Callan

May 15, 2019

Asset Allocation and Liability Study - Update

Arkansas Public Employees Retirement System (APERS)

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What is an Asset-Liability Study?

- A technique to evaluate assets and liabilities so that an adequate return may be targeted.
  - From a fiduciary perspective, prudent to review the long-term strategy every 3-5 years.
- Helps fiduciaries understand the nature of the Pension Plan they oversee.
  - Incorporates actuarial assumptions and actuarial valuation process.
  - Examines the current and projected financial condition of the Plan.
    - *Funding requirements, funded status, contributions, etc.*
  - Explores the major risk factors facing the Plan.
    - Market risk, inflation risk, interest rate risk, currency risk, demographic risk, etc.
  - Sets investment goals and/or objectives to fully fund the obligations over the long-term.
  - Defines the tolerance for risk, including the need to take risk in order to achieve the objective.
- Determines the optimal investment (asset allocation) strategy relative to the liabilities.
  - The expected return on assets should be sufficient to support the desired level of funding of the liabilities.
    - For example, discount rate of 7.15% is the plan's targeted return
  - Actuarial assumptions are set over a long time horizon (working life of a participant, typically 20 years +), whereas capital market expectations are formed with a 10-year time horizon.

Interaction of Three Key Policies

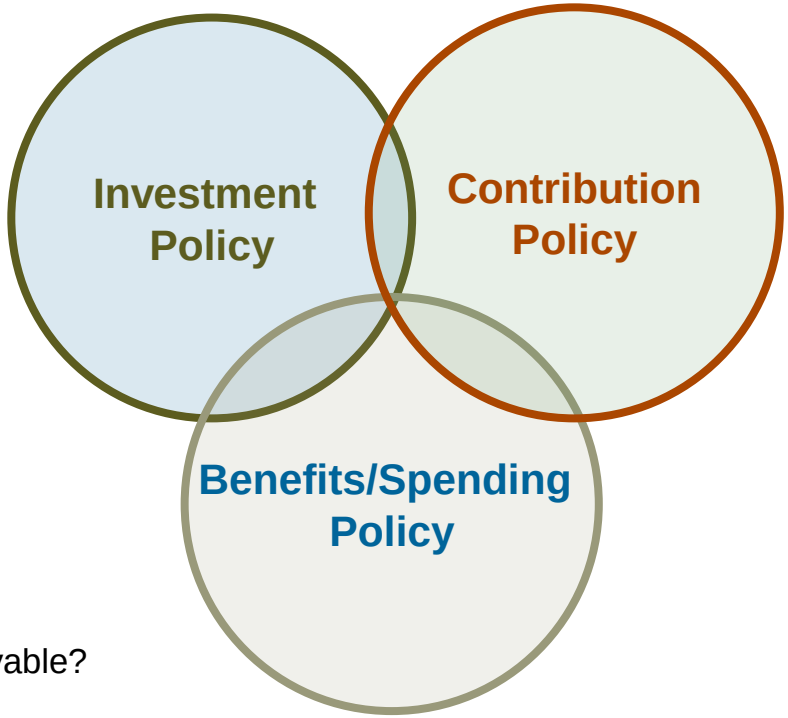
Asset-Liability study incorporates the three strategic policies that govern any pool of assets, whether it be a pension fund, endowment, or foundation.

Investment Policy

- How will the assets supporting the benefits be invested?
- What risk and return objectives?
- How to manage cash flows?

Benefits Policy

- What type/kind of benefits?
- What level of benefit?
- When and to whom are they payable?



Funding Policy

- How will the benefits be paid (funded)?
- What actuarial discount rate?

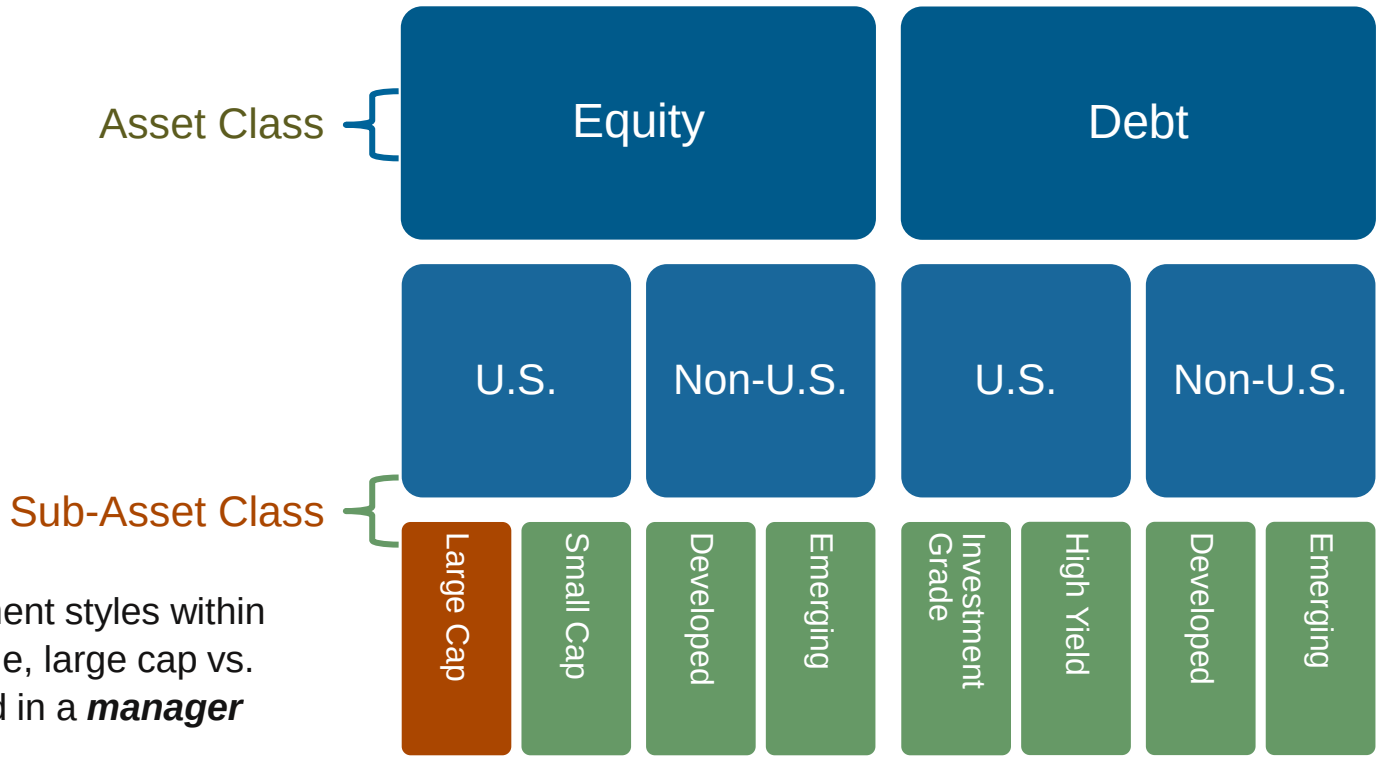
Goal of the Asset-Liability Study

- The goal of an asset-liability study is to establish a long-term strategic asset allocation target.
- Pension plan equation of balance:

- The primary goal of the Fund is to ensure sufficient liquidity to pay the benefits and expenses when due.
  - How do liquidity needs impact the investment decisions? For example, size of the equity allocation or commitment to illiquid asset classes.
- The secondary investment goal is to balance the competing objectives of:
  - Minimize costs over the long run (long-term goal)
    - How much return generation is necessary to meet actuarial return targets?
    - How much return generation is necessary to lower contributions and/or improve funded status?
  - Minimize funded status volatility (short-term goal)
    - How much risk reduction to reduce contribution/funded status volatility?
- The strategic asset allocation target should be an optimal balance between sustainable funded status volatility and minimization of contributions over the long run.
- The strategic asset allocation will vary by the unique circumstances of the Plan Sponsor
  - No “one-size-fits-all” solution exists.

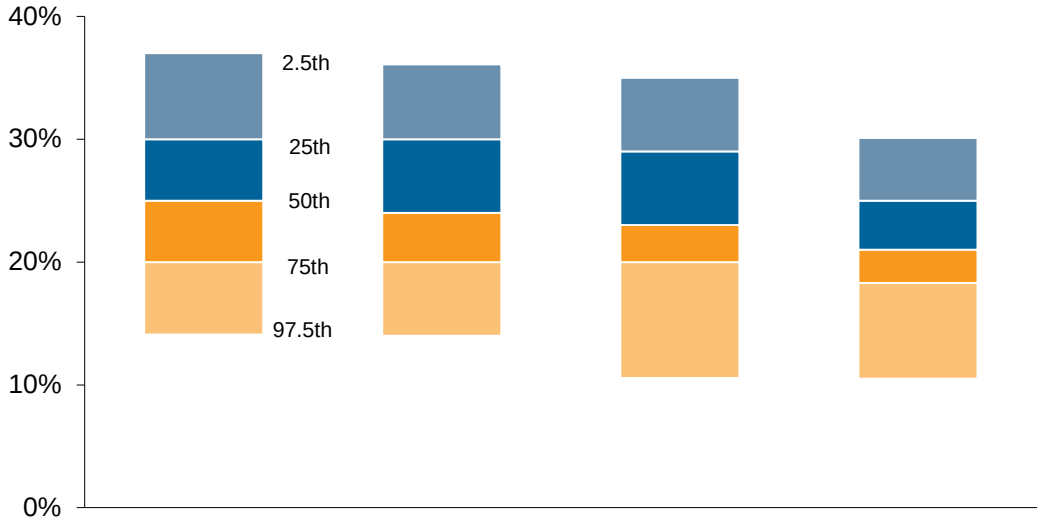
The Focus is on Broad Asset Classes

- Primary asset classes and important sub-asset classes include:
  - U.S. Stocks
  - U.S. Bonds
  - Non-U.S. Stocks
  - Non-U.S. Bonds
  - Alternative Investments
    - Real Estate
    - Private equity
    - Absolute return
  - Cash



- Breakdowns between investment styles within asset classes (growth vs. value, large cap vs. small cap) are best addressed in a ***manager structure analysis***.

Total Fixed Income Allocations

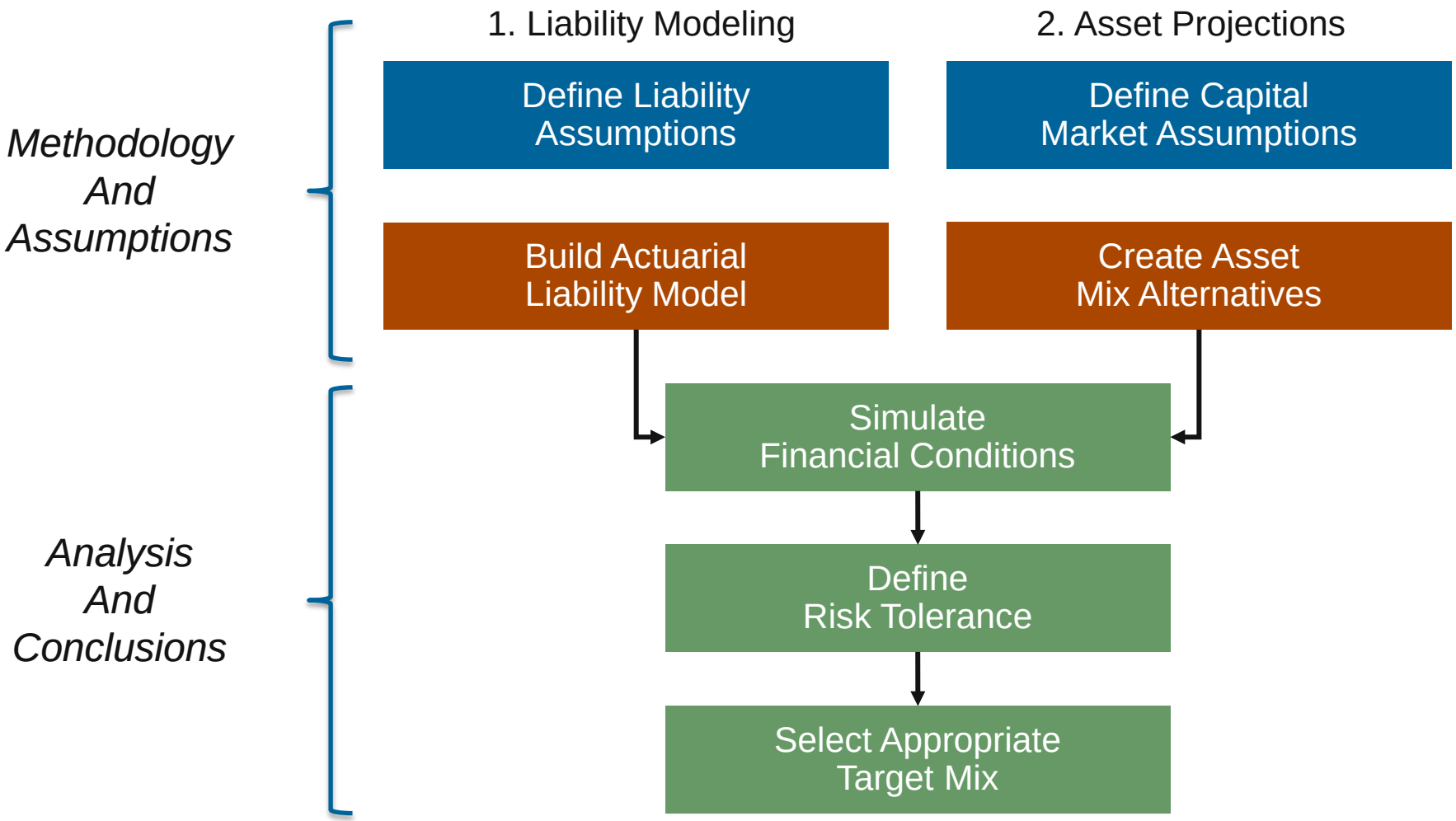


Percentile	Include Cash	Exclude Cash	Exclude Private Debt	Exclude Private Debt & TIPS
2.5th	37.0%	36.1%	35.0%	30.1%
25th	30.0%	30.0%	29.0%	25.0%
50th	**25.0%**	**24.0%**	**23.0%**	**21.0%**
75th	20.0%	20.0%	20.0%	18.3%
97.5th	14.1%	14.0%	10.6%	10.5%
% Invested	100.0%	100.0%	100.0%	100.0%

- Source: NASRA 2017 plan sponsor survey and Callan LLC

- Callan recently examined fixed income allocations in public funds using the largest public pension plans (NASRA) using 2017 data.
- The observed median fixed income allocation is 25%
  - 7.5% median actuarial discount rate
- Two standard deviation range is 14% to 37%
  - 6.5% to 8.0% range for the actuarial discount rate
- Median allocation declines if we exclude certain categories that are treated differently across plans:
  - Cash
  - Private debt
  - TIPS

Callan's Asset Allocation and Liability Process



Step 1 – Liability Modeling

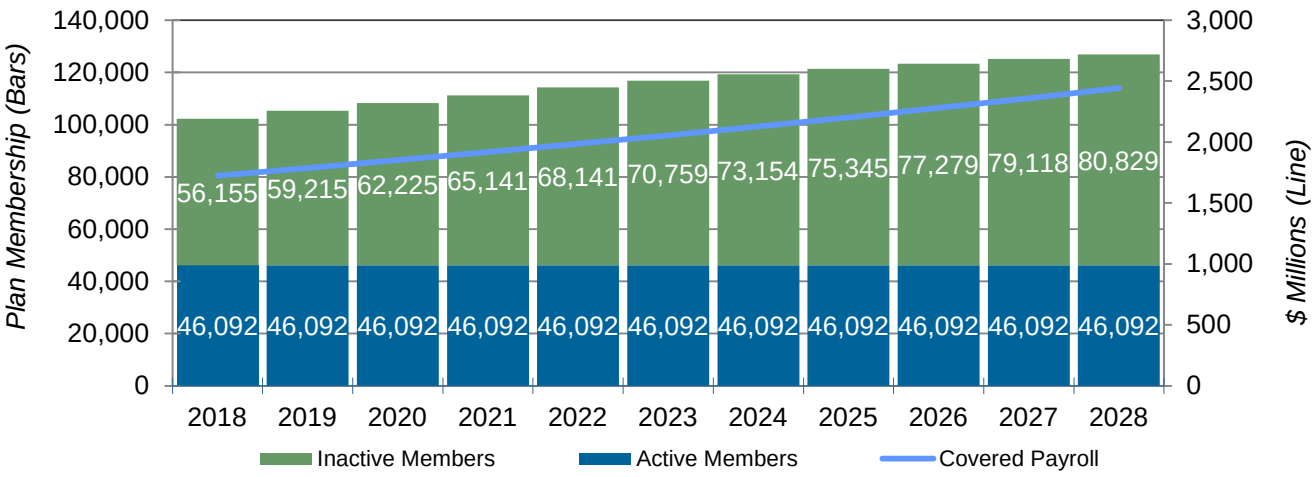
- July 1, 2017 data rolled forward 1 year. June 30, 2018 valuation results use latest experience study.
- Investment risk associated with the asset allocation decisions is reflected in the size of Unfunded Liability as well as the Employer Contribution.
  - Contribution amounts shown use a 30-year ***closed*** amortization beginning with June 30, 2017
    - Amortized $2.3B unfunded as of June 30, 2017 over 30 years.
    - Each new actuarial gain (loss) is subsequently amortized over a closed 30 year period.

	With Drop
Present Value Future Benefits (PVFB)	$ 12.24 B
less Present Value of Future Normal Costs	1.55
Actuarial Liability (AL)	10.69
Market Value of Assets (MVA)	$ 8.57 B
Actuarial Value of Assets (AVA)	$8.42 B
Surplus/(Unfunded Liability) = AVA-AL	$ -2.28 B
Funded Ratio = AVA/AL	78.7%
Normal Cost	11.36% of Pay
plus Amortization Payment (29-Year Closed)	7.43% of Pay
less Employee Contribution	- 3.47% of Pay
Employer Contribution	15.32% of Pay

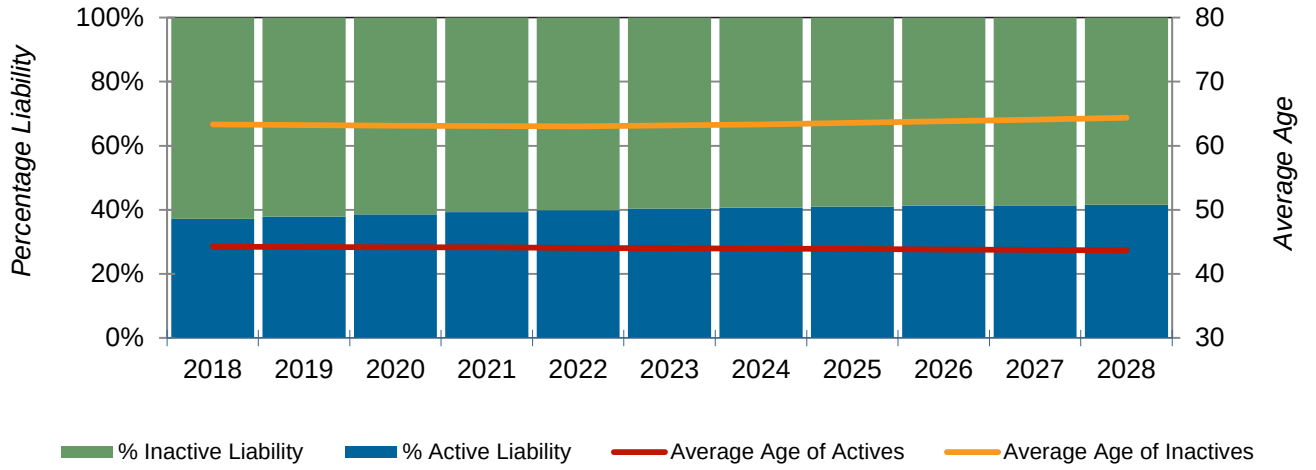
Step 1 – Liability Modeling

1. Level Population Characteristics

Plan Membership



Plan Maturity

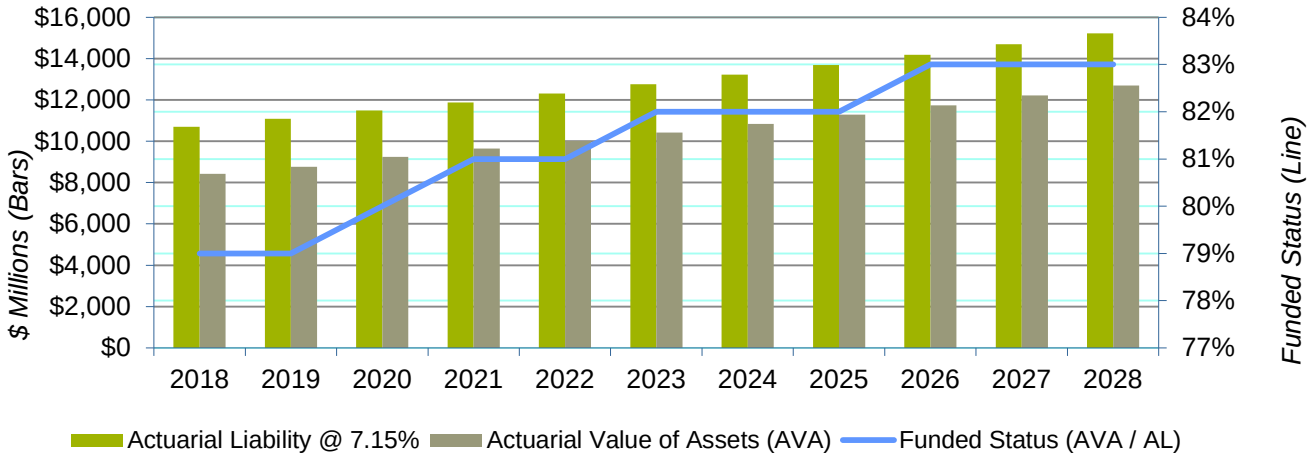


- Begin with a ***deterministic projection***, one scenario whereby the actuarial assumptions will be met (i.e., future experience will equal actuarial assumptions):
  - 7.15% investment return (i.e., actuarial discount rate)
  - 2.5% Wage Inflation
  - 3% Fixed COLA
  - New decrement assumptions from 2017 experience study.
- Level population assumption for active participants.
- Inactive includes retirees, beneficiaries, and deferred-terminated vested.
- Plan maturity indicates that active and inactive liabilities are fairly constant over next 10 years, with a larger portion associated with inactive.

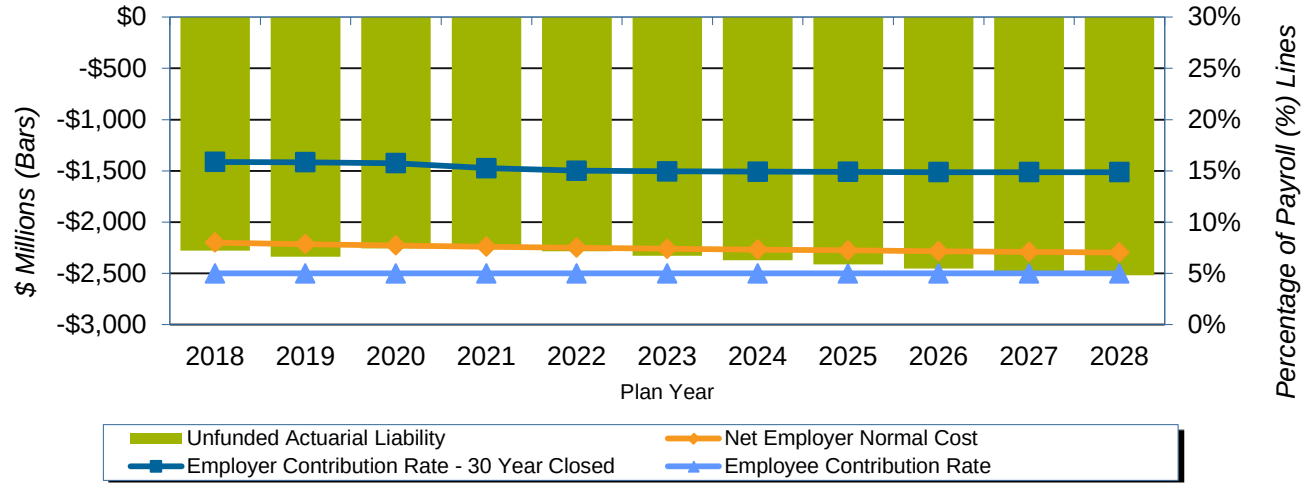
Step 1 – Liability Modeling

1. Level Population Funding Progress – 30 Year Closed Amortization

AL Funded Status



Contribution Rates

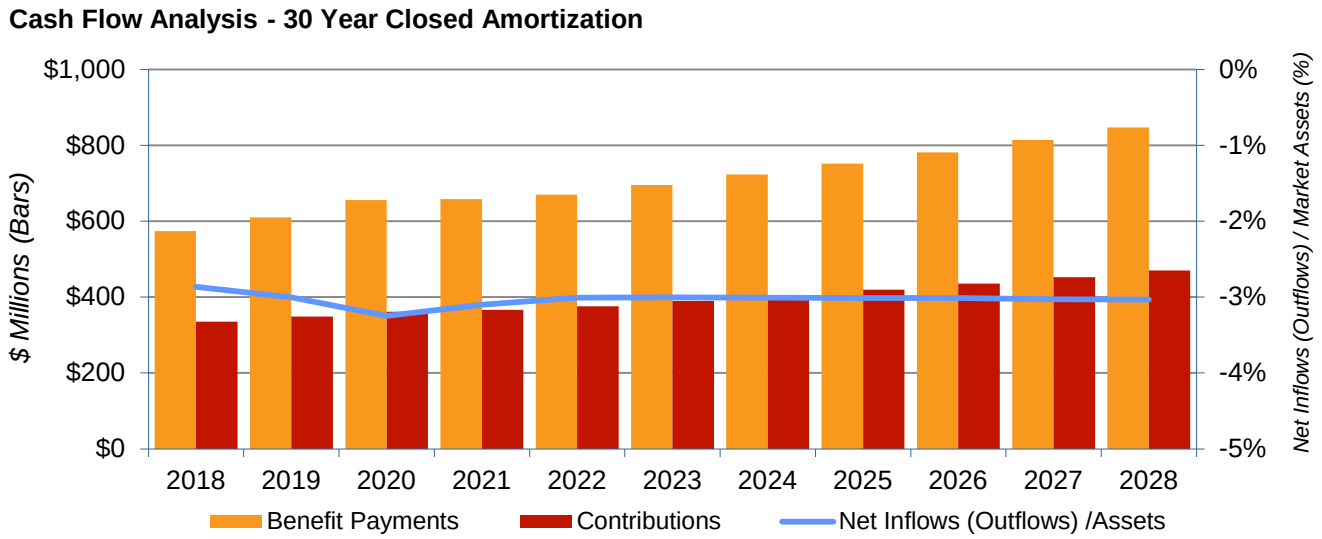


- Funded status and contribution projections reflect 7.15% return in each future year:
  - Stochastic modeling is necessary because a constant return assumption in each year is unlikely.
- Assets and liabilities are expected to grow due to level population assumption and the funding policy.
- Total Normal Cost rate falls marginally over the forecast period.
- Under a closed 30-year amortization, the Employer Contribution rate is expected to stay close to 15%;
  - However, the dollars of unfunded liability will grow before it begins to fall.

Step 1 - Building the Actuarial Valuation Model

Net Cash Flow / Liquidity Needs

- Net Cash Flow = Total Contributions – Benefit Payments - Expenses:
  - taken as a percentage of the market assets as of the beginning of the year.
- Liquidity needs help define the appropriate time horizon for investments and shape the ability of the Fund to commit to illiquid asset classes.
- Liquidity needs are close to 3% of the market value of assets each year, which are manageable even with no strategic cash allocation:
  - Rebalancing is a common strategy to raise sufficient cash.



Step 2 - 2019 Capital Market Projections

- Return and Risk 2019-2028

Asset Class	Index	Expected Return		Expected Risk	Projected Yield
		10-Year Geometric*	30-Year Geometric*	Standard Deviation	
Equities					
Broad Domestic Equity	Russell 3000	7.15%	7.65%	17.95%	2.00%
Large Cap	S&P 500	7.00%	7.50%	17.10%	2.10%
Small/Mid Cap	Russell 2500	7.25%	8.00%	22.65%	1.55%
Global ex-US Equity	MSCI ACWI ex USA	7.25%	7.85%	21.10%	3.10%
International Equity	MSCI World ex USA	7.00%	7.45%	19.75%	3.25%
Emerging Markets Equity	MSCI Emerging Markets	7.25%	8.15%	27.45%	2.65%
Fixed Income					
Short Duration	Bloomberg Barclays 1-3 Yr G/C	3.40%	4.00%	2.10%	3.25%
Domestic Fixed	Bloomberg Barclays Aggregate	3.75%	3.20%	3.75%	3.85%
Long Duration	Bloomberg Barclays Long G/C	3.75%	3.00%	10.65%	4.80%
TIPS	Bloomberg Barclays TIPS	3.75%	3.90%	5.05%	3.90%
High Yield	Bloomberg Barclays High Yield	5.35%	5.65%	10.35%	7.75%
Non-US Fixed	Bloomberg Barclays Glbl Agg xUSD	1.40%	2.90%	9.20%	2.35%
Emerging Market Debt	EMBI Global Diversified	5.05%	5.40%	9.50%	6.00%
Other					
Real Assets	Blended 90% Real Estate + 10% NR E	6.45%	6.80%	15.75%	4.70%
Real Estate	NCREIF ODCE	6.25%	6.60%	15.70%	4.75%
Natural Resource Equity	MSCI ACWI Energy	6.60%	6.60%	23.50%	4.00%
US REITS	FTSE EP/NA	6.70%	7.25%	20.70%	5.00%
Commodities	Bloomberg Commodity	3.20%	3.75%	18.00%	2.50%
Private Equity	Cambridge Private Equity	8.50%	9.50%	29.30%	0.00%
Diversifying Strategies	Callan Hedge FoF Database	5.50%	5.90%	8.85%	2.50%
Cash Equivalents	90-Day T-Bill	2.50%	2.90%	0.90%	2.50%
Inflation	CPI-U	2.25%	2.25%	1.50%	

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

- Note that return projections for public markets assume index returns with no premium for active management.
- Callan extended our “standard” 10 year capital market time horizon to 30 years to reflect the longer-term nature of the actuarial assumptions.
- Nevertheless, the 10 year expectations will be used to assess the impact on the funded ratio and contribution rates near term.

- * Geometric or compound returns are derived from arithmetic returns and the associated risk (standard deviation).
  Source: Callan

Step 2 - 2019 Callan Capital Market Projections

- Correlation: 2019–2028

		Broad	Lg Cap	Sm/Mid	GlobxUS	Int'l Eq	Emerge	Sht Dur	Dom Fix	TIPS	Hi Yield	NUS Fix	EMD	Real Asset	Real Est	NR Eq	REITs	Comm	Priv Eq	Divers	Cash Eq	Inflation
1	Broad Domestic Equity	1.000																				
2	Large Cap	0.996	1.000																			
3	Small/Mid Cap	0.960	0.930	1.000																		
4	Global ex-US Equity	0.853	0.842	0.842	1.000																	
5	International Equity	0.811	0.800	0.800	0.988	1.000																
6	Emerging Markets Equity	0.872	0.860	0.860	0.940	0.875	1.000															
7	Short Duration	-0.232	-0.220	-0.255	-0.248	-0.225	-0.275	1.000														
8	Domestic Fixed	-0.113	-0.100	-0.145	-0.136	-0.115	-0.170	0.875	1.000													
9	TIPS	-0.049	-0.040	-0.075	-0.063	-0.050	-0.085	0.555	0.640	1.000												
10	High Yield	0.636	0.630	0.620	0.625	0.605	0.615	-0.130	0.020	0.055	1.000											
11	Non-US Fixed	0.008	0.010	0.000	0.068	0.050	0.100	0.480	0.530	0.400	0.120	1.000										
12	EMD	0.573	0.570	0.550	0.568	0.540	0.580	-0.040	0.100	0.180	0.600	0.010	1.000									
13	Real Assets (90-10)	0.775	0.769	0.753	0.744	0.714	0.743	-0.140	-0.054	0.003	0.577	-0.040	0.496	1.000								
14	Real Estate	0.736	0.730	0.715	0.706	0.680	0.700	-0.125	-0.035	0.000	0.560	-0.051	0.470	0.994	1.000							
15	NR Equity	0.771	0.765	0.750	0.743	0.700	0.770	-0.190	-0.150	0.020	0.500	0.040	0.500	0.732	0.650	1.000						
16	US REITs	0.830	0.825	0.800	0.837	0.820	0.800	-0.210	-0.100	0.110	0.500	0.010	0.500	0.744	0.700	0.780	1.000					
17	Commodities	0.152	0.150	0.150	0.161	0.155	0.160	-0.220	-0.100	0.120	0.100	0.150	0.190	0.237	0.200	0.385	0.135	1.000				
18	Private Equity	0.917	0.915	0.875	0.883	0.860	0.855	-0.300	-0.225	-0.135	0.550	0.060	0.450	0.707	0.660	0.770	0.820	0.180	1.000			
19	Diversifying Strategies	0.760	0.755	0.735	0.738	0.715	0.725	-0.080	0.090	0.085	0.570	-0.050	0.540	0.655	0.640	0.545	0.640	0.210	0.620	1.000		
20	Cash Equivalents	-0.043	-0.030	-0.080	-0.040	-0.010	-0.100	0.300	0.100	0.120	-0.110	0.000	-0.070	-0.046	-0.060	0.050	-0.060	0.070	0.000	-0.070	1.000	
21	Inflation	-0.010	-0.020	0.020	0.010	0.000	0.030	-0.200	-0.280	0.100	0.070	-0.100	0.000	0.137	0.100	0.320	0.140	0.400	0.060	0.200	0.000	1.000

- Relationships between asset classes are 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

Step 2 - Current Asset Classes

- Callan 2019 10-Year Capital Market Expectations

Component	Current	Min	Max	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5	Mix 6
US Broad Equity	37%	0%	100%	27%	29%	31%	33%	34%	36%
Global ex-US Equity	24%	0%	100%	18%	20%	22%	21%	23%	25%
Real Assets (90-10)	16%	0%	100%	13%	14%	15%	16%	16%	17%
Diversifying Strategies	5%	0%	100%	7%	7%	7%	10%	7%	7%
Domestic Fixed	18%	0%	100%	35%	30%	25%	20%	20%	15%
Total	**100%**			**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Total Fixed Income	**18%**			**35%**	**30%**	**25%**	**20%**	**20%**	**15%**
Total Public Equity	**61%**			**45%**	**49%**	**53%**	**54%**	**57%**	**61%**
10 Year									
10 Year Expected Return	6.79%			6.26%	6.41%	6.56%	6.64%	6.70%	6.83%
Standard Deviation	13.65%			10.47%	11.33%	12.19%	12.72%	13.06%	13.94%
Sharpe Ratio	0.305			0.349	0.336	0.324	0.317	0.313	0.302
30 Year									
30 Year Expected Return	7.25%			6.68%	6.85%	7.01%	7.10%	7.15%	7.30%
Standard Deviation	13.85%			10.62%	11.51%	12.39%	12.92%	13.27%	14.17%
Sharpe Ratio	0.304			0.344	0.332	0.321	0.314	0.310	0.300

- 10-year expected return = compound (geometric mean) returns, incorporating the impact of volatility and correlation between asset classes
- Mix 4 = potential portfolio target selected in 2018
- Real Assets (90-10) modeled as 90% private real estate and 10% natural resource equity
- Diversifying strategies modeled using Callan's expectations for absolute return (hedge funds)

Step 2 - Current Asset Classes – Diversifying Strategies Constrained to 5%

- Callan 2019 10-Year Capital Market Expectations

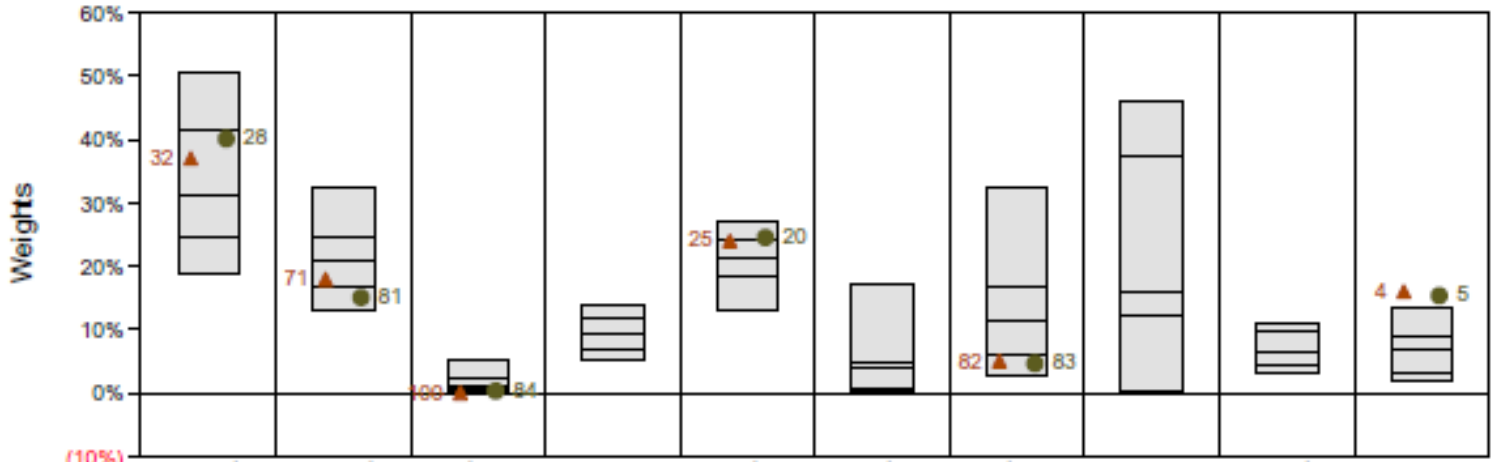
Component	Current	Min	Max	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5	Mix 6
US Broad Equity	37%	0%	100%	28%	30%	33%	33%	35%	37%
Global ex-US Equity	24%	0%	100%	19%	21%	22%	21%	24%	26%
Real Assets (90-10)	16%	0%	100%	13%	14%	15%	16%	16%	17%
Diversifying Strategies	5%	0%	100%	5%	5%	5%	10%	5%	5%
Domestic Fixed	18%	0%	100%	35%	30%	25%	20%	20%	15%
Total	**100%**			**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Total Fixed Income	**18%**			**35%**	**30%**	**25%**	**20%**	**20%**	**15%**
Total Public Equity	**61%**			**47%**	**51%**	**55%**	**54%**	**59%**	**63%**
10 Year									
10 Year Expected Return	6.79%			6.30%	6.45%	6.60%	6.64%	6.73%	6.86%
Standard Deviation	13.65%			10.69%	11.55%	12.42%	12.72%	13.30%	14.17%
Sharpe Ratio	0.305			0.346	0.333	0.321	0.317	0.310	0.299
30 Year									
30 Year Expected Return	7.25%			6.72%	6.89%	7.04%	7.10%	7.19%	7.33%
Standard Deviation	13.85%			10.84%	11.73%	12.60%	12.92%	13.49%	14.39%
Sharpe Ratio	0.304			0.341	0.329	0.318	0.314	0.308	0.298

- 10-year expected return = compound (geometric mean) returns, incorporating the impact of volatility and correlation between asset classes
- Holding fixed income exposure constant from Slide 13, diversifying strategies are limited to 5% of the portfolio (except for Mix 4, the potential portfolio target selected in 2018)
- Model reallocates the assets from diversifying strategies back to equity, increasing both return and risk for a given level of fixed income

Step 2 – Asset Projections

What are Other Public Funds Doing? Peer Group Comparisons

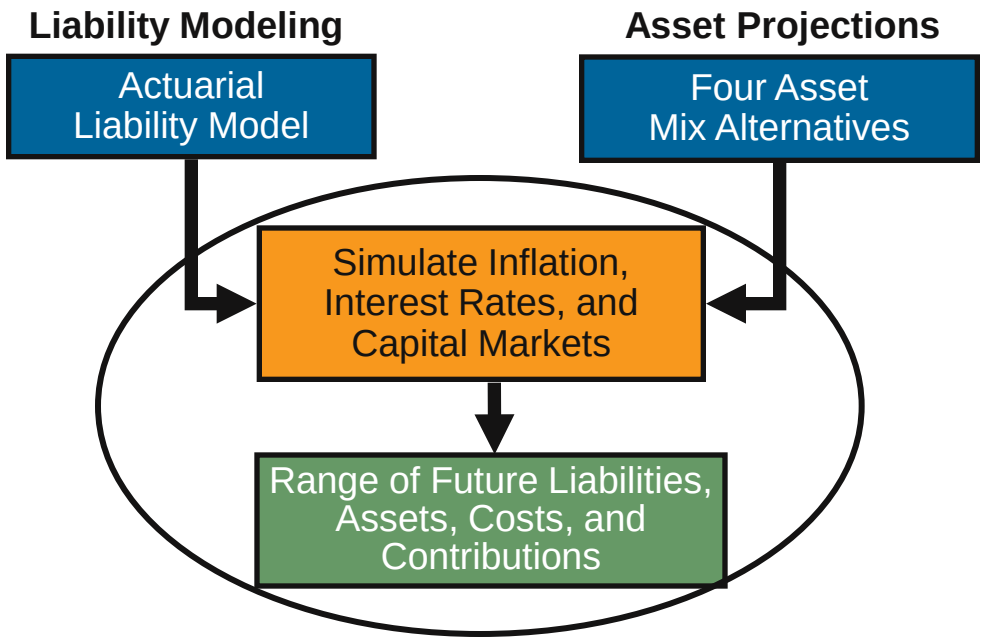
Asset Class Weights vs Callan Public Fund Sponsor - Large (>1B)



	Domestic Equity	Domestic Fixed-Income	Other	Real Estate	Intl Equity	Intl Fixed-Inc	Other Alternatives	Global Equity Broad	Private Equity	Real Assets
10th Percentile	50.70	32.60	5.27	13.85	27.08	17.18	32.55	46.17	11.00	13.39
25th Percentile	41.65	24.62	2.14	11.68	24.02	4.71	16.70	37.27	9.60	8.74
Median	30.98	20.82	1.08	9.51	21.27	3.80	11.29	16.06	6.26	6.82
75th Percentile	24.42	16.78	0.57	6.94	18.60	0.59	6.15	12.09	4.47	2.97
90th Percentile	19.01	13.09	0.22	5.26	13.25	0.09	2.79	0.23	3.00	1.81
Fund ●	40.08	15.08	0.33	-	24.52	-	4.65	-	-	15.35
Target ▲	37.00	18.00	0.00	-	24.00	-	5.00	-	-	16.00
% Group Invested	100.00%	94.12%	76.47%	76.47%	98.04%	21.57%	62.75%	23.53%	45.10%	33.33%

- NASRA data as well as our internal peer groups confirm that the current Target of 18% fixed income is near the lower quartiles:
  - despite the plan having a lower discount rate (7.15%) than the median public plan (7.50%).

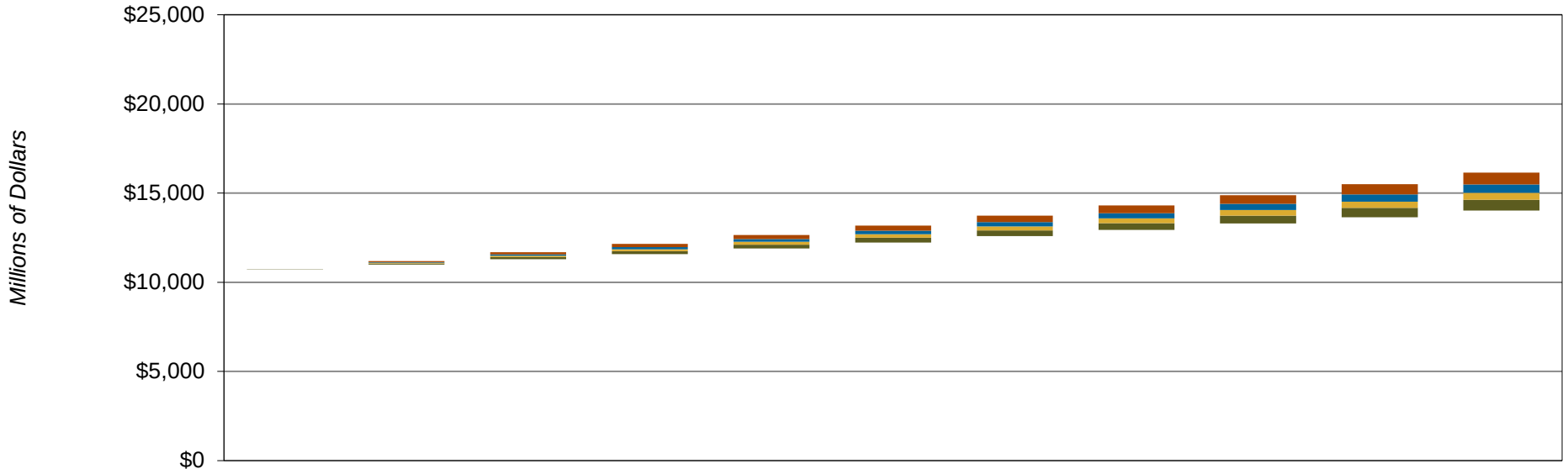
Step 3 - Simulating the Financial Condition



- This section demonstrates a ***stochastic forecast***: the modeling of uncertainty associated with the capital markets.
  - Simulate three (3) key variables: inflation rate, interest rate, asset class returns.
  - Assume annual rebalancing of portfolio mixes.
  - Generate 2,000 simulations per year, per asset mix to capture possible future economic scenarios and their effect on the pension plan.
  - Rank the results from highest to lowest to develop probability distributions.

Step 3 - Range of Actuarial Liability – Current Policy

Level Population

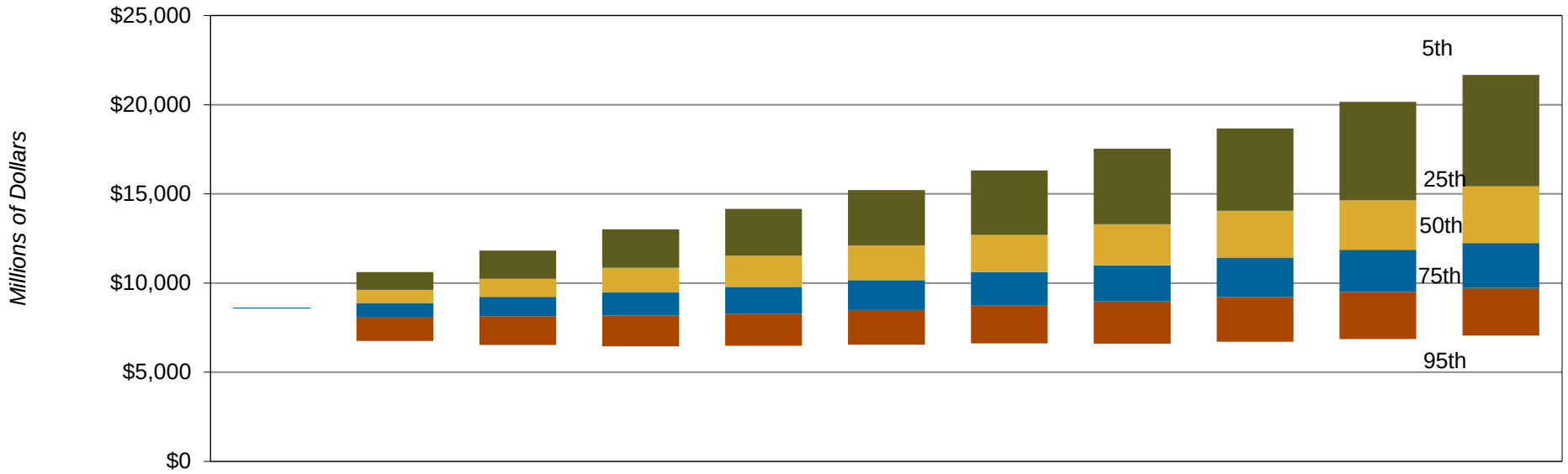


Percentile	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
95th	**$10,694**	**$11,192**	**$11,681**	**$12,151**	**$12,643**	**$13,185**	**$13,732**	**$14,312**	**$14,884**	**$15,501**	**$16,152**
75th	10,694	11,132	11,559	11,975	12,421	12,889	13,373	13,865	14,395	14,927	15,484
50th	**10,694**	**11,094**	**11,482**	**11,857**	**12,266**	**12,692**	**13,137**	**13,587**	**14,048**	**14,528**	**15,012**
25th	10,694	11,054	11,407	11,741	12,112	12,502	12,910	13,312	13,736	14,169	14,625
5th	10,694	10,994	11,292	11,583	11,889	12,221	12,583	12,936	13,303	13,646	14,018
VAR	**0**	**98**	**199**	**294**	**377**	**493**	**595**	**725**	**836**	**973**	**1,140**

- Actuarial liabilities have much less capital market risk, since they are not marked to market using current interest rates. Chart above assumes discount rate of 7.15% remains constant.
- Current variability reflects the uncertainty of inflation, as it impact participant's salary:
  - No COLA variability – fixed rate of 3% regardless of what inflation does.
- Chart also demonstrates why a duration-matching bond strategy may not be appropriate: while duration is long, liabilities have no market-based interest rate sensitivity.

Step 3 - Range of Market Values – Current Policy

Level Population

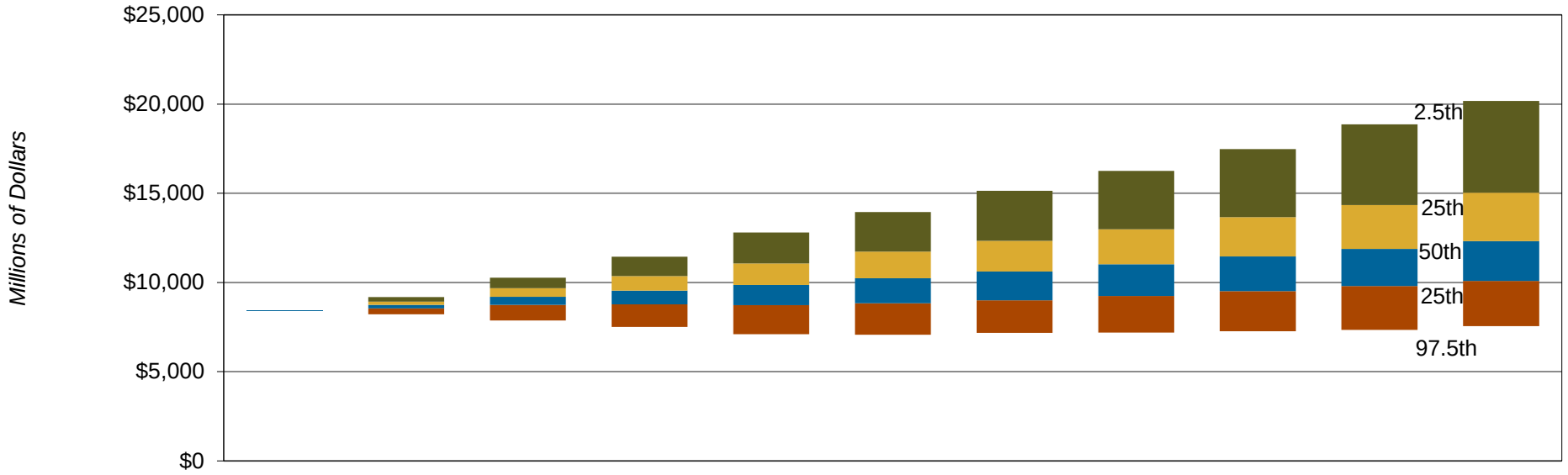


Percentile	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
5th	$8,572	$10,607	$11,815	$13,008	$14,162	$15,210	$16,323	$17,544	$18,673	$20,160	$21,675
25th	8,572	9,621	10,234	10,857	11,536	12,105	12,701	13,294	14,056	14,642	15,420
50th	**8,572**	**8,878**	**9,229**	**9,467**	**9,783**	**10,165**	**10,612**	**10,990**	**11,422**	**11,861**	**12,241**
75th	8,572	8,064	8,143	8,176	8,267	8,492	8,731	8,971	9,203	9,498	9,722
95th	**8,572**	**6,753**	**6,519**	**6,454**	**6,474**	**6,541**	**6,623**	**6,604**	**6,709**	**6,854**	**7,049**
VAR	**0**	**2,126**	**2,710**	**3,013**	**3,309**	**3,625**	**3,990**	**4,386**	**4,713**	**5,008**	**5,191**

- Market assets are impacted by both asset returns and cash flows, and shows significantly more volatility than the liabilities.
- Range of outcomes widens as time horizon lengthens, and distribution of asset values shows non-symmetry (skew).
- VAR (or value at risk) measures downside risk, or the difference between the expected (50th percentile) and worse-case (97.5th percentile) results, in this case how much the assets could fall.

Step 3 - Range of Actuarial Asset Values for Current Policy

Level Population

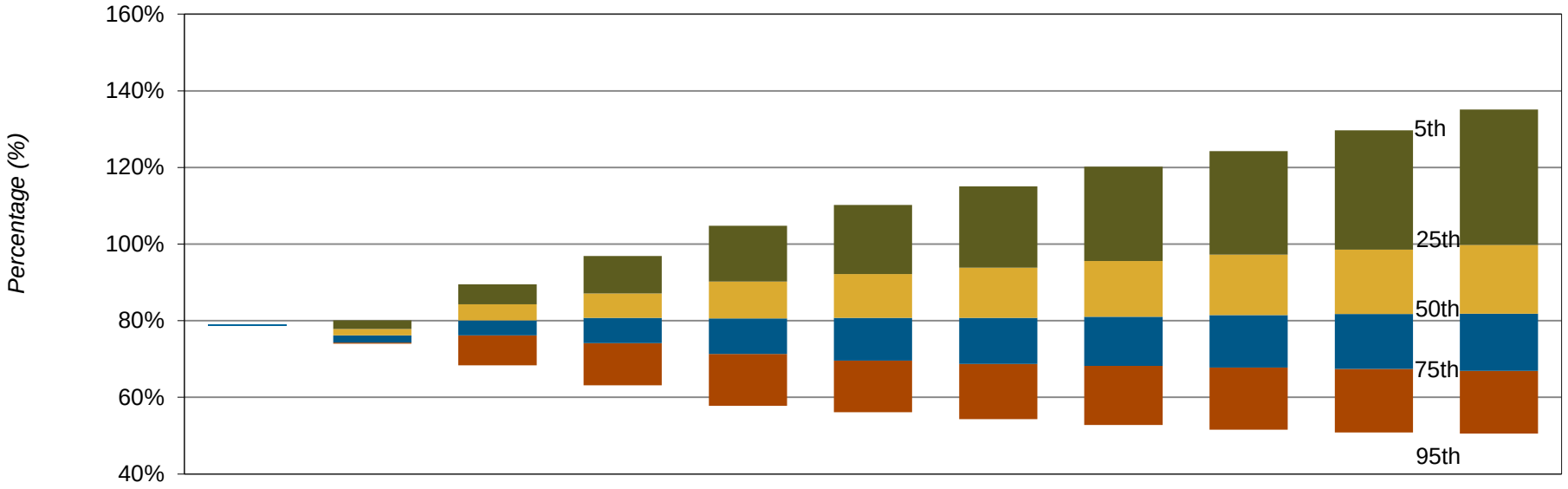


Percentile	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
5th	$8,416	$9,178	$10,262	$11,449	$12,794	$13,953	$15,146	$16,261	$17,473	$18,862	$20,179
25th	8,416	8,932	9,674	10,359	11,069	11,729	12,326	12,976	13,662	14,340	15,030
50th	**8,416**	**8,746**	**9,197**	**9,548**	**9,855**	**10,244**	**10,615**	**11,023**	**11,457**	**11,884**	**12,315**
75th	8,416	8,542	8,750	8,781	8,727	8,836	9,002	9,234	9,518	9,805	10,081
95th	**8,416**	**8,215**	**7,862**	**7,499**	**7,098**	**7,074**	**7,168**	**7,188**	**7,268**	**7,343**	**7,545**
VAR	**0**	**531**	**1,335**	**2,049**	**2,757**	**3,170**	**3,447**	**3,834**	**4,189**	**4,542**	**4,771**

- Asset performance is smoothed over a 4-year period.
- Smoothing marginally reduces volatility and downside risk (VAR) when measuring funded ratio performance.

Step 3 - Range of Funded Ratio (AVA/AL) for Current Policy

Level Population



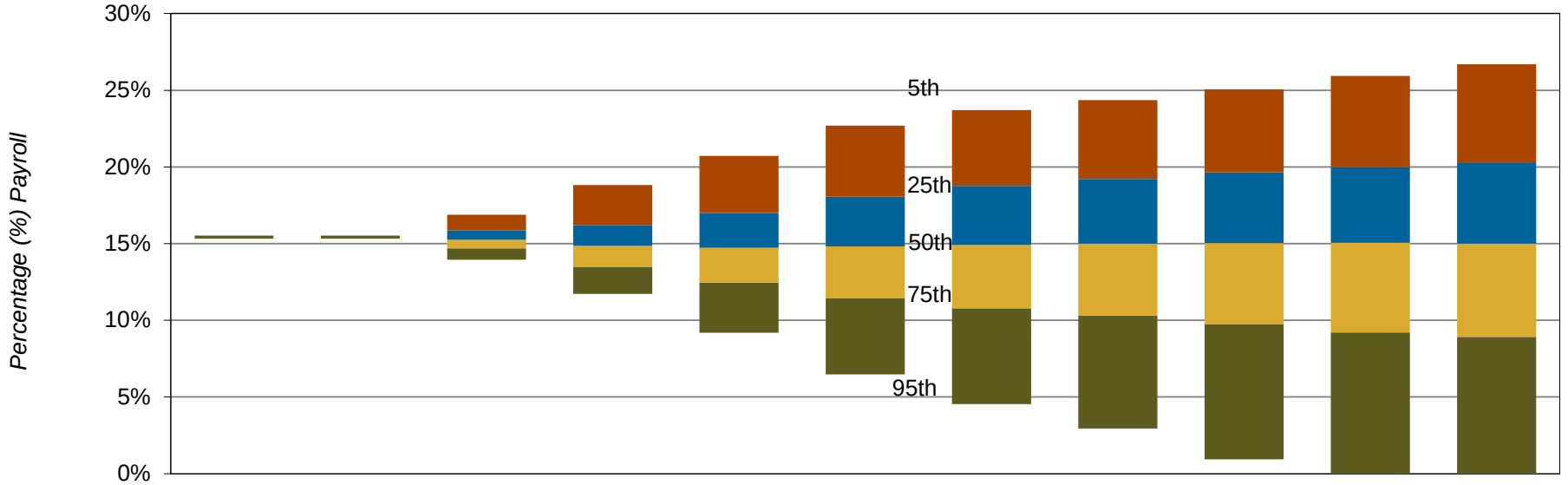
Percentile	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
5th	78.6%	82.8%	89.5%	96.9%	104.8%	110.2%	115.1%	120.2%	124.2%	129.7%	135.1%
25th	78.6	80.5	84.3	87.1	90.2	92.2	93.9	95.6	97.2	98.5	99.8
50th	**78.6**	**78.9**	**80.1**	**80.7**	**80.6**	**80.7**	**80.7**	**81.0**	**81.5**	**81.8**	**81.8**
75th	78.6	77.0	76.2	74.2	71.3	69.6	68.7	68.2	67.8	67.4	66.9
95th	**78.6**	**74.0**	**68.4**	**63.1**	**57.8**	**56.1**	**54.3**	**52.8**	**51.6**	**50.8**	**50.5**
VAR	**0.0**	**4.9**	**11.7**	**17.6**	**22.8**	**24.6**	**26.5**	**28.2**	**29.9**	**30.9**	**31.3**

- The funded ratio combines assets and liabilities and captures one dimension of investment risk: how much larger can the unfunded liability grow as the funded ratio falls.
  - A larger unfunded liability will increase the annual contribution requirement.
- Funded ratio volatility is largely driven by asset volatility, highlighting the importance of the asset mix decision.

Step 3 - Range of Employer Contribution Rate for Current Policy

Level Population

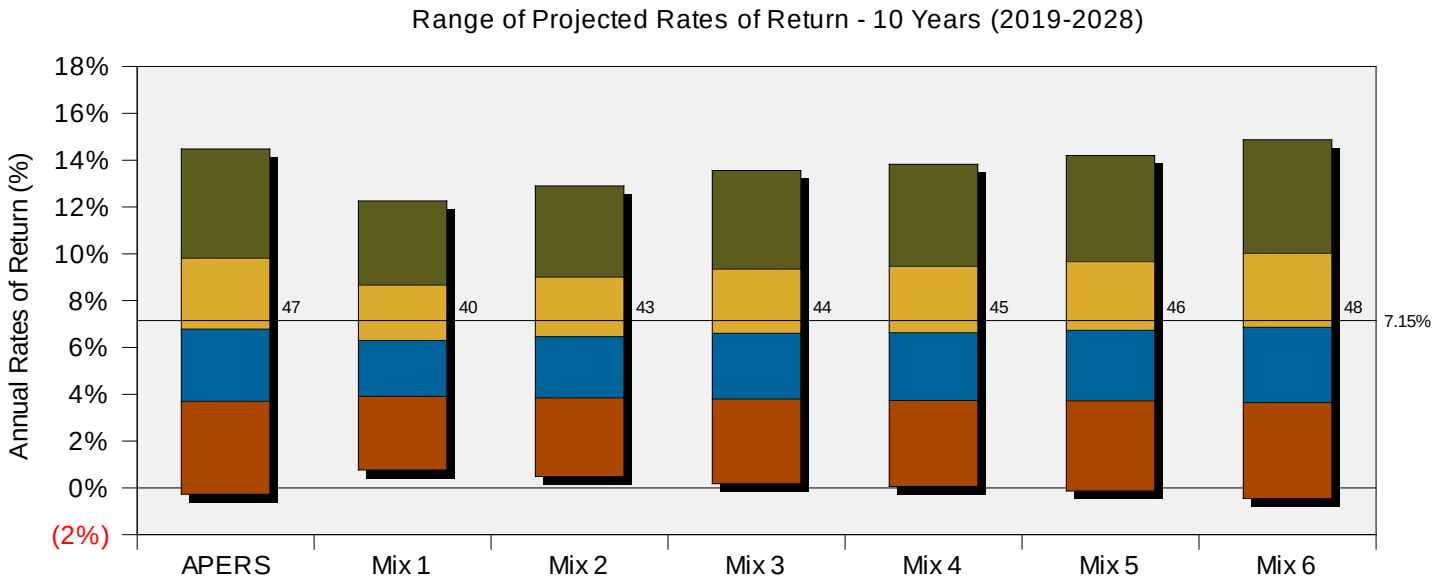
- The potential range of outcomes for employer contributions is another important measure of investment risk. The range of contribution in any one year demonstrates the volatility under the funding policy.
- Note that a worse-case scenario is unlikely to occur in every year, so the study will focus on contributions over multiple periods like a 5 and 10-year time horizons.
  - Cumulative analysis focuses on contributions starting in 2019, since investment risk taken this year will impact next years contribution amount.



Percentile	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
95th	15.32%	15.32%	16.89%	18.81%	20.72%	22.69%	23.71%	24.35%	25.07%	25.93%	26.70%
75th	15.32	15.32	15.87	16.19	16.98	18.06	18.77	19.21	19.65	20.00	20.25
50th	**15.32**	**15.32**	**15.24**	**14.86**	**14.72**	**14.82**	**14.91**	**14.99**	**15.04**	**15.05**	**15.01**
25th	15.32	15.32	14.70	13.46	12.47	11.45	10.79	10.31	9.73	9.21	8.91
5th	**15.32**	**15.32**	**13.95**	**11.73**	**9.18**	**6.47**	**4.53**	**2.94**	**0.93**	**0.00**	**0.00**
VAR	**0.0**	**0.0**	**1.6**	**4.0**	**6.0**	**7.9**	**8.8**	**9.4**	**10.0**	**10.9**	**11.7**

Step 4 – Define Risk Tolerances

Compare Alternative Asset Mixes - Range of Compound Returns



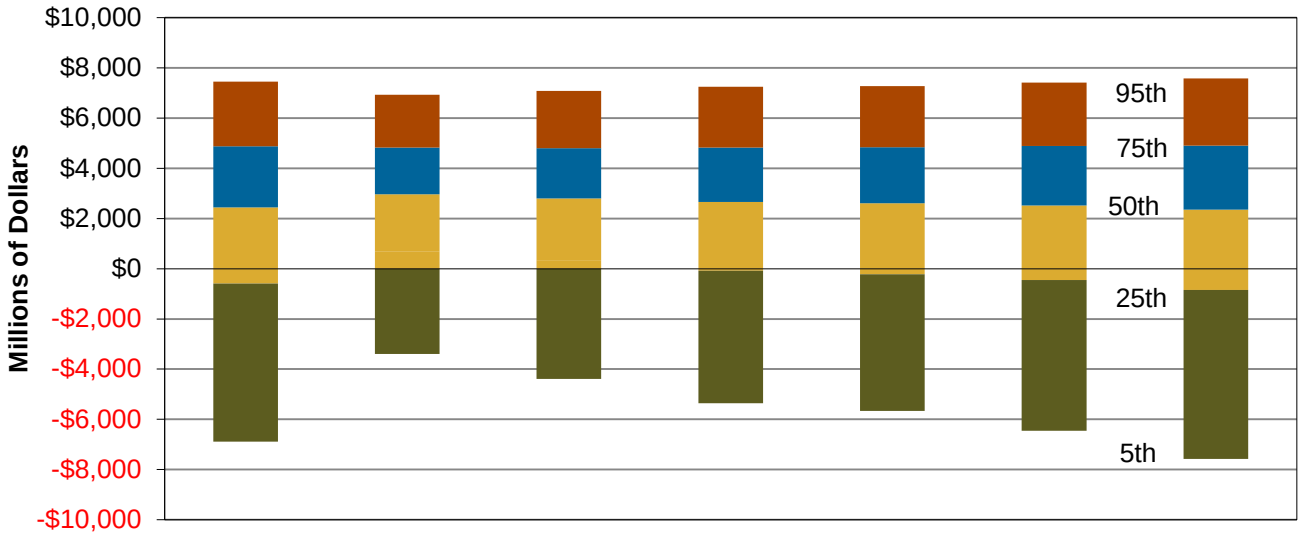
	APERS	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5	Mix 6
5th Percentile	14.5%	12.3%	12.9%	13.6%	13.8%	14.2%	14.9%
25th Percentile	9.8%	8.7%	9.0%	9.3%	9.5%	9.7%	10.0%
Median	6.8%	6.3%	6.5%	6.6%	6.6%	6.7%	6.9%
75th Percentile	3.7%	3.9%	3.8%	3.8%	3.7%	3.7%	3.6%
95th Percentile	(0.3%)	0.8%	0.5%	0.2%	0.1%	(0.1%)	(0.5%)
Prob > 7.15%	46.6%	40.4%	42.6%	44.3%	45.0%	46.1%	47.5%

- Ranges of returns show the impact of capital market uncertainty over time. The range for each mix widens as we move from Mix 1 (less equity, therefore less potential volatility) to Mix 6 (more equity and greater potential volatility.
- Returns are compound geometric results, and reflect the range of potential paths each asset mix can follow over 10 years

Step 4 – Define Risk Tolerances

Compare Alternative Asset Mixes –Value of Unfunded Liability

In Year 10 (2028)



Percentile	Current	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5	Mix 6
95th	**$7,451**	**$6,926**	**$7,086**	**$7,255**	**$7,273**	**$7,411**	**$7,580**
75th	4,876	4,831	4,805	4,831	4,838	4,887	4,900
50th	**2,437**	**2,967**	**2,805**	**2,663**	**2,603**	**2,515**	**2,360**
25th	-593	696	308	-85	-219	-457	-843
5th	-6,885	-3,394	-4,388	-5,365	-5,672	-6,451	-7,577
VAR	**5,014**	**3,959**	**4,281**	**4,592**	**4,670**	**4,895**	**5,220**

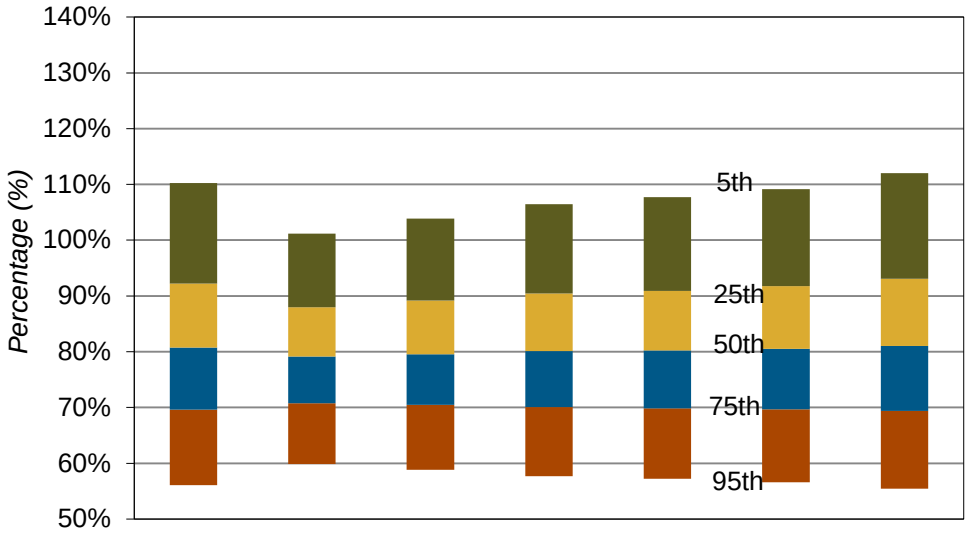
** Negative number implies surplus.*

- Value of unfunded liability in year 10, on the same basis as market value of assets in 10 years
  - Mixes 1, 2 and 3, with greater % fixed income, provide some improvement in downside risk protection (lower worse case result) compared to the current policy, and narrow the range of potential outcomes

Step 4 – Define Risk Tolerances

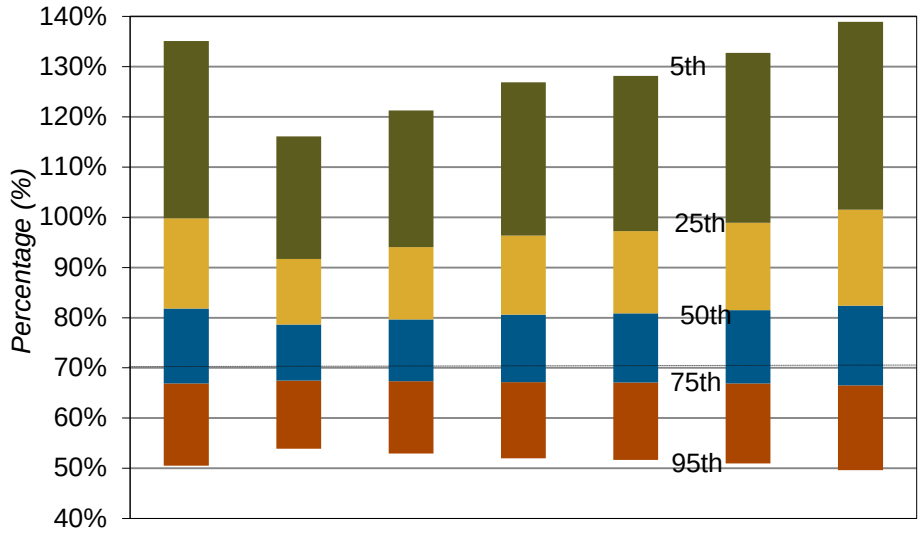
Compare Alternative Asset Mixes – Range of Funded Ratio (AVA/AL)

In Year 5 (2023)



Percentile	Current	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5	Mix 6
5th	145.8%	122.9%	129.7%	136.2%	138.2%	142.9%	150.4%
25th	102.5	93.2	96.1	98.7	99.7	101.4	104.0
50th	**81.4**	**77.6**	**78.7**	**79.9**	**80.3**	**81.1**	**82.0**
75th	64.7	65.0	65.0	64.8	64.8	64.6	64.5
95th	**46.4**	**50.0**	**48.9**	**48.0**	**47.5**	**46.8**	**45.6**
VAR	**-35.0**	**-27.6**	**-29.8**	**-31.9**	**-32.8**	**-34.3**	**-36.4**

In Year 10 (2028)



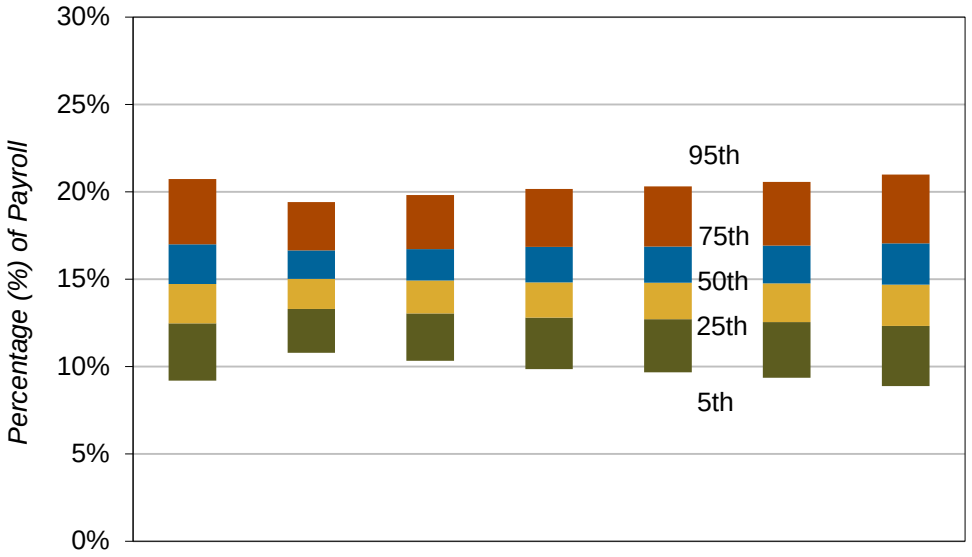
Percentile	Current	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5	Mix 6
5th	135.1%	116.1%	121.3%	126.9%	128.2%	132.8%	139.0%
25th	99.8	91.7	94.0	96.3	97.2	98.9	101.5
50th	**81.8**	**78.7**	**79.6**	**80.6**	**80.9**	**81.5**	**82.4**
75th	66.9	67.5	67.3	67.2	67.1	66.9	66.5
95th	**50.5**	**53.9**	**53.0**	**52.0**	**51.7**	**50.9**	**49.6**
VAR	**-31.3**	**-24.7**	**-26.7**	**-28.6**	**-29.2**	**-30.5**	**-32.8**

- The key takeaway is that the asset allocation policy can have an impact on the volatility of funded status, even after accounting for contribution
- Mixes 1, 2 and 3, with greater % fixed income, provide some improvement in downside risk protection (better worse case funded status) compared to the current policy, and narrow the range of potential outcomes

Step 4 – Define Risk Tolerances

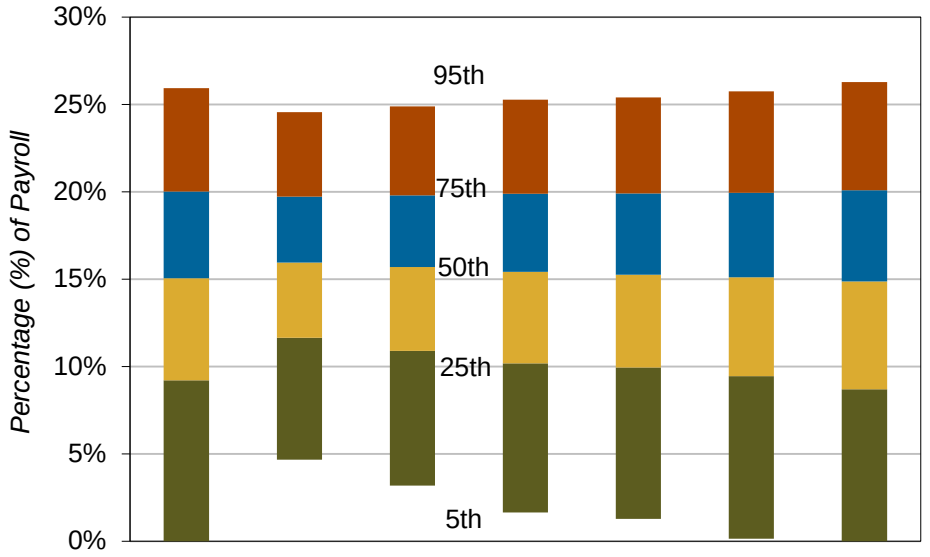
Compare Alternative Asset Mixes – Employer Contribution Rates

In Year 5 (2023)



Percentile	Current	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5	Mix 6
95th	20.7%	19.4%	19.8%	20.2%	20.3%	20.6%	21.0%
75th	17.0	16.6	16.7	16.8	16.9	16.9	17.0
50th	**14.7**	**15.0**	**14.9**	**14.8**	**14.8**	**14.8**	**14.7**
25th	12.5	13.3	13.0	12.8	12.7	12.5	12.3
5th	**9.2**	**10.8**	**10.3**	**9.8**	**9.7**	**9.4**	**8.9**
VAR	**6.0**	**4.4**	**4.9**	**5.3**	**5.5**	**5.8**	**6.3**

In Year 10 (2028)



Percentile	Current	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5	Mix 6
95th	25.9%	24.6%	24.9%	25.3%	25.4%	25.7%	26.3%
75th	20.0	19.7	19.8	19.9	19.9	19.9	20.1
50th	**15.1**	**16.0**	**15.7**	**15.4**	**15.2**	**15.1**	**14.9**
25th	9.2	11.6	10.9	10.2	9.9	9.4	8.7
5th	**0.0**	**4.7**	**3.2**	**1.6**	**1.3**	**0.1**	**0.0**
VAR	**10.9**	**8.6**	**9.2**	**9.9**	**10.2**	**10.6**	**11.4**

- The key takeaway is that while all of the asset mixes display a similar expected contribution rate, the asset allocation can have an impact on the volatility of the contribution rate
  - Mixes 1, 2 and 3, with greater % fixed income, provide some improvement in downside risk protection (lower worse case result) compared to the current policy, and narrow the range of potential outcomes

Step 5 – Select An Appropriate Asset Mix

Summary and Conclusions

- The liability and demographic profiles suggest that APERS has a sufficiently long term time horizon in which to take investment risk.
  - Both assets and liabilities are expected to grow over time as new participants enter the plan.
- Liquidity needs are very manageable, which requires selling roughly 3% of the market assets each year.
  - Sufficient liquidity can be provided with rebalancing or within fixed income in times of stress.
- The volatility in the future actuarial liability is overshadowed by asset volatility, which will drive both funded status and contribution volatility.
  - Board of Trustees and stakeholders need to acknowledge the potential for volatility in contribution rates over the next 5 to 10 years if capital markets deliver returns much lower than expected.
- A range of mixes were tested around the current policy target. Mixes with less growth assets and more in fixed income can reduce the risk of the plan, as defined by variability in funded status, contribution and unfunded liability, reducing the impact of worse case outcomes. The trade-off is a lower return in the expected case, with higher contribution and lower funded status, which represents the cost to reducing risk.
- The plan currently retains a strong tilt toward growth assets in pursuit of sufficient return to meet the long-term investment return target as defined by the actuarial discount rate of 7.15%.
  - Current target is projected to generate a compound return of 6.79% over the next ten years, reflecting lower expectations for the capital markets compared to long-term history
  - Over the longer term we expect capital market returns to revert toward long-run averages

Step 5 – Select An Appropriate Asset Mix

Summary and Conclusions

- The projections look exact, but are in fact the midpoint of a range, defined by the variability in the capital markets. The current policy portfolio has reasonable probability of achieving the target return in both a given year and over the 10-year horizon
  - Expected case = median result, with a 50% probability; current target has a 46.6% probability of achieving at least 7.15% over ten years
- APERS could consider maintaining the current level of risk or reducing risk and further diversifying the policy target.
  - The current exposure to fixed income is low relative to peers and will not provide much cushion in the event of market downturn and a flight to quality. The asset/liability study suggests that a greater allocation to fixed income can reduce the worse case outcomes, but at a cost of lower return in the expected case.
  - The plan already has a 5% target to Diversifying Strategies. The plan could consider a greater allocation funded from equity, which would de-risk the portfolio, at the cost of reducing expected return. A shift from equity to diversifying assets would reduce expected return by less than shifting the assets to fixed income.
  - The plan could consider an allocation to private equity. Private equity can generate return in excess of the public markets, aiding in the pursuit of return, at the cost of added complexity and illiquidity. The addition of private equity could enable the plan to increase fixed income while retaining the potential for return.
    - Callan suggests further education for APERS to understand long-term return opportunities for private equity, and the complications and resource requirements to properly execute in this strategy

Glossary of Terms

Glossary of Terms

Actuary

A specialist in the application of mathematics, probability, statistics and risk theory to financial problems involving future uncertainty. These uncertainties are usually associated with life insurance, property and casualty insurance, annuities, pension or other employee benefit plans and investments.

Actuarial (Accrued) Liability (AL)

The actuarial present value of all benefits accrued or earned under the Plan as of the beginning of the year, based on the anticipated salary increases for pay-related plans. Under the entry age normal cost method, the actuarial liability is the difference between the actuarial present value of future benefits and the actuarial present value of future normal cost.

Actuarial Value of Assets (AVA)

The value of cash, investments and other property belonging to a pension plan, as used by the actuary for the purpose of an actuarial valuation.

Alternative Investments

Refers broadly to non-traditional investment strategies such as hedge funds, private equity, distressed debt, commodities and futures.

Glossary of Terms (Continued)

Bond

A bond is a debt instrument issued by entities such as corporations, municipalities, federal, state and local government agencies for the purpose of raising capital through borrowing. Bonds typically pay interest periodically while repaying the principal, or par value, at maturity. Bonds with maturities of five years or less are often called notes.

Cost-of-Living Adjustment (COLA)

An increase (or decrease) in pension benefits according to the rise (or fall) in the cost of living as measured by an index, often the Consumer Price Index (CPI).

Deterministic Forecast

An outcome that is precisely determined in advance, using single estimates and without variation.

Diversification

The allocation of funds across different asset classes or securities within a portfolio.

Equity

The ownership interest of common and preferred stockholders in a company.

Glossary of Terms (Continued)

Funded Status

The status of a pension plan that has accumulated and set aside assets for the payment of retirement benefits to employees. Funded status is measured as the ratio of the Actuarial Value of Assets / Actuarial Liability.

Government Accounting Standards Board (GASB)

The designated organization for establishing standards of financial accounting and reporting in the public sector.

Inflation

A period in which the general level of prices for goods and services is increasing, and, thus, purchasing power is decreasing.

Liquidity

In general, liquidity refers to the ease by which a financial asset can be converted into cash. Liquidity is often more narrowly defined as the ability to sell an asset quickly without having to make a substantial price concession.

Liquidity Risk

Liquidity risk is the risk stemming from a lack of marketability of an investment, which makes it difficult to sell when desired.

Glossary of Terms (Continued)

Market Value of Assets (MVA)

An asset valuation that is based on the price for which an asset could be sold on the valuation date (also known as fair market or actual value).

Normal Cost (NC)

The annual accrual cost attributable to the upcoming plan year.

Present Value

Present value is the value on a given date of a future payment/receipt or series of future payments/receipts, discounted to reflect the time value of money, usually by the current relevant market interest rate.

Present Value of Benefits (PVB)

The actuarial present value all benefits (accrued service plus future service) under the Plan as of the beginning of the year, based on the anticipated salary increases for pay-related plans.

Purchasing Power Risk

Purchasing power risk is the risk that a portfolio or investment will earn a return less than the rate of inflation.

Glossary of Terms (Continued)

Sharpe Ratio

The Sharpe ratio is a commonly used measure of risk-adjusted return. It is calculated by subtracting the risk-free return (usually the 3 month Treasury bill) from a portfolio's return and then dividing this excess return by the portfolio's total standard deviation (a measure of portfolio volatility, or risk). The ratio thus represents the return gained per unit of risk taken.

Standard Deviation

Standard deviation is a statistical measure of portfolio risk. It reflects the average deviation of returns from their mean. Standard deviation is used as an estimate of risk since it measures how wide the range of returns has been.

Stochastic Forecast

An outcome based on variability or a range of values, and expressed in the form of a probability distribution.

Strategic Asset Allocation

Strategic asset allocation requires rebalancing back to a pre-determined policy allocation at specified time intervals or when established tolerance bands are violated.

Glossary of Terms (Continued)

Tactical Asset Allocation

Tactical Asset Allocation involves actively altering allocation among broad asset classes in an attempt to capture the highest returns. It is also referred to as "market timing."

Unfunded Liability

The difference between the actuarial (accrued) liability and the actuarial value of assets. A surplus exists if assets exceed liabilities.

VAR (Value at Risk)

The difference between the Downside Scenario (97.5th) and the Expected Case (50th): How much could be lost in a downside scenario relative to where you expected to be.

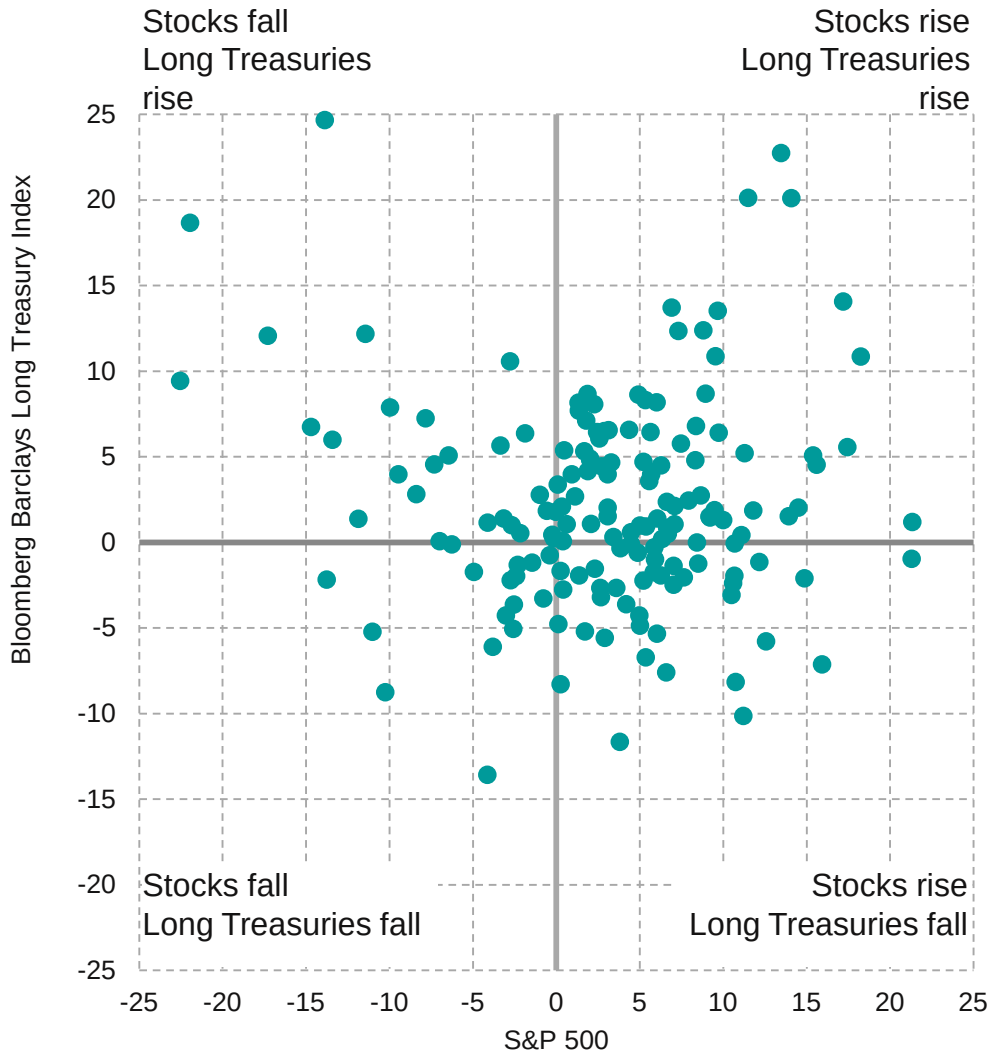
Volatility

The degree to which an investment's market value goes up and down over time.

Appendix

1. High-quality sovereign debt (aka Long Treasuries)

- Treasuries purport to offer true flight to quality protection, as investors typically flock to Treasuries in an equity drawdown. However, long Treasuries have substantial interest rate risk and can suffer losses when rates rise more than expected.
- The potential protection offered by long-term Treasuries comes with the risk of underperformance
- Other types of bonds may offer less protection, but also have less volatility
- Levered short-duration Treasuries may offer the promise of protection with less of the duration risk

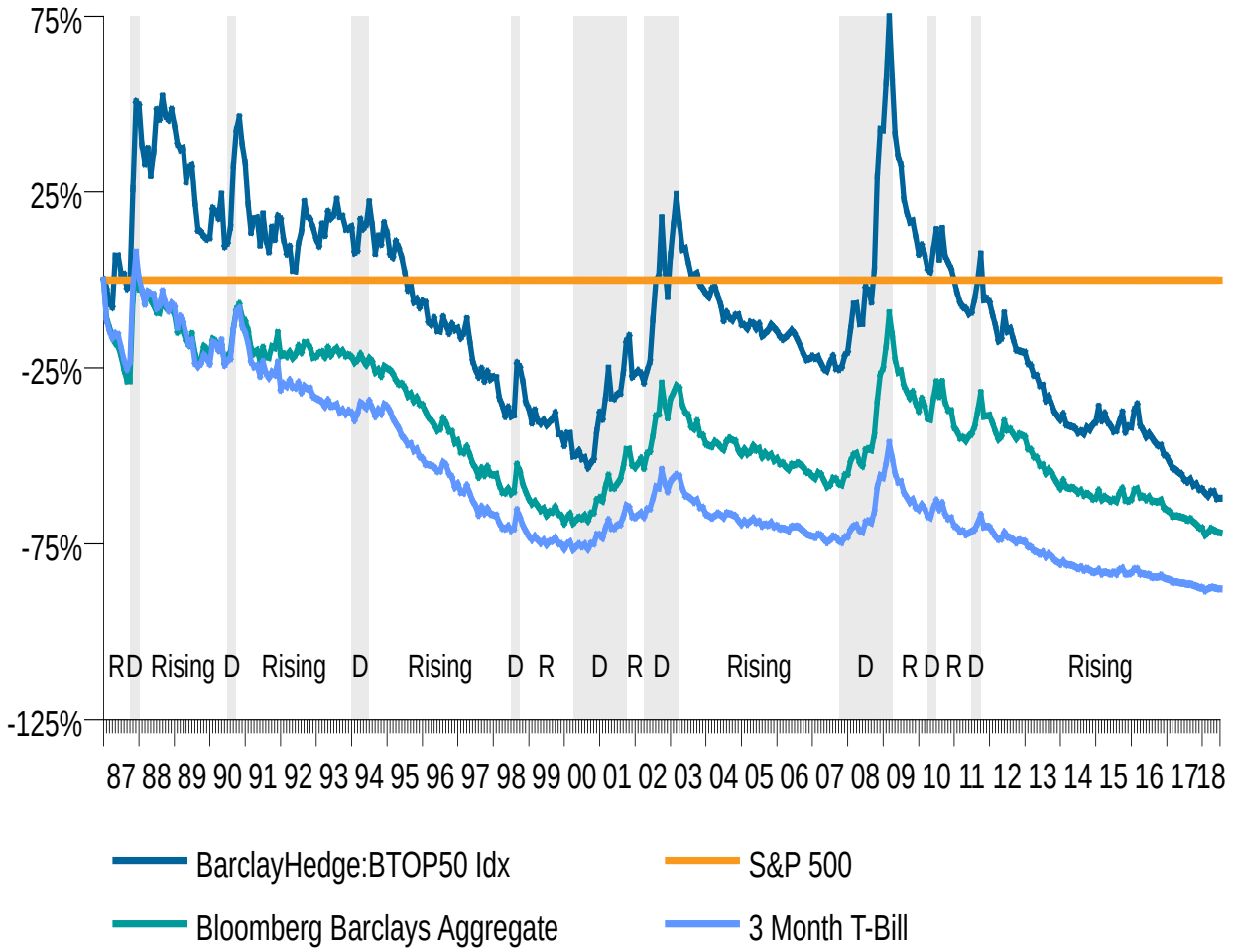


Sources: Bloomberg Barclays, Standard & Poor's

2. Trend-following strategies (aka momentum)

- Designed to benefit from trending markets in either direction – up or down
- Trend-following can be attractive during periods of market volatility and a shift in economic cycles
- During bear markets, trend followers typically deliver positive results
- Vulnerable to sudden market reversals and range-bound markets
- High trading activity requires efficient, disciplined process
- Pairs well with other diversifiers and traditional stock and bond exposures

Cumulative Relative Returns vs S&P 500 since January 1, 1987



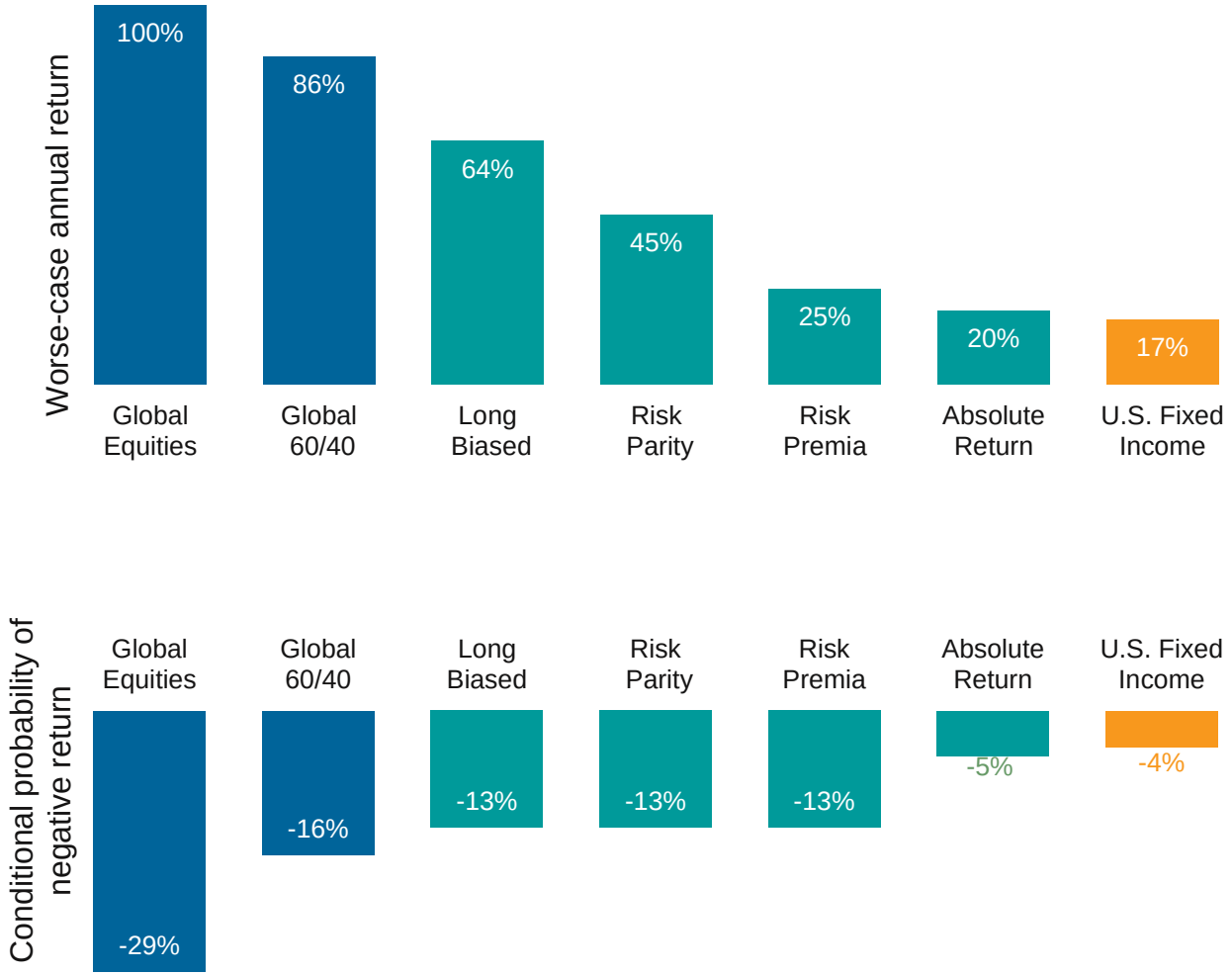
Sources: BarclayHedge, Bloomberg Barclays, Callan, Federal Reserve, Standard & Poor's

3. Alternative risk premia and other MAC strategies

- Multi-asset class (MAC) strategies are explicitly designed to emphasize the benefit of diversification
- All four categories of MAC strategies are expected to offer good diversification to equity risk
  - Absolute return: macroeconomic forecasting, non-directional exposures
  - Risk premia: low positive or negatively correlated risk premia
  - Long biased: macroeconomic forecasting, dynamic risk management
  - Risk parity: well-diversified beta approach with constrained equity risk contribution
- A multi-manager approach can be expected to significantly improve risk-adjusted returns due to low correlation between multi-asset class categories and strategies
- Risk parity may be the exception; a systematic approach to total portfolio construction

3. MACs offer potential for drawdown protection

- Multi-asset class strategies focus on risk management and drawdown protection
- The top graph is a forward-looking based Monte Carlo simulation of a worse-case scenario (i.e., a two standard deviation event)
- The bottom graph is from the same simulation and illustrates the probability of a negative return occurring given that equities incur a negative return



Source: Callan

4. Tail risk hedging/insurance

- Portfolio of options to explicitly hedge against tail events – insurance. Pay premiums and realize payout only upon the appearance of a tail event (equity selloff).
- A diversifier may not add to a portfolio's return, but if it can reduce total portfolio volatility sufficiently, the return over time will compound higher. Tail risk hedging offers this potential, more than the other diversifiers.
- This volatility benefit may take a while to show up for tail risk/insurance strategies. When the event in which the diversifier is expected to shine does not occur for an extended period, the portfolio will compound to a lower return until the event hits. The payback to tail risk hedging can be huge, and can offset the cost over many years.
- However, until a tail event shows up it's just a drag on the portfolio. In addition, the payout may not be sufficient to overcome premium expense over the long term.

5. Conservative equity

- Defining conservative equity
  - Low volatility
  - Maximum decorrelation
  - Value
  - Options-based strategies
- Will it really protect in a downdraft?
  - Low vol strategies (really, almost all smart beta) will exhibit high correlation to equity at the end of the day – it's equity!
  - Options-based strategies may hold greater promise of an asymmetric payoff with downside protection
  - Strategy may not show its benefit until the drawdown appears, and the investor may hand over excess upside, or at least suffer the cost of the options
  - In the GFC, Buy/Writes still lost money, just a lot less than a long equity market index exposure, so less of a true equity risk mitigation strategy
  - More expansive options-based strategies than Buy/Writes and Put/Writes can protect in a downdraft, include elements of tail risk hedging