,254	18.54%	1.30			0.22			1.56	22993351.88	-	
Searchlight Capital Partners II, L.P.	2015	Special Situations	74,000,000	22,307,040	1,638,201	26,133,896	22.42%	1.24	4.00		1.11		1.37	1.08	24164264.1	4.00	
Summit Partners Growth Equity Fund IX, I	2015	Venture Capital	100,000,000	6,000,000		9,176,221	52.94%	1.53	5.40		1.50		0.79	1.00	5999724.53	5.40	
Summit Partners Venture Capital Fund IV,	2015	Venture Capital	50,000,000	12,481,575		14,069,196	15.97%	1.13	2.70		0.75		0.40	0.81	10086780.46	2.70	
Tenaya Capital VII, L.P.	2015	Venture Capital	100,000,000	35,366,880	5,845,583	29,366,723	-0.35%	1.00	5.40		1.50			1.25	44183291.77	5.40	
Venor Special Situations Fund II, L.P.	2015	Special Situations	100,000,000	90,392,327	1,428	96,762,940	5.72%	1.07	5.40		1.50			1.22	110698359	5.40	
Versa Capital Fund III, L.P.	2015	Special Situations	150,000,000	67,500,000	1,875,000	29,790,321	-59.07%	0.47	8.10		2.25			0.85	57193245.54	8.10	
Woodstream	2015	PSERS Private Eq	8,682,106	8,682,106		14,741,967	35.81%	1.70			0.13			1.73	15017327.99	-	
			27,474.19	25,246.54	30,377.20	7,637.72		1.51		1.378	1.626	412	215	2.873	3.94	4.01	1.142
			13,588.26	11,924.52	10,305.00	6,546.06		1.41		1.127	846	204	107	1.071	2.93	3.37	1.378

Funds highlighted in yellow had its IRR corrected as it was inconsistent with its TVPI (same if IRR was missing; assumed 4 years HP)

#### Assumptions

If this portfolio is liquidated today

Only keep pre 2015 inv (no dist for more recent)

Mngt fees commitment period 1.8%

Mngt fees post commitment period 1.5%

Carry always 20%, hurdle 8%, US style

PC fees (% inv) 6%

% rebated 80%

Fund expenses (% Kcom) 1.5%

PC fees only if Private Equity 1

No fee paid if PSERS Private Equity Internal 1

Results	From inception	From 2007 vintage
Weighted average Implied inv duration	4.01	3.37
TVPI	1.51	1.41
RoR using weighted average implied inv d	10.7%	10.8%
TVPI gross of fees	1.80	1.61
Impact of fees on RoR	5.1%	4.5%
RoR gross of fees	15.8%	15.3%
Total Invested (billion)	25.2	11.9
Total value (billion)	38.0	16.9
Total Fees Paid (billion)	7.5	2.4
	30%	7.4%
		20%
		6.0%

Estimate of reported fees per year (billion)	0.8	0.4
Estimate of average NAV	35	16
Estimate of reported annual TER	2.2%	2.5%
Estimate of actual annual TER	5.3%	4.6%

0

# INVESTMENT COSTS AND TRANSPARENCY GUIDELINES

AS PART OF NOVARCA'S ENGAGEMENT UNDER AGREEMENT BETWEEN \_\_\_\_\_ AND NOVARCA, THESE GUIDELINES HAVE BEEN PRODUCED TO MAXIMIZE THE COST CONSCIOUSNESS AND EFFICIENCY IN THE PROCESS OF INVESTING.



# Guidelines for

## To meet Novarca Investment Cost and Transparency Guidelines, an Investor must:

1. Have regular access to all information to adequately compute and compare its costs and it must establish procedures to do so.
2. Compensate its Managers through management and incentive fees only.
  - Any other direct or indirect compensation or benefits, received by Manager or its affiliates resulting from the investment, must be credited back to the Investor.
  - Research, market data and travel costs need to be borne by the manager, and brokerage must be “unbundled” from these costs.
  - All expenses, including operating expenses, must be transparently reported.
3. Establish appropriate Benchmarks to evaluate its Managers’ performance.
  - Incentive fees should only be accrued for true long-term performance over those Benchmarks (consistent alpha) and where positive.
  - Manager should be incentivized to take appropriate risks by limiting fees through use of tools such as hurdles, caps, high watermarks; and avoiding use of catch-up clauses.
4. Invest through the vehicles, structures, and share classes that minimize total costs over the lifetime of the investment.
5. Receive benefits from both the economies of scale and the status that its investment brings.
6. Establish that transactions are executed efficiently, taking into account state of the market and order timing, while minimizing the costs.
7. Identify the next-best alternative to the current investment (e.g., passive, internally managed, alternative manager, etc.).
8. Prohibit undue special treatment of individual Managers which inhibits us from achieving our objective of full transparency.

# Sample Checklist

## Transparency And Flexibility

- Has the Manager committed to being completely transparent by regularly sharing any requested documentation?
- Do we have a system in place to regularly review the documentation?
- Are the procedures in place to calculate total costs for this Manager?
- Is our capacity to invest unencumbered by capacity constraints? (If no, explain constraints.)
- Has the Manager shown willingness to renegotiate terms with us at a later date if the relationship or investment evolves?
- Will the Manager give us security-level transaction and holdings information?
- Will the Manager give us trade blotter details on a periodic basis so we can monitor trading efficiency as we desire?

## Structure And Comparability

- Is the investment in the most efficient vehicle possible (e.g. separate account where applicable, invested in most appropriate share class)?
- Do we have the processes to make adequate comparisons of this investment to other managers?
- Are all costs including operating expenses, (un)bundled brokerage, management fees, and incentive fees reported on a consistent basis to allow comparison with other managers?
- Has the next-best alternative to the current investment been identified (e.g. passive, other manager, other allocation, etc.)?
- Do we have an appropriate Benchmark to evaluate the success of the investment?
- Do we and the Manager use the same Benchmark or performance metric to evaluate the success of the investment?

# Sample Checklist

## Management Fees

- How are the total fees tiered and calculated to reflect economies of scale driven by increase of assets under management?
- Is the incentive scheme for the Manager appropriately tied to its Benchmark?
  - Does the Incentive Fee have a hurdle?
  - Does the hurdle reflect the strategy of the investment?
  - Is there a limit to the total fee (including incentive fee), e.g., is there an appropriate cap?
  - Is the long-term performance properly measured ?
  - Does the Manager forgo all Incentive Fees on a negative return (full claw-back)?
  - Does the Manager forgo catch-up clauses that might result in fees paid for underperforming periods?
  - Do fee calculations include a high water mark?

## Operating Expenses

- Does the Manager pay all operating expenses out of its management fee? (If no, list all sunk costs not included in management fee.)
- Do we pay execution-only, as opposed to bundled brokerage?
- In cases where bundled brokerage (soft dollars) occurs, are these research-related fees credited against management fees?
- Are any trade handling or administrative fees charged by broker or custodian/administrator?

## Other

- Are there any fees for withdrawing funds?
- Has a cost-minimizing entry and exit strategy for the investment been established (to minimize transaction costs, market timing risk, etc.)?



# Contact

---

Novarca North America  
380 Hamilton Avenue #115  
Palo Alto, CA 94302

Thomas Welsh  
Telephone: +1 415 699 3388  
Email: [thomas.welsh@novarca.com](mailto:thomas.welsh@novarca.com)  
[www.novarca.com](http://www.novarca.com)

## Global Offices

---

Novarca International Ltd.  
Oberdorfstrasse 11  
8808 Pfaeffikon  
Switzerland

Novarca Benelux  
Strawinskylaan 411  
1077 XX Amsterdam  
The Netherlands

Novarca U.K. Ltd  
Mutual House  
70 Conduit St.  
Mayfair, London  
W1S 2GF  
United Kingdom

Novarca Australia  
Macquarie House  
167 Macquarie Street  
Sydney NSW  
Australia

## Disclaimer

---

This document has been produced by Novarca International, its advisers and its affiliates (together, "Novarca").

The findings, ratings and/or opinions expressed herein are the intellectual property of Novarca and are subject to change without notice. They are not intended to convey any guarantees as to the future performance of the investment products, asset classes or capital markets discussed. Past performance does not guarantee future results. The future value of investments may rise and fall with changes in the market. This document does not constitute or form part of any offer to issue or sell, or any solicitation of any offer to subscribe or purchase, any securities nor shall it or the fact of its distribution form the basis of, or be relied on in connection with, any contract thereof. Potential investors should consult their advisers to discuss the suitability and implications of the underlying products and instruments referred to therein.

Information contained herein has been obtained from a range of third party sources and from conversations held with stakeholders. While the information is believed to be reliable and Novarca have used their best efforts in collecting the information, Novarca has not sought to verify it and has not been subject to an Audit. As such, Novarca makes no representations or warranties as to the accuracy of the information presented.

The work presented in this report represents our best efforts and judgments based on the information available at the time this report was prepared. No guarantee or warranty is made as to the reasonableness of the assumptions or the accuracy of the models or market data used by Novarca. Similarly, all the calculations made are non-binding for Novarca. Estimates contained in this Report are based upon information and assumptions that we consider reasonable, subject to uncertainties as to circumstances, and are subject to material variation. The information contained herein has not been independently verified and no representation or warranty, express or implied, is made to and no reliance should be placed on the fairness, accuracy, completeness or correctness of the information or opinions contained in this document. Novarca shall not have any liability whatsoever for any loss whatsoever arising from use of this document, its contents or otherwise arising in connection with this document.

The document has been provided by Novarca exclusively for the use of the selected recipient and shall not be altered in any way, transmitted to, copied or distributed, in part or in whole, to any other person or to the media or reproduced in any form.

This document cannot be considered to meet all decision requirements the recipient may have. The latter is therefore not exempt to conduct its own analysis and due diligence it deems appropriate to make an investment decision.

By accepting this presentation and not immediately returning it the recipient warrants, represents and agrees that to have read and agreed and to comply with the contents of this disclaimer.