Minnesota State Board of Investment

Legislative Commission on Pensions and Retirement

September 20, 2017

Mansco Perry | Executive Director and Chief Investment Officer

60 Empire Drive | Suite 355 | St. Paul, MN 55103 | 651-296-3328 | http://mn.gov/sbi/

State Board of Investment

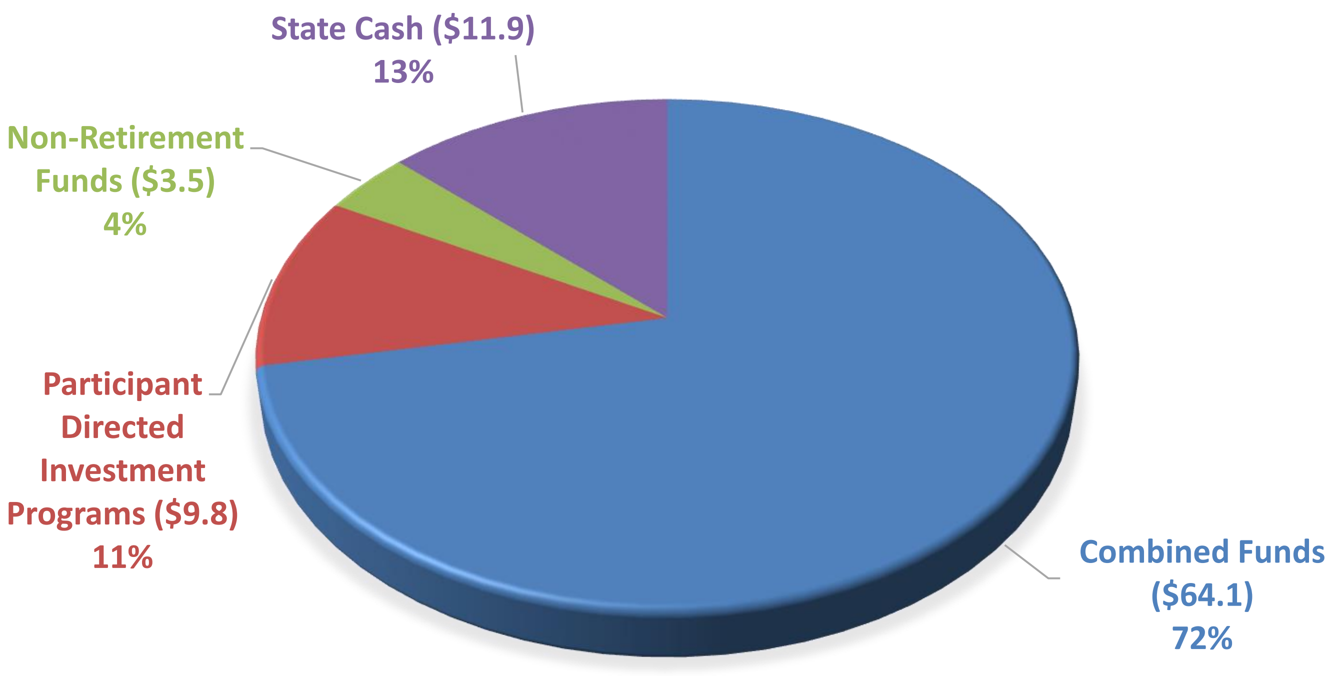
- Board is defined in Article XI of Minnesota Constitution

Constitutional Members of the State Board	
Governor	Mark Dayton
State Auditor	Rebecca Otto
Secretary of State	Steve Simon
Attorney General	Lori Swanson

- Assisted by 17-member Investment Advisory Council (IAC)
  - 10 experienced investment professionals
  - Executive directors of statewide retirement plans
  - Commissioner of Minnesota Management & Budget
  - Two active members and one retired member appointed by the governor
- Managed by an internal staff of 24

SBI Funds Under Management – Total Assets

As of June 30, 2017 (In $ Billions)



- Participant Directed Investment Programs include the Deferred Compensation Plan, Unclassified Plan, Health Care Savings Plan, and Hennepin County Supplemental Retirement Plan, Minnesota College Savings Plan, and the Achieve a Better Life Experience Plan.
- Non-Retirement Funds include statewide trusts, Assigned Risk Plan, and Other Post Employment Benefits Accounts.

What is the State Board of Investment (SBI)?

- Established in Article XI of the Minnesota Constitution for the purpose of managing and directing the investments of all state funds and pension funds.
- Not a pension plan or a sponsoring entity. By statute, the SBI has the investment authority and responsibility to manage assets. The SBI has limited capability and resources to administer accounts.
- All investments are codified in Minnesota Statutes Chapters 11A and 356A. The SBI owes a fiduciary duty to: the active, deferred, and retired members of the plan; the taxpayers of the state or political subdivision who help to finance the plan; and the state of Minnesota, which established the plan.

Investment Funds Managed by The SBI	
Combined Funds	Represents the assets of the active and retired public employees who participate in ten defined benefit retirement plans administered by the three statewide retirement systems: Teachers Retirement Association (TRA), Public Employees Retirement Association (PERA), and Minnesota State Retirement System (MSRS). The assets are all invested with external institutional investment managers.
State Deferred Compensation Plan	Provides public employees with a tax-sheltered defined contribution retirement savings plan that is supplemental to their retirement plan. These assets are invested in mutual funds and commingled investment trusts and are directed by the participants.

Additional Funds listed on next page

Funds Managed by State Board of Investment

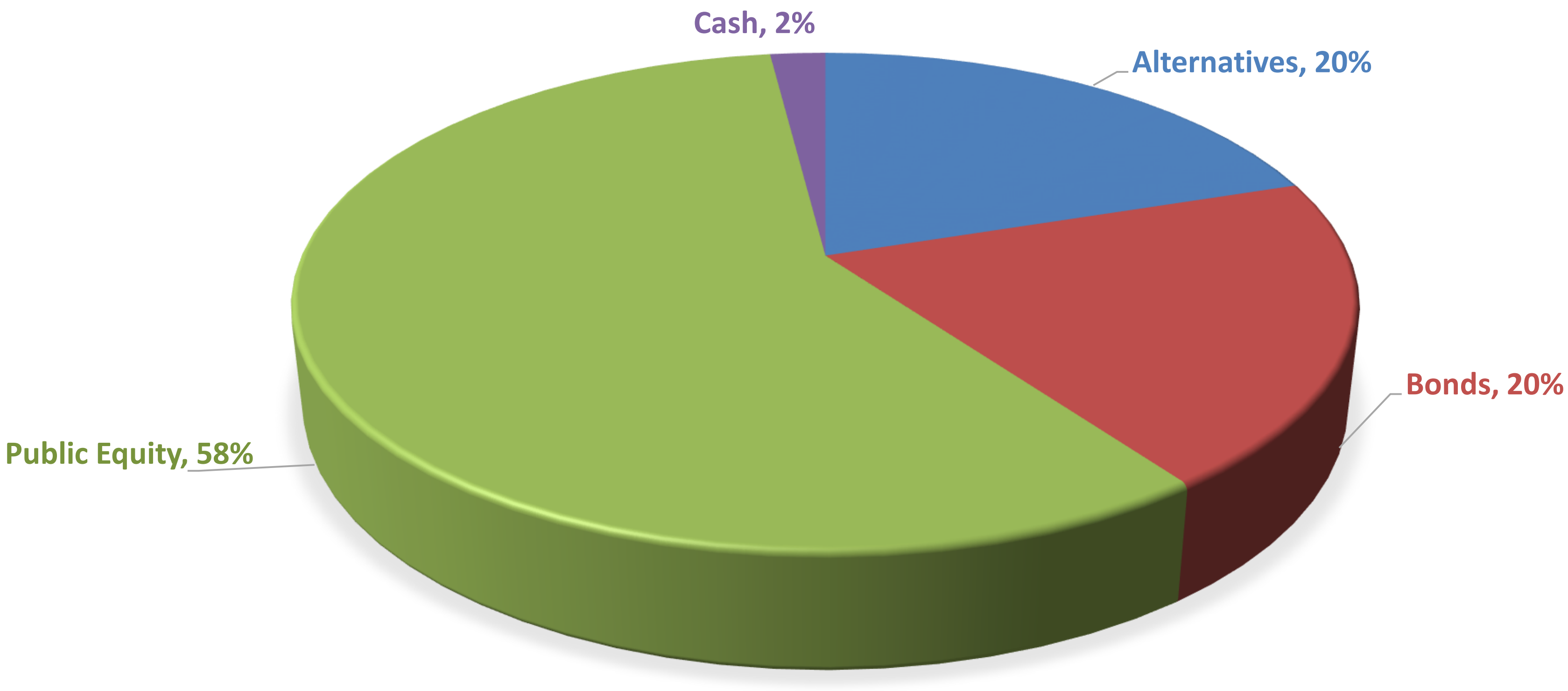
Investment Funds Managed by the SBI	
Supplemental Investment Fund (SIF)	SIF is a multi-purpose investment program that offers a range of externally and internally managed investment options to state and local public employees. Participating groups use the SIF for a variety of reasons. The assets of the Unclassified Plan, Health Care Savings Plan, PERA DC Plan, Hennepin County Supplemental Retirement Plan, Statewide Volunteer Firefighter Retirement Plan, and some local police and firefighter retirement accounts are all invested through the SIF.
Assigned Risk Plan	The Assigned Risk Plan provides workers compensation coverage to Minnesota employers rejected by licensed insurance companies. These assets are invested externally with institutional investment managers.
Minnesota College Savings Plan	The Minnesota College Savings Plan is administered and invested with a third-party firm, TIAA-CREF. SBI and Office of Higher Education (OHE) contract jointly with TIAA-CREF to provide these services.
State Cash Accounts	State Cash Accounts represent over 400 separate accounts that flow through state treasury. These assets are invested internally by SBI staff.
Non-Retirement Funds	Non-Retirement Funds represents the assets of various state trust funds that include, among others, the Permanent School Fund, Environmental Trust Fund, and Closed Landfill; and Other Post Employment Benefit (OPEB) Accounts. All of these funds have three investment options that are managed by internal SBI staff: equity (S&P 500), fixed income (Bloomberg Barclays Aggregate), and cash.

Combined Funds - Summary

- The Combined Funds constitute the assets of Minnesota’s three statewide pension plans—MSRS, PERA, and TRA—from which the plans draw funds to pay retirement benefits to public employees.
- The State Board of Investment serves the pension plans by investing plan assets through outside investment managers.
- The Board and staff provide on-going monitoring of investment managers.

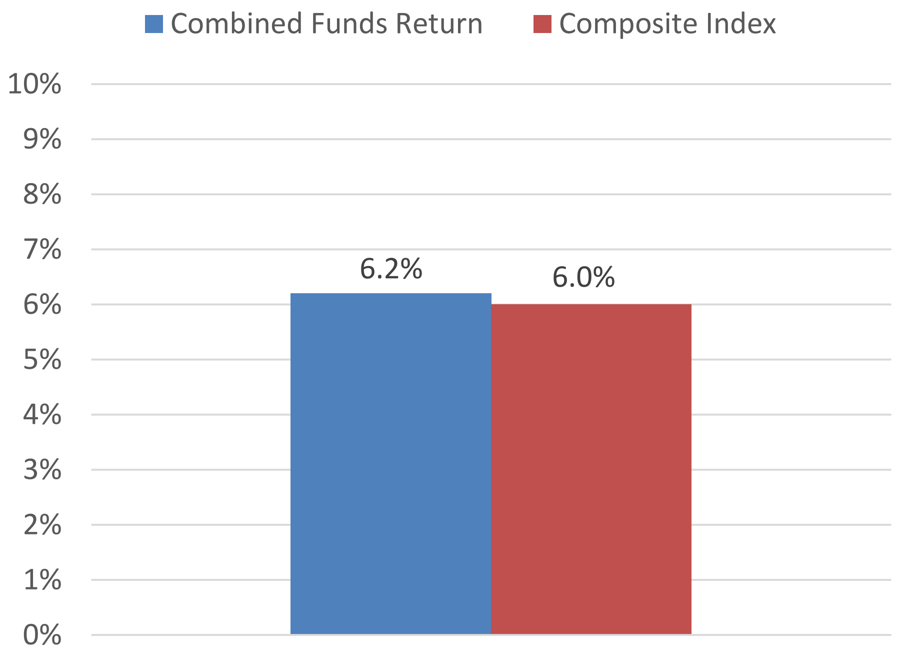
Combined Funds

Strategic Asset Allocation as of June 30, 2017



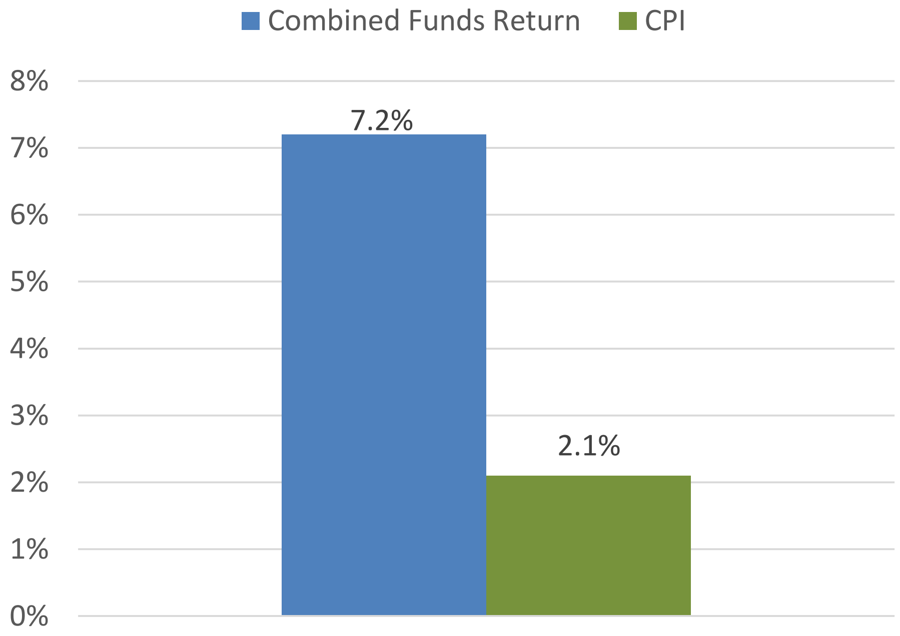
Combined Funds
Long-Term Investment Objectives
Periods ending June 30, 2017

Match or Exceed Composite Index (10 Yr)

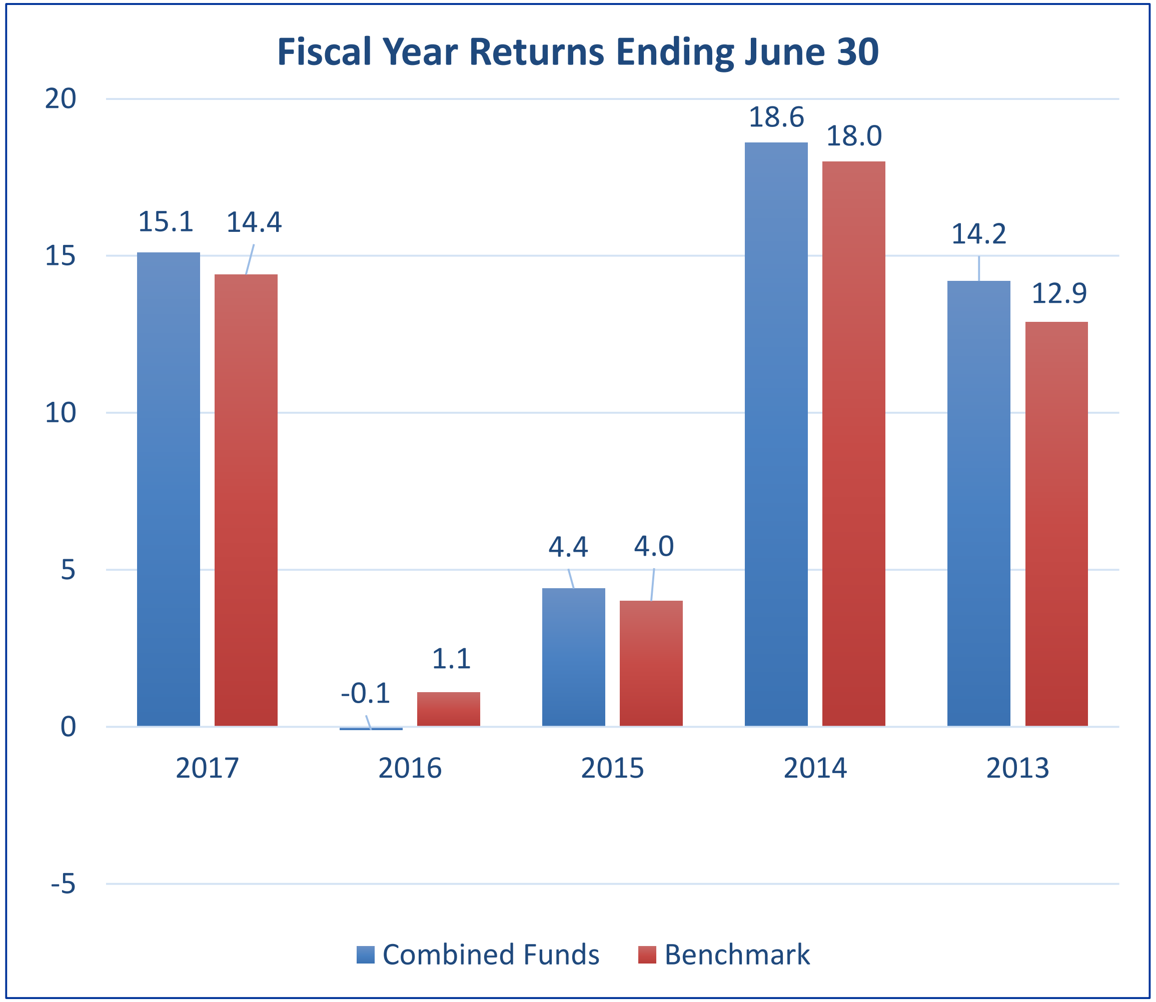


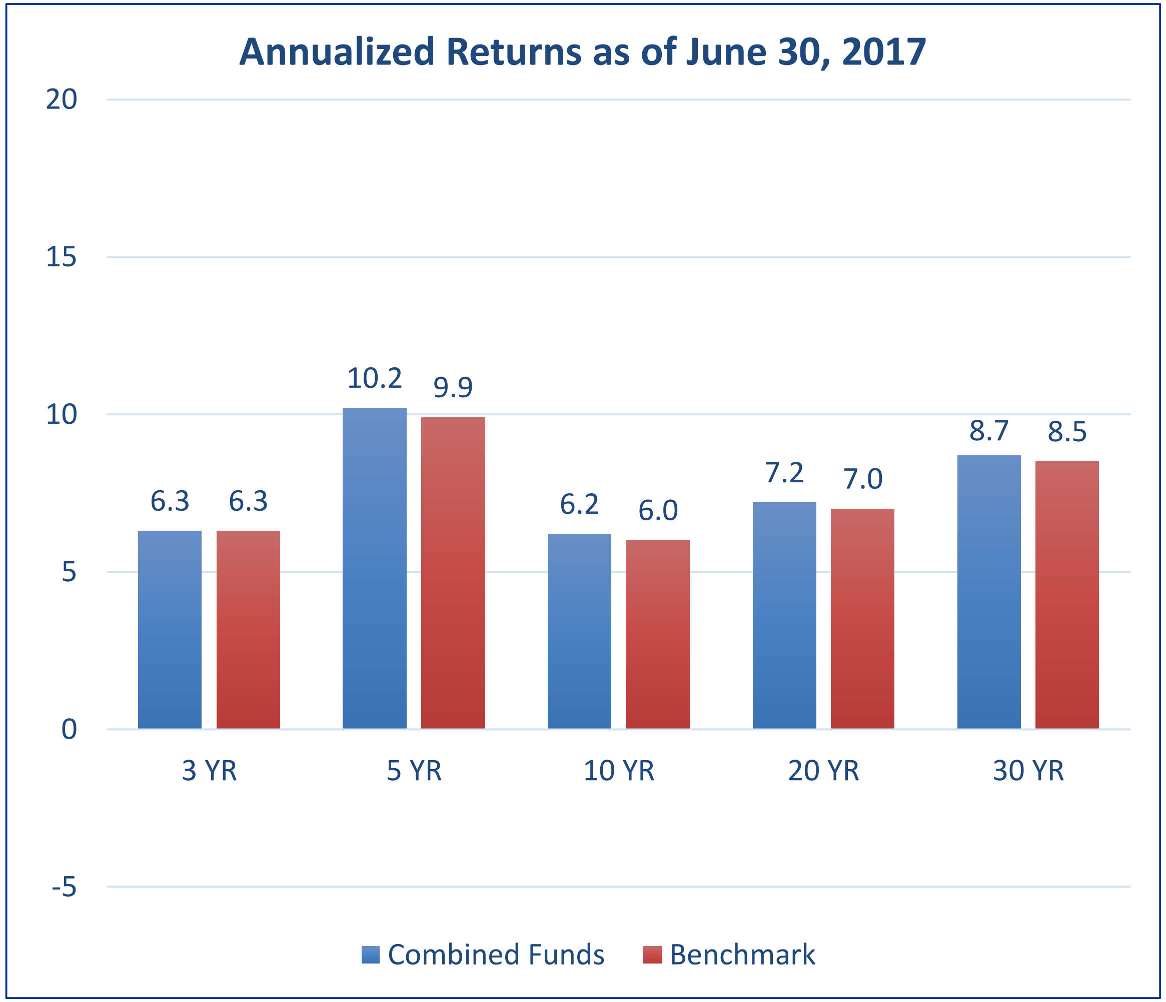
Provide Real Return (20 Yr)

(Provide 3-5 percentage points over inflation)



Combined Pension Funds Investment Returns





Performance Compared to Other Pension Funds

For Time Periods Ending June 30, 2017

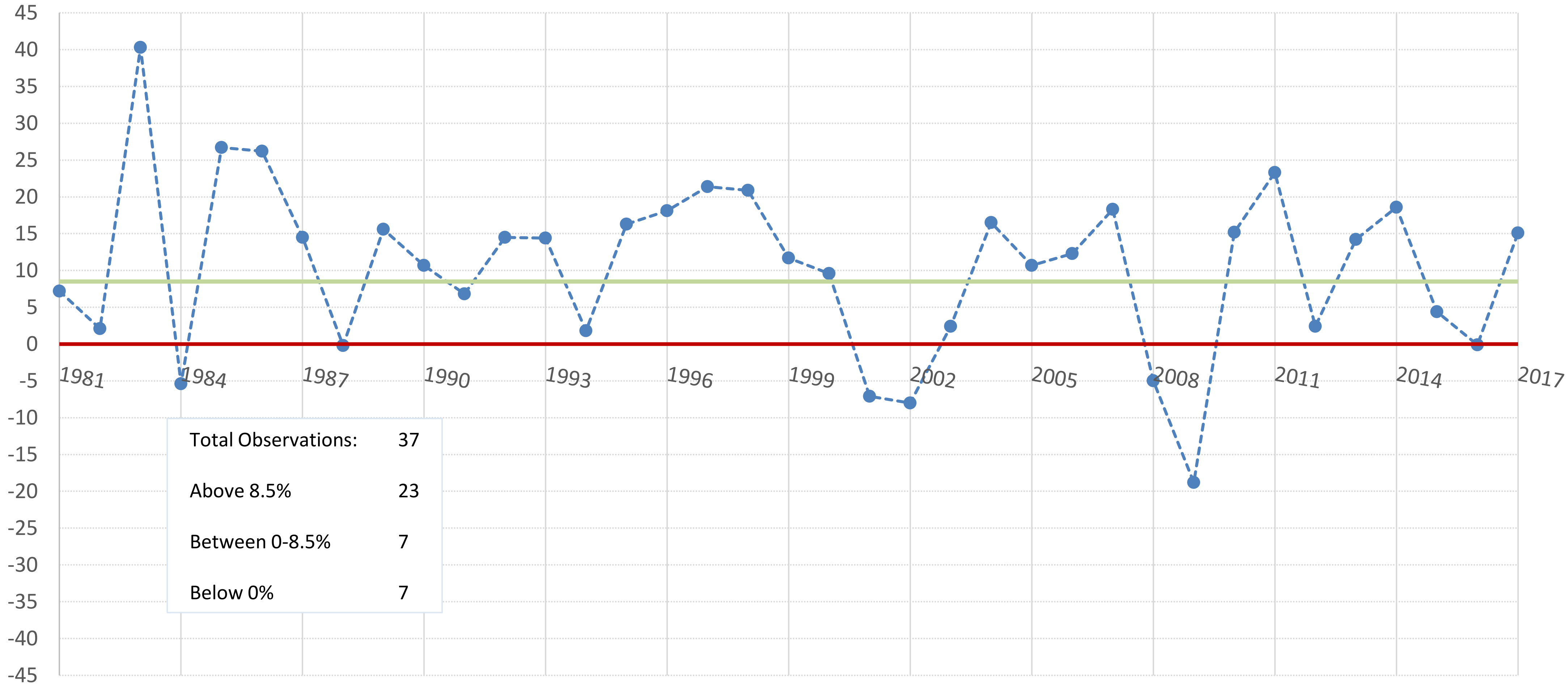
TUCS Universe Ranking[1]	1 Yr	3 Yrs	5 Yrs	10 Yrs
Combined Funds Returns	15.1%	6.3%	10.2%	6.2%
SBI Combined Funds Percentile Rank in TUCS[2]	7th	18th	10th	19th

[1] Source: Trust Universe Comparison Service (TUCS) includes the total returns of both public and private plans with assets over $1 billion.

[2] Top performing plans will have low percentile rankings. For example, a plan that is ranked 24th would be a top quartile performing plan.

Combined Funds Returns

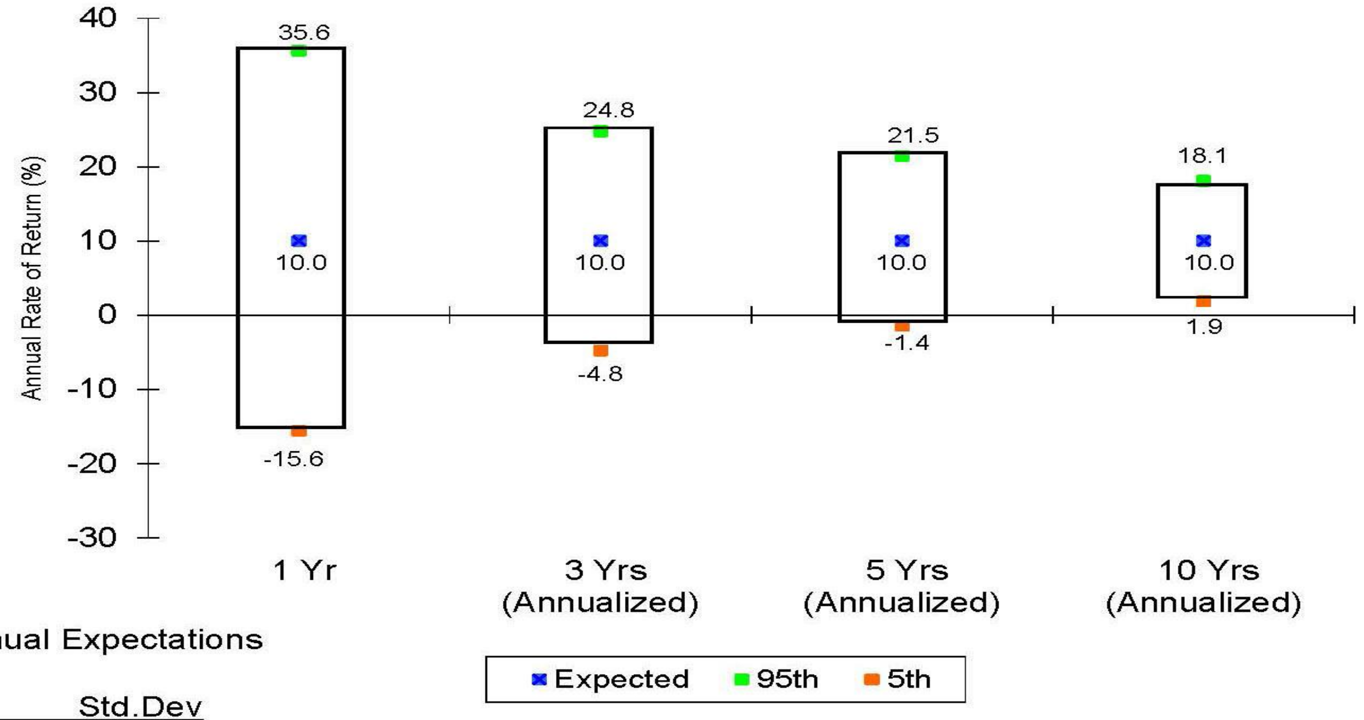
Fiscal Years 1981-2017



Total Observations:	37
Above 8.5%	23
Between 0-8.5%	7
Below 0%	7

Market Risk Simulation: An Example

Capital Market Risk
Asset Simulation: 75% Equity Allocation



Assumptions: Annual Expectations

	Return	Std.Dev
Equity	11.2	20.0
Bonds	6.5	6.5

Phase 1: Methodology and Assumptions

Long-Term Capital Market Projections (2016 – 2025)

Asset Class	Index	PROJECTED RETURN 1-Year Arithmetic	PROJECTED RETURN 10-Year Geometric*	PROJECTED RETURN Real	PROJECTED RISK Standard Deviation	Sharpe Ratio	Projected Yield	2015 - 2024 10-Year Geometric*	2015 - 2024 Standard Deviation	Geometric* Delta
Equities										
Broad Domestic Equity	Russell 3000	8.85%	7.35%	5.10%	18.70%	0.353	2.40%	7.60%	19.00%	-0.25%
Large Cap	S&P 500	8.60%	7.25%	5.00%	17.95%	0.354	2.50%	7.50%	18.30%	-0.25%
Small/Mid Cap	Russell 2500	9.85%	7.55%	5.30%	22.75%	0.334	1.90%	7.85%	22.95%	-0.30%
Global ex-U.S. Equity	MSCI ACWI ex USA	9.55%	7.55%	5.30%	21.30%	0.343	2.70%	7.80%	21.45%	-0.25%
International Equity	MSCI World ex USA	9.00%	7.25%	5.00%	20.05%	0.337	3.00%	7.50%	20.20%	-0.25%
Emerging Markets Equity	MSCI Emerging Markets	11.15%	7.60%	5.35%	27.85%	0.320	1.70%	7.90%	27.95%	-0.30%
Fixed Income										
Short Duration	Barclays G/C 1-3	2.60%	2.60%	0.35%	2.25%	0.156	2.80%	2.40%	2.25%	0.20%
Domestic Fixed	Barclays Aggregate	3.05%	3.00%	0.75%	3.75%	0.213	4.60%	3.00%	3.75%	0.00%
Long Duration	Barclays Long G/C	4.30%	3.70%	1.65%	11.40%	0.197	5.30%	3.20%	11.40%	0.50%
TIPS	Barclays TIPS	3.10%	3.00%	0.75%	5.30%	0.160	4.20%	3.00%	5.30%	0.00%
High Yield	Barclays High Yield	5.40%	5.00%	2.75%	10.50%	0.300	8.00%	5.00%	11.10%	0.00%
Non-U.S. Fixed	Barclays Global Aggregate ex US	1.80%	1.40%	-0.85%	9.20%	-0.049	4.00%	2.30%	9.40%	-0.90%
Emerging Market Debt	EMBI Global Diversified	5.00%	4.60%	2.35%	9.90%	0.278	6.50%	4.70%	10.00%	-0.10%
Other										
Real Estate	Callan Real Estate	7.20%	6.00%	3.75%	16.45%	0.301	5.00%	6.15%	16.50%	-0.15%
Private Equity	TR Post Venture Cap	13.15%	8.15%	5.90%	32.80%	0.322	0.00%	8.50%	33.05%	-0.35%
Hedge Funds	Callan Hedge FOF Database	5.55%	5.25%	3.00%	9.30%	0.355	2.25%	5.25%	9.30%	0.00%
Commodities	Bloomberg Commodity	4.40%	2.75%	0.50%	18.50%	0.116	2.25%	2.75%	18.50%	0.00%
Cash Equivalents	90-Day T-Bill	2.25%	2.25%	0.00%	0.90%	0.000	2.25%	2.25%	0.90%	0.00%
Inflation	CPI-U		2.25%		1.50%			2.25%	1.50%	0.00%

* Geometric returns are derived from arithmetic returns and the associated risk (standard deviation).

Phase 1: Methodology and Assumptions

2016 Correlation Matrix

	Broad US Eq	Large Cap	Sm/Mid Cap	Global ex-US	Non-US Equity	Em Mkt Eq	Defens	US Fixed	Long Duration	TIPS	High Yield	Non-US Fixed	Em Mkt Debt	Real Estate	Private Equity	Hedge Funds	Comm	Cash Equiv	Inflation
Broad US Equity	1.000																		
Large Cap	0.997	1.000																	
Small/Mid Cap	0.965	0.940	1.000																
Global ex-US Equity	0.882	0.879	0.853	1.000															
Non-US Equity	0.852	0.850	0.820	0.986	1.000														
Em Mkts Equity	0.861	0.855	0.840	0.933	0.860	1.000													
Defensive	-0.240	-0.230	-0.260	-0.254	-0.230	-0.280	1.000												
US Fixed	-0.108	-0.100	-0.130	-0.123	-0.105	-0.150	0.870	1.000											
Long Duration	0.136	0.138	0.121	0.106	0.119	0.069	0.729	0.925	1.000										
TIPS	-0.050	-0.045	-0.065	-0.053	-0.045	-0.065	0.530	0.580	0.527	1.000									
High Yield	0.640	0.640	0.610	0.629	0.610	0.610	-0.170	0.020	0.220	0.060	1.000								
Non-US Fixed	0.014	0.050	-0.100	0.013	0.060	-0.090	0.480	0.510	0.542	0.340	0.120	1.000							
Em Mkt Debt	0.579	0.580	0.550	0.550	0.530	0.540	-0.120	0.030	0.159	0.150	0.600	0.010	1.000						
Real Estate	0.735	0.730	0.715	0.669	0.650	0.645	-0.140	-0.020	0.190	0.005	0.560	-0.050	0.450	1.000					
Private Equity	0.948	0.945	0.915	0.934	0.905	0.905	-0.240	-0.190	0.062	-0.100	0.640	-0.060	0.560	0.710	1.000				
Hedge Funds	0.797	0.795	0.765	0.760	0.735	0.740	-0.120	0.080	0.303	0.055	0.570	-0.080	0.540	0.600	0.770	1.000			
Commodities	0.167	0.165	0.165	0.177	0.170	0.175	-0.220	-0.120	-0.042	0.100	0.100	0.050	0.190	0.200	0.180	0.210	1.000		
Cash Equivalents	-0.043	-0.030	-0.080	-0.040	-0.010	-0.100	0.300	0.100	-0.049	0.070	-0.110	-0.090	-0.070	-0.060	0.000	-0.070	0.070	1.000	
Inflation	-0.011	-0.020	0.020	0.010	0.000	0.030	-0.200	-0.280	-0.284	0.180	0.070	-0.150	0.000	0.100	0.000	0.200	0.400	0.000	1.000

- Relationships between asset classes is as important as standard deviation.
- To determine portfolio mixes, Callan employs mean-variance optimization.
- Return, standard deviation and correlation determine the composition of efficient asset mixes.

Source: Callan Associates

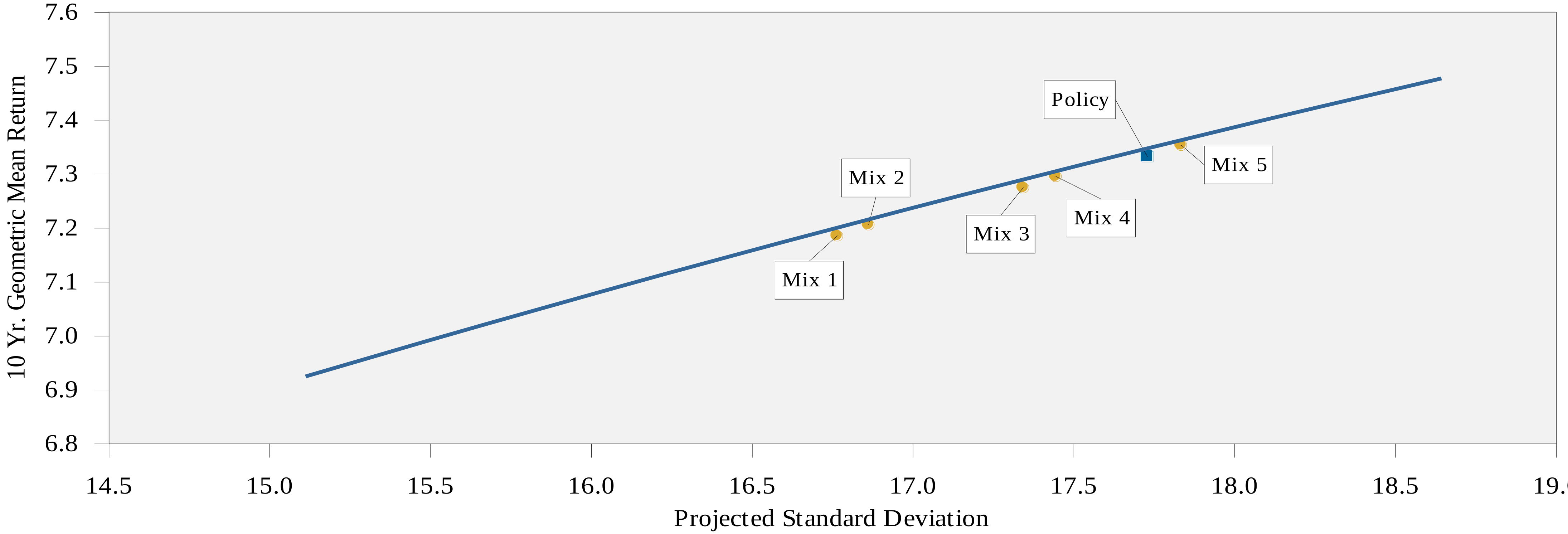
Phase II: Create Alternative Asset Mixes

Asset Classes	Policy	Constraints Min	Constraints Max	Optimal Mixes Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
US Broad Equity	45	0	100	41	37	44	39	40
International Equity	15	0	100	14	18	15	19	20
Domestic Fixed	18	0	100	23	23	20	20	18
Private Equity	20	0	100	20	20	20	20	20
Cash Equivalents	2	2	100	2	2	2	2	2
Totals	100			100	100	100	100	100
Arithmetic Return	8.65			8.35	8.39	8.53	8.57	8.69
Compound Expected Return	7.34			7.19	7.21	7.27	7.30	7.35
Risk (Standard Deviation)	17.73			16.76	16.86	17.34	17.44	17.83
Public Equity	60.00			55.00	55.00	58.00	58.00	60.00
Public Fixed	20.00			25.00	25.00	22.00	22.00	20.00

- The alternative mixes were created by staff to compare allocations to fixed income and public equity US vs NonUS ratio
  – All mixes hold allocations to Private Equity constant at the current policy weight of 20%
  – Cash Equivalents are held constant at 2% to accommodate cash flows
- Mixes 1 and 2 have 23% in domestic fixed income
  – Mix 1 reflects current US vs NonUS ratio of 75/25
  – Mix 2 reflects US vs Non US ratio of 67/33
- Mixes 3 and 4 have 20% in domestic fixed income
  – Mix 3 reflects current US vs NonUS ratio (75/25)
  – Mix 4 reflects US vs NonUS ratio of 67/33
- Mix 5 has 18% in domestic fixed with US vs NonUS ratio of 67/33

Phase II: Create Alternative Asset Mixes

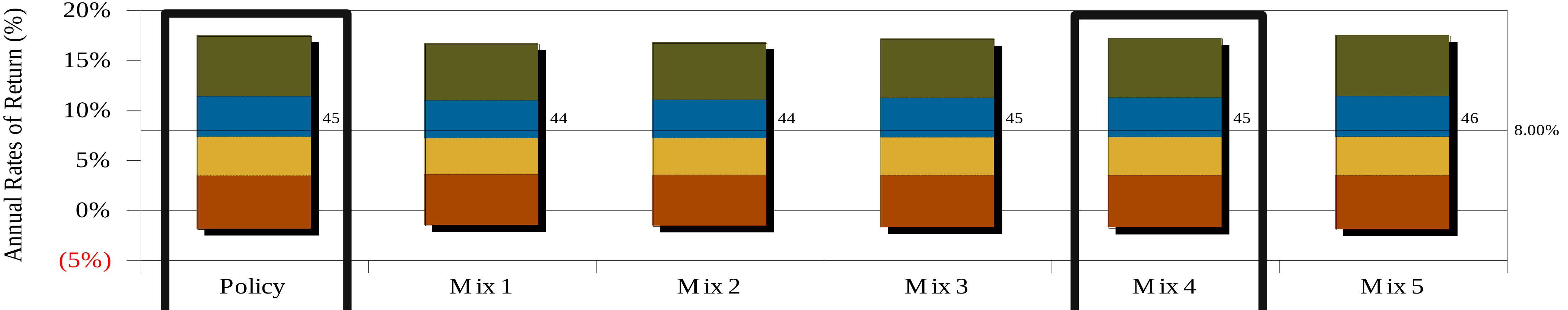
Efficient Frontier



- All of the asset mixes lie close to the efficient frontier
  - Mixes 1 and 3 lie slightly below the frontier
- When all mixes under consideration are essentially efficient, the mix with the maximum acceptable risk is often chosen

Phase II: Create Alternative Asset Mixes

Range of Returns, 10 Years



	Policy	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
5th Percentile	17.4%	16.6%	16.7%	17.1%	17.2%	17.5%
25th Percentile	11.3%	10.9%	11.0%	11.2%	11.2%	11.3%
Median	7.3%	7.1%	7.2%	7.2%	7.3%	7.3%
75th Percentile	3.4%	3.5%	3.5%	3.4%	3.4%	3.4%
95th Percentile	(1.9%)	(1.5%)	(1.6%)	(1.7%)	(1.8%)	(1.9%)
Prob > 8.00%	45.3%	44.3%	44.3%	44.9%	45.0%	45.5%

- The ten-year distributions continue the trends shown in the five-year distributions
- Median returns fall further due to five additional years of volatility drag
- The probability of achieving 8% is now near 45%