

**PERSPECTIVES
THAT DRIVE
ENTERPRISE
SUCCESS**



JULY 2018

Asset/Liability Study

Kern County Employees' Retirement Association

Table of Contents



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Setting the stage **PAGE 3**

Deterministic forecasts **PAGE 7**

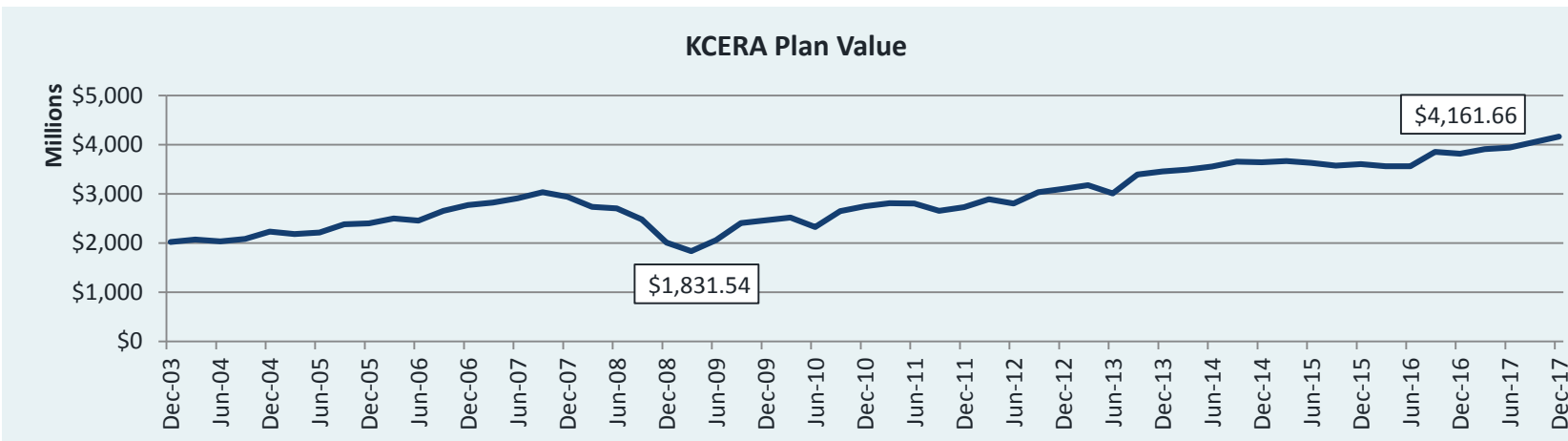
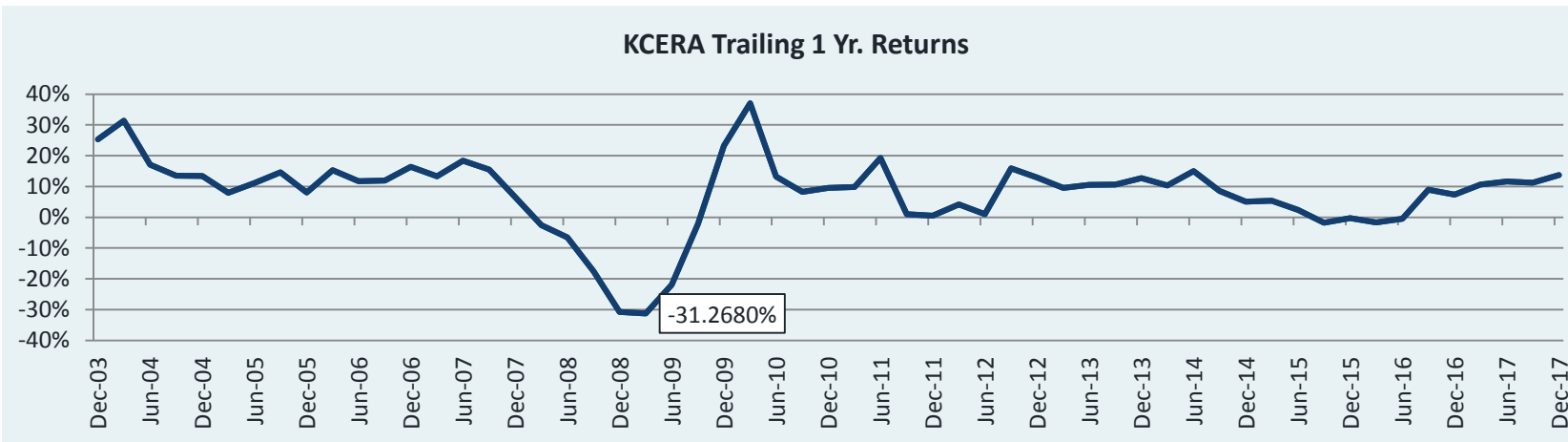
Stochastic forecasts **PAGE 19**

Appendix **PAGE 31**

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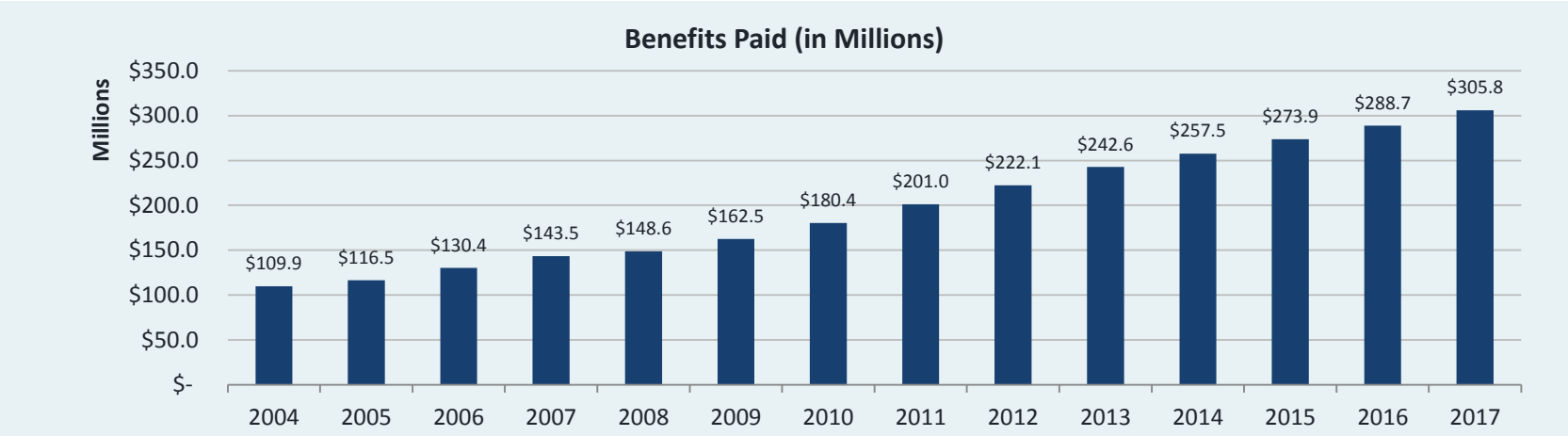
Setting the stage

Rolling returns and plan value

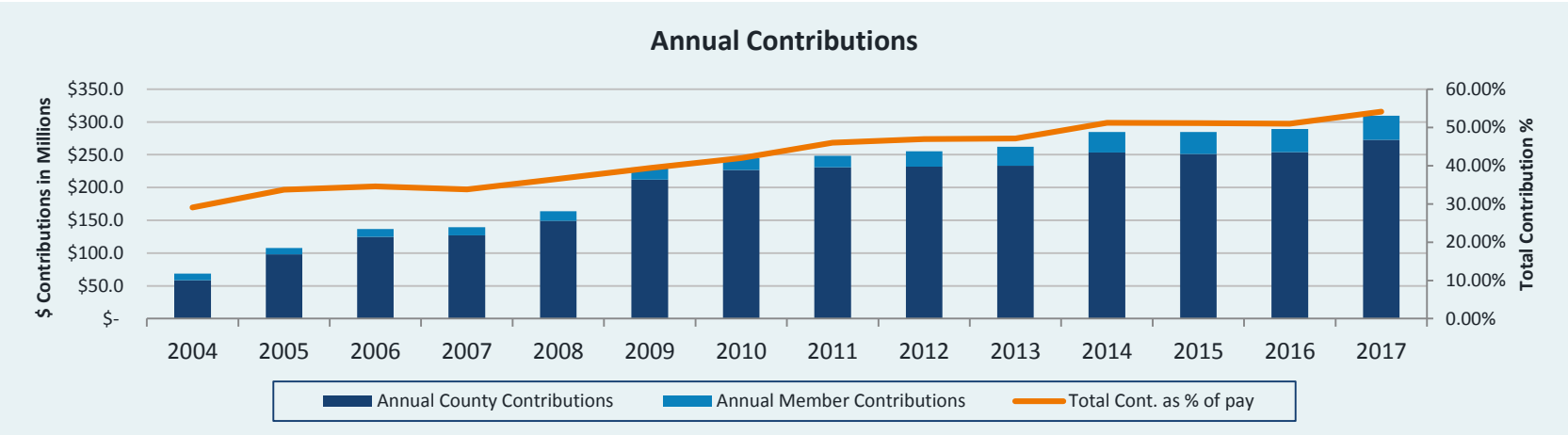


Although historical returns have not consistently met the assumed rate, assets have recovered significantly since the Global Financial Crisis.

Benefit payments and contributions

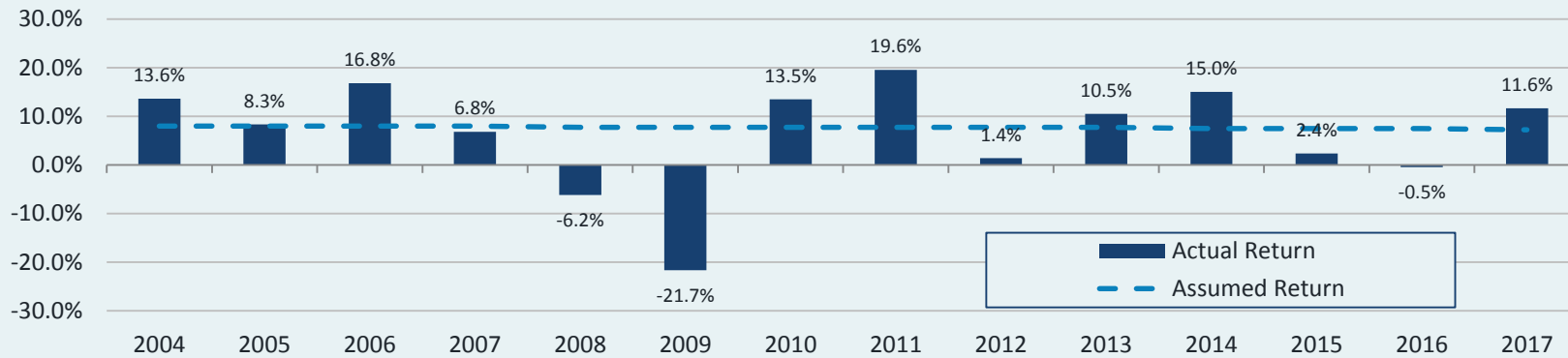


Aggregate benefits have increased steadily, and plan sponsor contributions have risen as well.



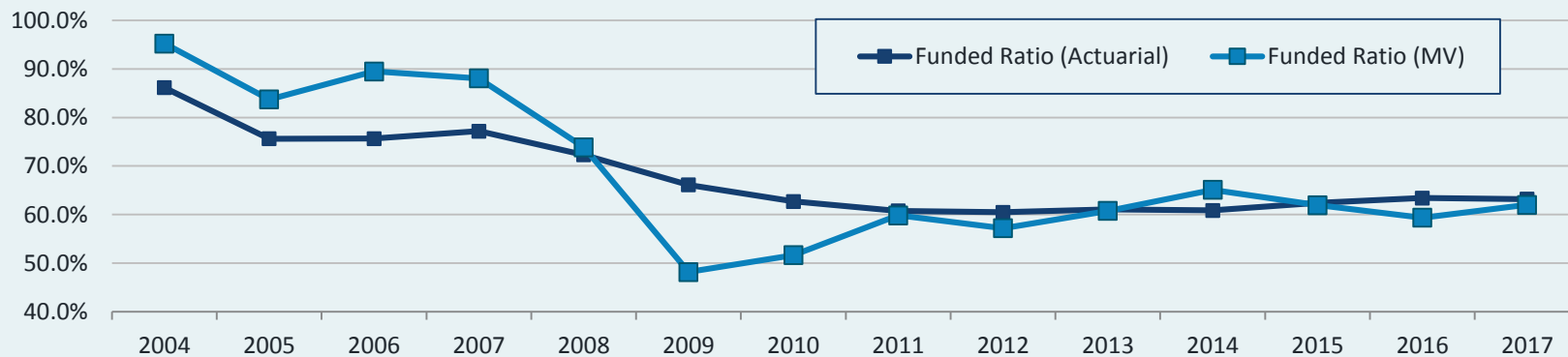
Returns and funding

Actual vs. Assumed Returns



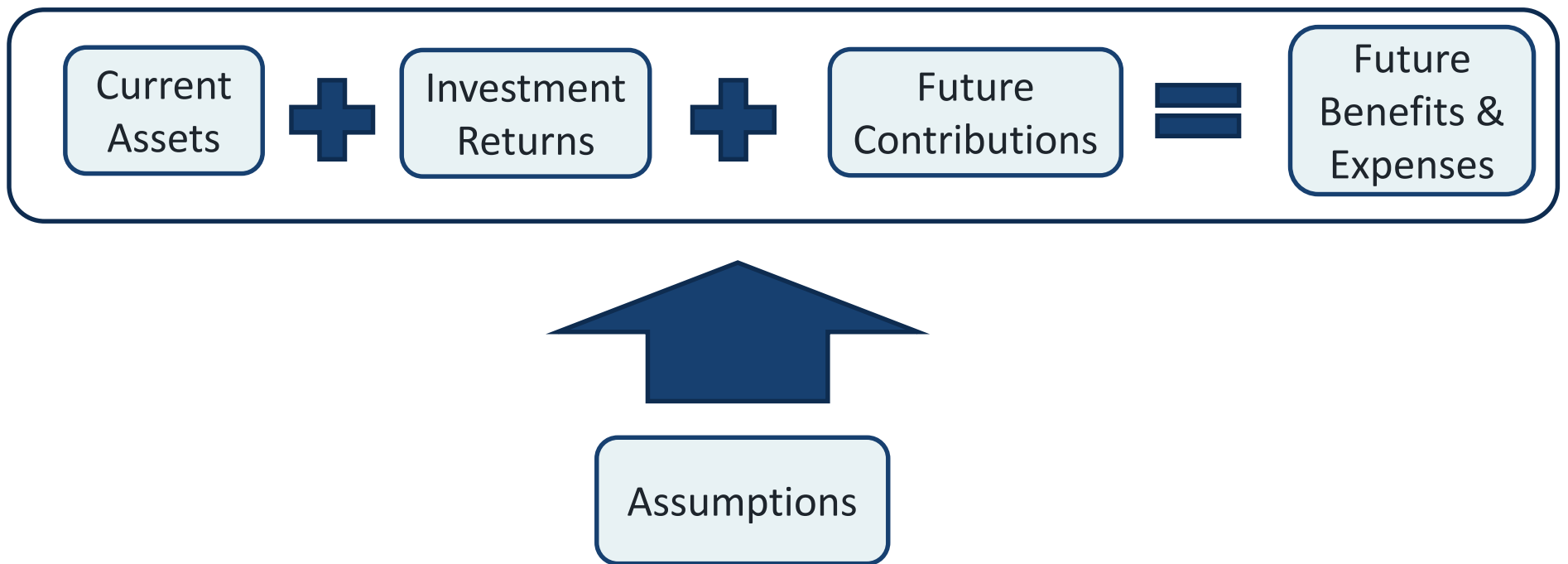
Market returns below the assumed rate has led to declining liability coverage.

Funded Ratio



Deterministic projections

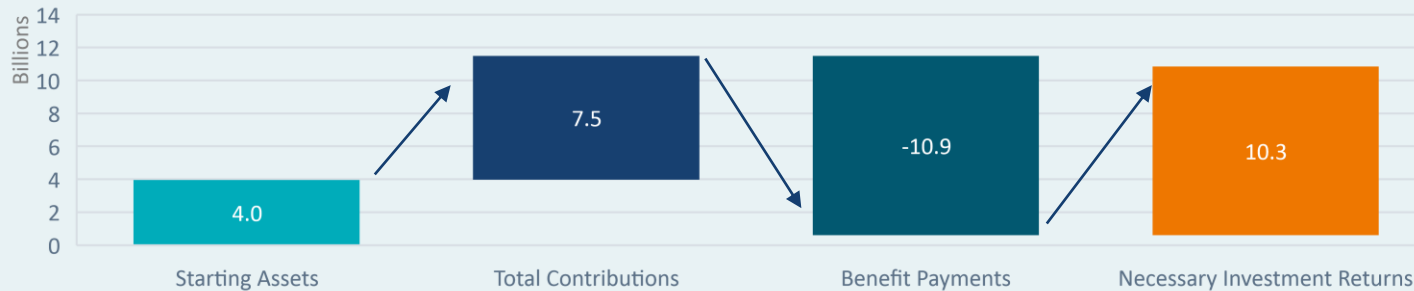
The pension equation



The pension equation in action

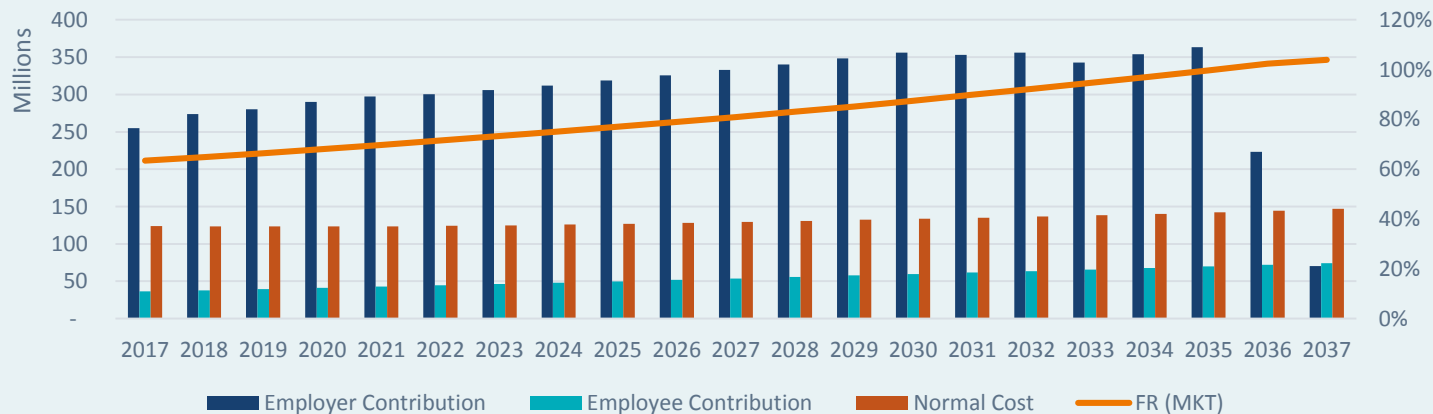


20 Year Outlook:
Investment Return Necessary for Full Funding



Under the current funding policy, the Plan will require approx. \$10.3b of investment returns to become fully funded by 2037.

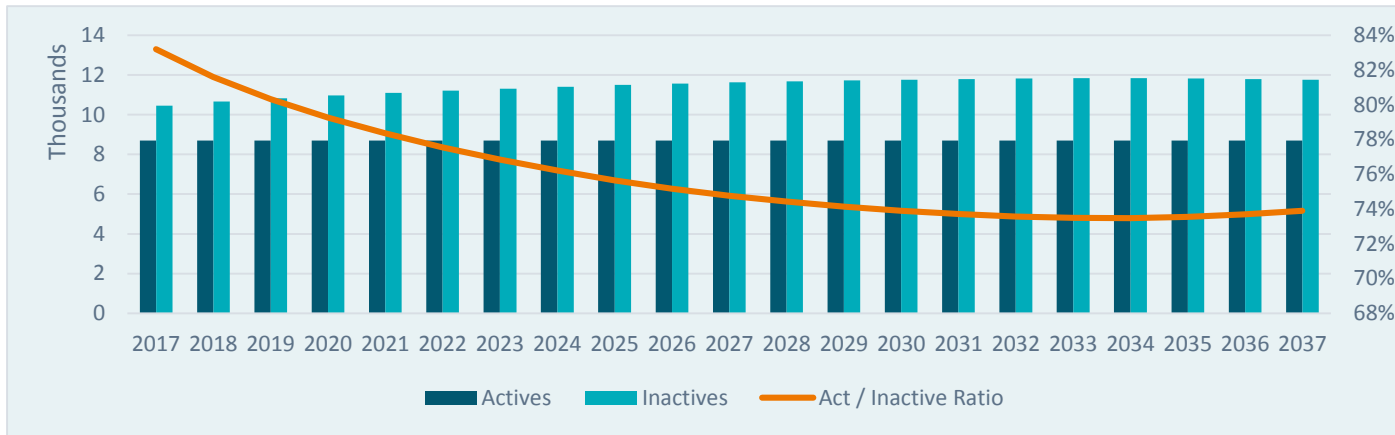
Baseline Deterministic Forecast (7.25% Return)



Assuming the current discount rate of 7.25%, contributions will rise steadily until the Plan is fully funded.

Impact of plan demographics

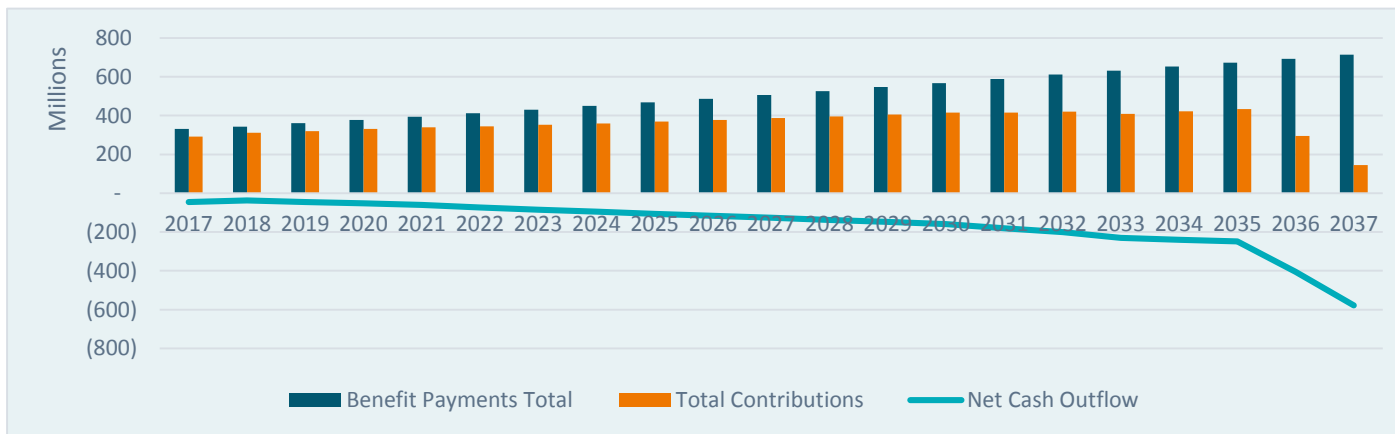
ACTIVE TO INACTIVE RATIO



Inactive count includes retirees, beneficiaries, and terminated vested members.

Assuming zero plan growth, the proportion of active members to retirees declines steadily over the next 20 years.

BENEFIT PAYMENTS, CONTRIBUTIONS, AND OUTFLOW

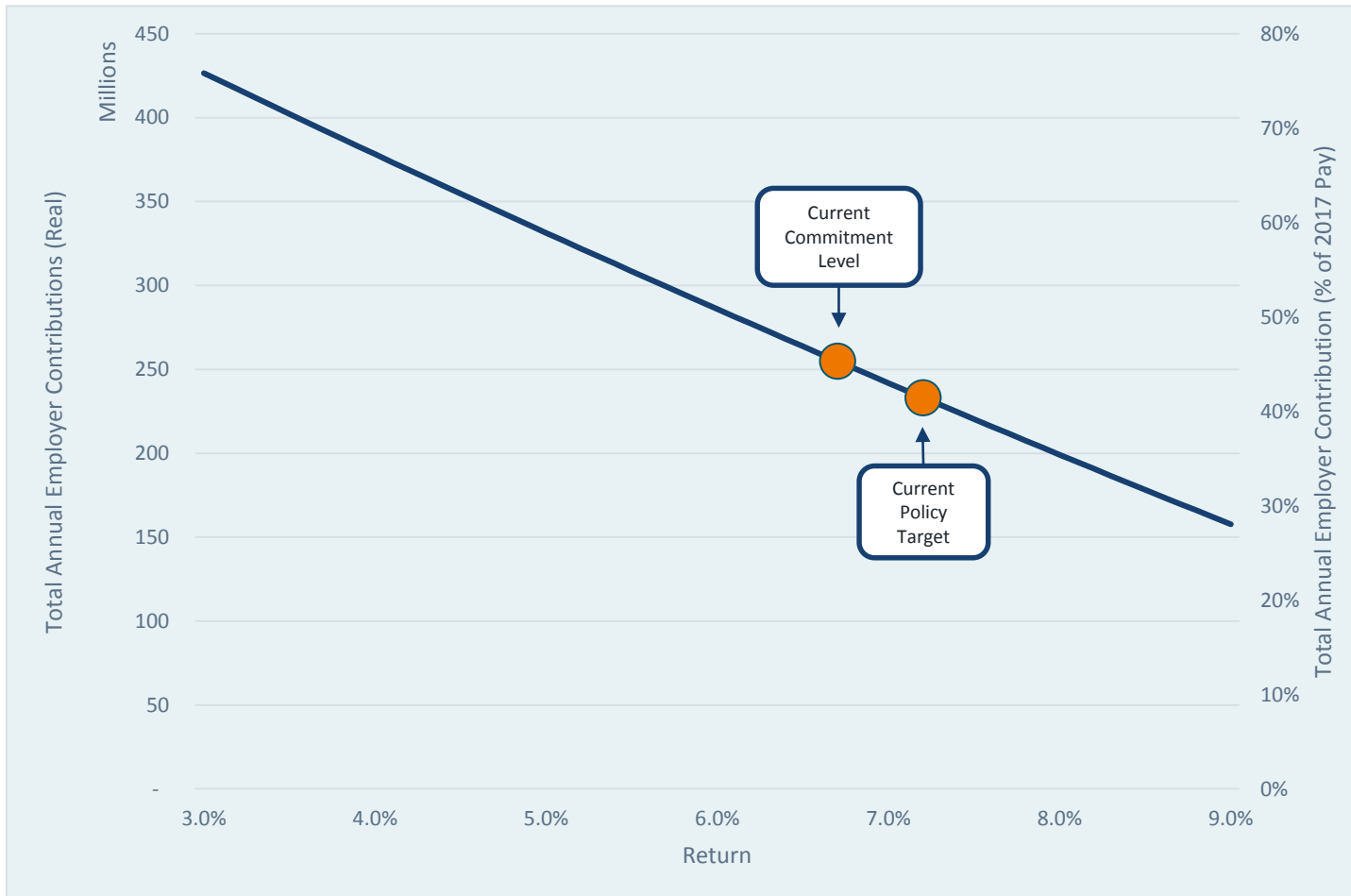


Includes employer and employee contributions projected at a return of 7.25%.

As the plans funding improves and inactive pool grows larger, there is a greater strain on investments to meet cashflow needs.

Getting to fully funded: investment returns vs. contributions

THE COST OF FULL FUNDING



Contributions reflected in this graph are displayed as an annual cost in real terms via the inflation assumption of 3.0%. Assumes all other assumptions (mortality, disability, plan growth, etc.) are met exactly.

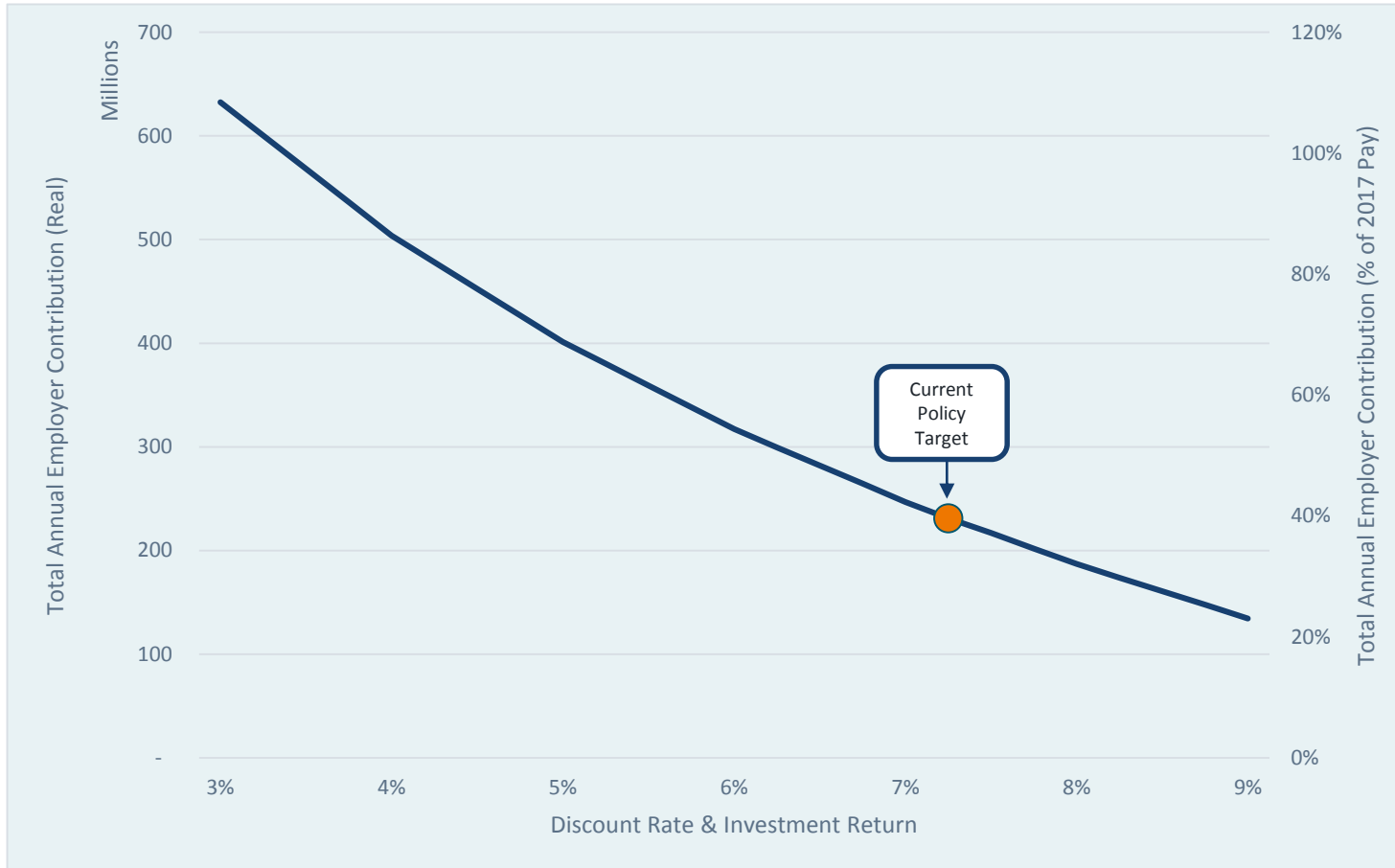
There is a relationship between the contributions the plan makes and the return which it must attain to achieve its goals.

Current total contributions amount to roughly 291 million.

The Annual Required Contribution (ARC) contribution plan will (if our projections of the current policy are correct), increase contributions in line with this chart.

Cost of de-risking

THE COST OF DE-RISKING

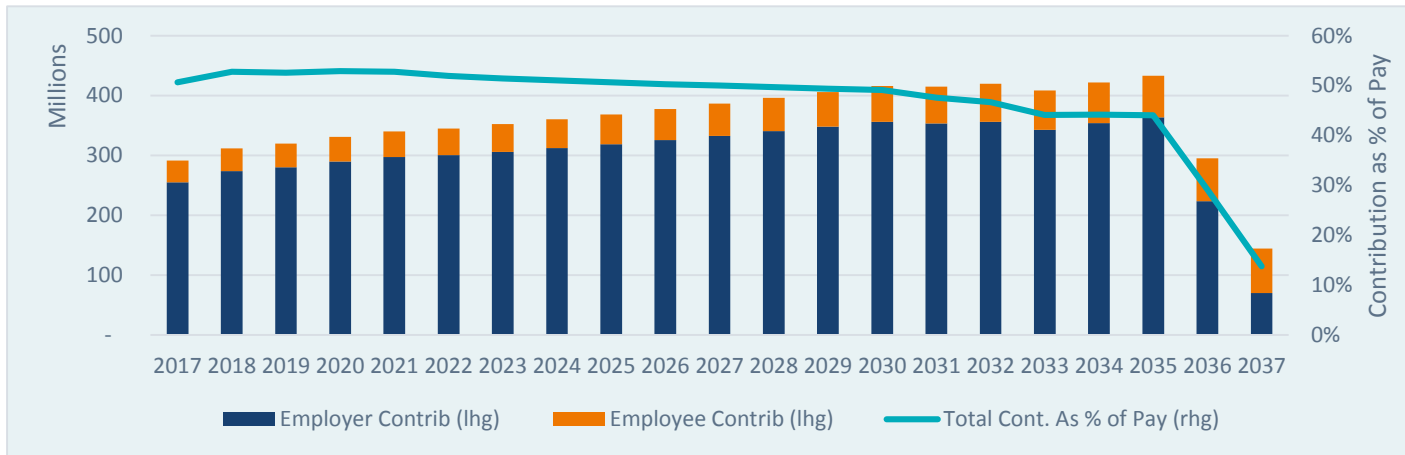


Assuming the current funding policy, a 1% change in the discount rate results in a change of roughly \$69mm in total real contributions through 2037.

Contributions reflected in this graph are displayed as an annual cost in real terms via the inflation assumption of 3.0%. Data displayed in this chart assumes investment returns equal the discount rate for the entire modeling period and all other assumptions (mortality, disability, plan growth, etc.) are met exactly.

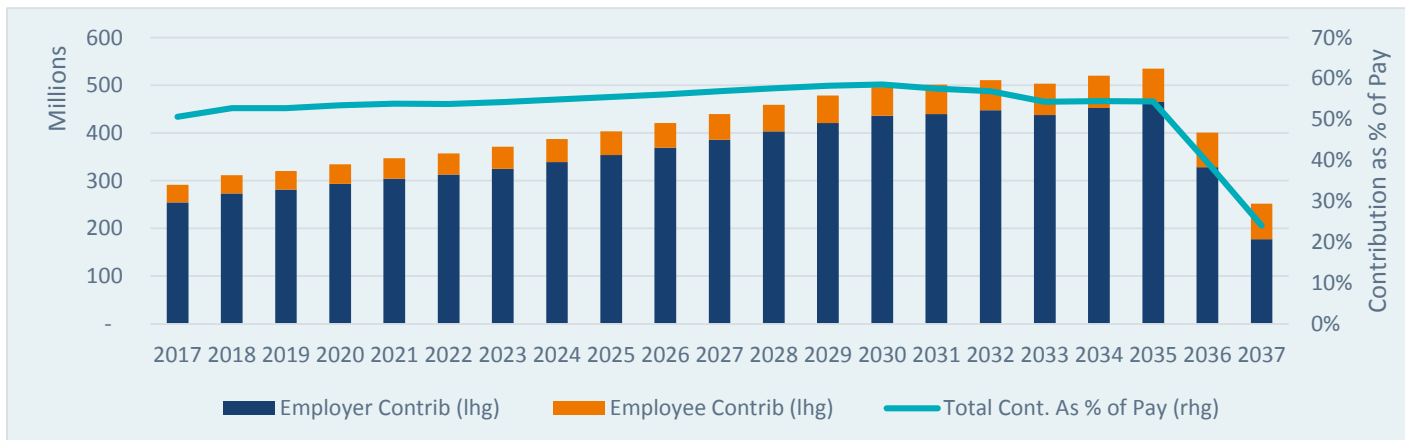
Contributions as a % of pay

BASELINE PROJECTION: 7.25% RETURN SCENARIO



Assuming current funding policy, baseline projections show contributions as a % of pay remaining fairly steady between 45-50% until 2035.

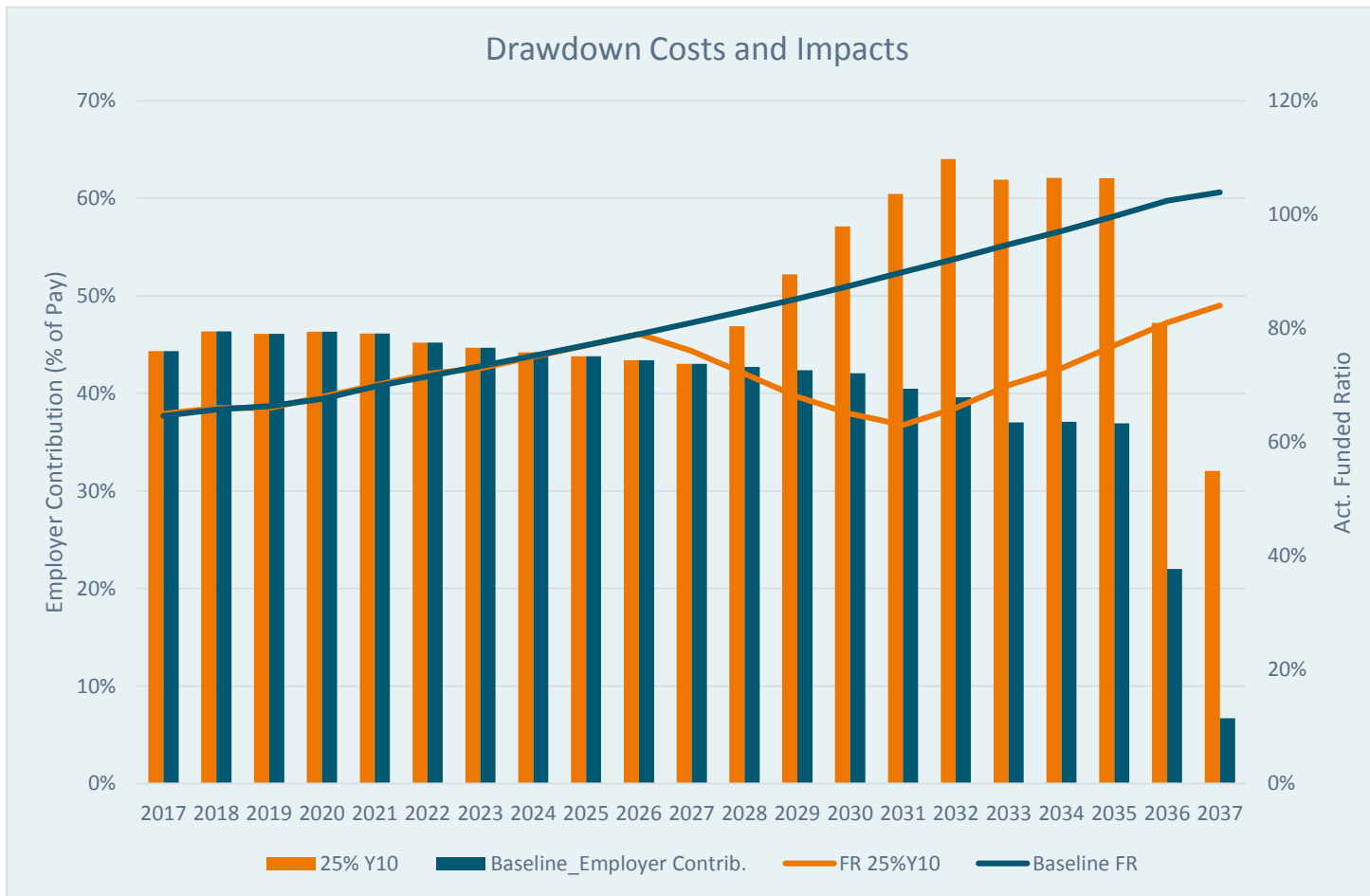
ALTERNATIVE PROJECTION: 5.7% 10 YR & 7.25% 10 YR RETURN SCENARIO



If the Plan achieves a return of 5.7% for the first 10 years and 7.25% thereafter, contributions increase steadily to nearly 60% of pay before decreasing.

Cost of a drawdown

IMPACT OF 25% DRAWDOWN ON CONTRIBUTIONS (7.25% INVESTMENT RETURN OTHERWISE)

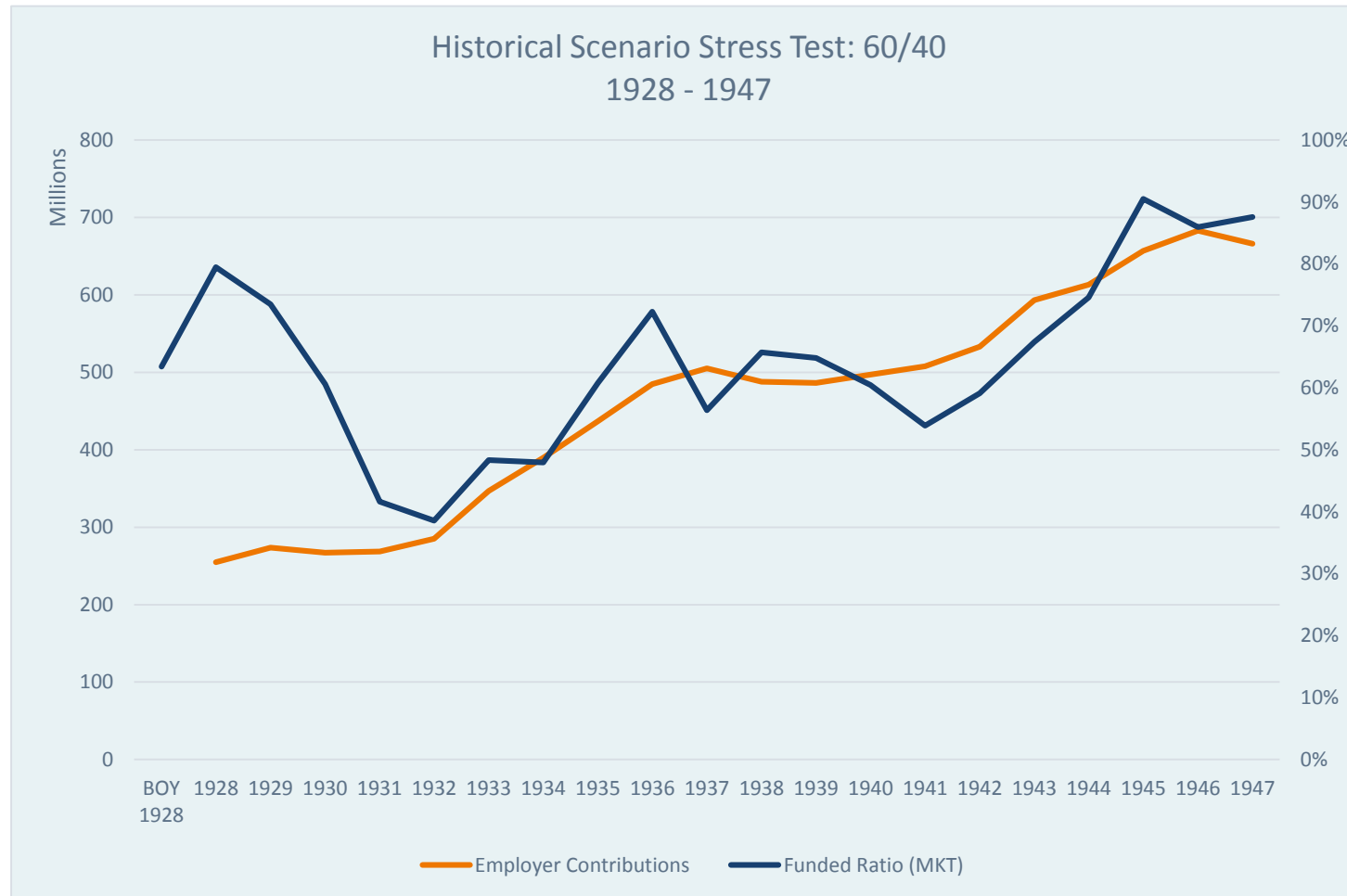


A significant drawdown may require an adjustment to the current funding policy.

Assumes a year to year return of 7.25% before and after the one year drawdown of 25%.

Path dependency: Deterministic Stress Tests

HISTORICAL SCENARIO STRESS TEST: 1928 -1947 (60/40 ALLOCATION)



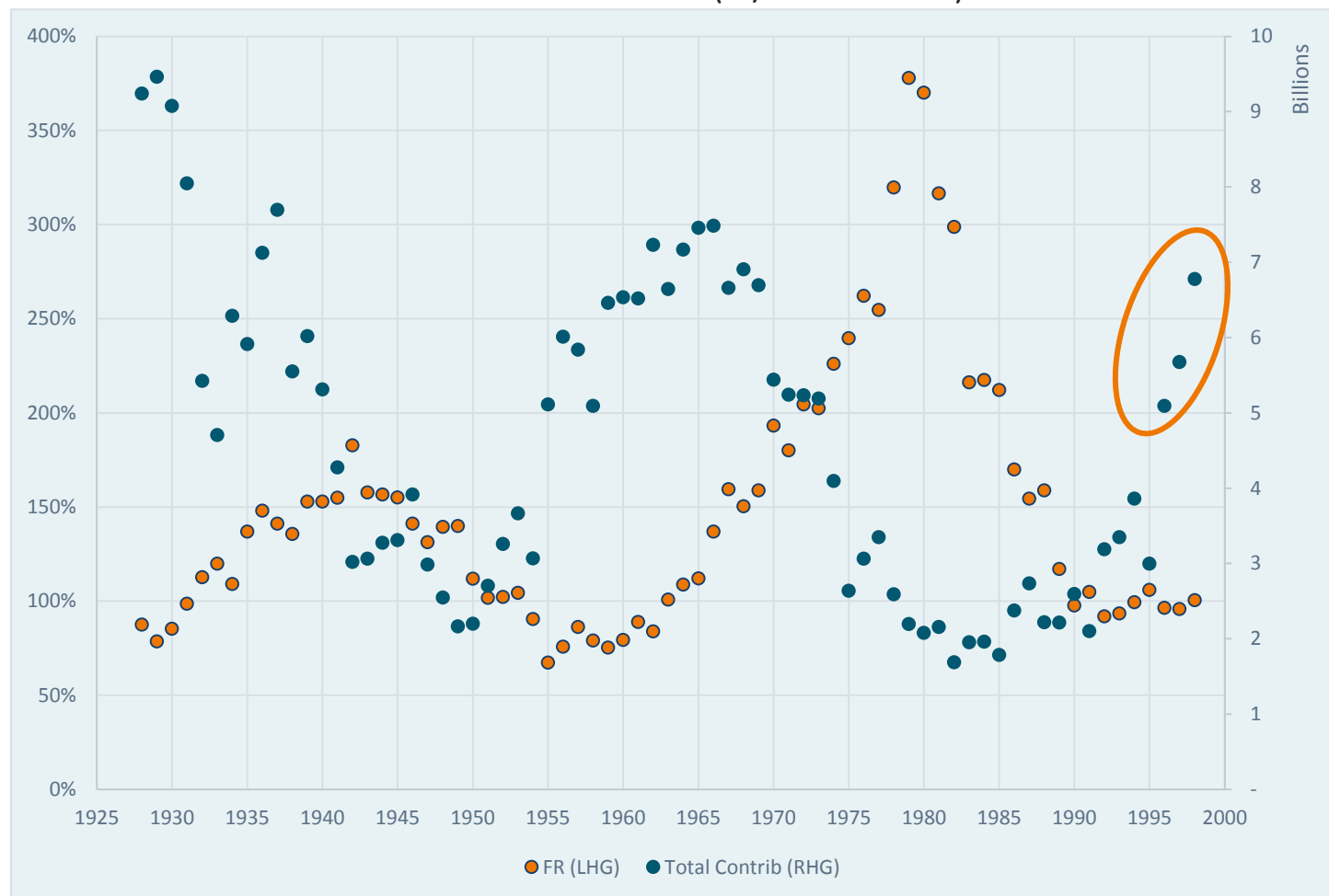
Assume the pension has a traditional 60/40 allocation and were to experience some historical market movements.

In the case of 1928-1947, the plan's funding policy would have the employer contribute 8.9b over 20 years. Our baseline assumptions have the employer contribution amount at 6.3b.

Assumes portfolio allocation is 60% S&P 500 and 10% 10 Year US Treasuries.

Path dependency: Deterministic Stress Tests

HISTORICAL SCENARIO STRESS TEST: ALL 20 YEAR PERIODS (60/40 ALLOCATION)



Now view the relationship of cost to outcome for every 20 year scenario.

Differences in just one year of investment performance and one year of return timing can have dramatic impacts on the costs and financial results of the plan.

For example, take 1996, 1997, and 1998. What causes the difference of nearly 1.6 billion dollars in contributions?

Assumes portfolio allocation is 60% S&P 500 and 10% 10 Year US Treasuries.

Path dependency: Deterministic Stress Tests

60/40 PORTFOLIO RETURN: THREE 20 YEAR PERIODS



1996-2016: Has two years of >20% investment performance, both drawdowns occur latest

1997-2017: Has two years of >20% investment performance, 1 year drawdown timing difference resulting in roughly 0.6b contribution difference from prior year.

1998-2018: Only 1 year of >20% return performance, earliest drawdowns, 1b difference from prior year.

Stochastic projections

10-year return & risk assumptions

Asset Class	Index Proxy	Ten Year Return Forecast		Standard Deviation Forecast	Sharpe Ratio Forecast (g)	Sharpe Ratio Forecast (a)	10-Year Historical Sharpe Ratio (g)	10-Year Historical Sharpe Ratio (a)
		Geometric	Arithmetic					
Equities								
U.S. Large	S&P 500	4.5%	5.6%	15.7%	0.15	0.22	0.50	0.56
U.S. Small	Russell 2000	4.4%	6.5%	21.5%	0.10	0.20	0.36	0.44
International Developed	MSCI EAFE	8.6%	10.1%	18.1%	0.35	0.44	0.11	0.2
International Developed Hedged	MSCI EAFE Hedged	8.6%	9.8%	16.2%	0.40	0.47	0.21	0.28
International Small	MSCI EAFE Small Cap	7.9%	10.2%	22.7%	0.25	0.35	0.24	0.33
International Small Hedged	MSCI EAFE Small Cap Hedged	7.9%	9.7%	20.1%	0.28	0.37	0.36	0.43
Emerging Markets	MSCI EM	7.3%	10.4%	26.6%	0.19	0.31	0.17	0.28
Global Equity	MSCI ACWI	6.3%	7.7%	17.5%	0.23	0.31	0.27	0.35
Private Equity	Cambridge Private Equity	6.4%	9.3%	25.8%	0.16	0.28	0.93	0.92
Fixed Income								
Cash	30 Day T-Bills	2.2%	2.2%	1.2%	-	-	-	-
U.S. TIPS	BBgBarc U.S. TIPS 5 - 10	2.6%	2.7%	5.5%	0.07	0.09	0.57	0.59
U.S. Treasury	BBgBarc Treasury 7-10 Year	2.4%	2.6%	6.8%	0.03	0.06	0.68	0.70
Global Sovereign ex U.S.	BBgBarc Global Treasury ex U.S.	2.7%	3.2%	9.9%	0.05	0.10	0.30	0.33
Global Sovereign ex U.S. Hedged	BBgBarc Global Treasury ex U.S. Hedged	2.7%	2.8%	3.3%	0.15	0.18	1.23	1.22
Core Fixed Income	BBgBarc U.S. Aggregate Bond	2.9%	3.1%	6.4%	0.11	0.14	1.09	1.08
Core Plus Fixed Income	BBgBarc U.S. Corporate IG	3.3%	3.6%	8.4%	0.13	0.17	0.81	0.81
Short-Term Gov't/Credit	BBgBarc U.S. Gov't/Credit 1 - 3 year	2.5%	2.6%	3.7%	0.08	0.11	1.36	1.34
Short-Term Credit	BBgBarc Credit 1-3 Year	2.4%	2.5%	3.7%	0.05	0.08	1.05	1.05
Long-Term Credit	BBgBarc Long U.S. Corporate	3.5%	3.9%	9.4%	0.14	0.18	0.64	0.67
High Yield Corp. Credit	BBgBarc U.S. Corporate High Yield	3.7%	4.3%	11.6%	0.13	0.18	0.64	0.67
Bank Loans	S&P/LSTA	4.9%	5.4%	10.5%	0.26	0.30	0.48	0.51
Global Credit	BBgBarc Global Credit	1.7%	2.0%	7.6%	-0.07	-0.03	0.59	0.61
Global Credit Hedged	BBgBarc Global Credit Hedged	1.7%	1.8%	5.0%	-0.10	-0.08	1.01	1.00
Emerging Markets Debt (Hard)	JPM EMBI Global Diversified	5.1%	5.9%	12.8%	0.23	0.29	0.74	0.76
Emerging Markets Debt (Local)	JPM GBI EM Global Diversified	5.8%	6.5%	12.1%	0.30	0.36	0.31	0.37
Private Credit	Bank Loans + 200 bps	6.9%	7.5%	10.5%	0.45	0.50	-	-
Other								
Commodities	Bloomberg Commodity	4.3%	5.5%	15.9%	0.13	0.21	-0.33	-0.25
Hedge Funds	HFRI Fund of Funds	4.0%	4.8%	7.9%	0.23	0.33	0.21	0.23
Hedge Fund of Funds	HFRI Fund of Funds	3.0%	3.8%	7.9%	0.10	0.20	0.21	0.23
Hedge Funds - Equity Hedge	HFRI Equity Hedge	4.2%	5.5%	11.1%	0.18	0.30	0.36	0.39
Hedge Funds - Event Driven	HFRI Event Driven	4.5%	5.6%	9.9%	0.22	0.34	0.55	0.57
Hedge Funds - Relative Value	HFRI Relative Value	3.9%	4.5%	6.8%	0.25	0.34	0.89	0.89
Hedge Funds - Macro	HFRI Macro	3.3%	4.7%	8.5%	0.12	0.29	0.43	0.44
Core Real Estate	NCREIF Property	6.0%	6.7%	12.7%	0.30	0.35	0.77	0.75
Value-Add Real Estate	NCREIF Property + 200bps	8.0%	9.7%	19.5%	0.30	0.38	-	-
Opportunistic Real Estate	NCREIF Property + 400bps	10.0%	12.9%	26.0%	0.30	0.41	-	-
REITs	Wilshire REIT	6.0%	7.7%	19.5%	0.19	0.28	0.16	0.28
Infrastructure	S&P Global Infrastructure	7.1%	8.7%	18.9%	0.26	0.34	0.27	0.34
Risk Parity	Risk Parity	7.2%	7.7%	10.0%	0.50	0.55	-	-
Currency Beta	Russell Conscious Currency	2.2%	2.3%	4.4%	0.00	0.02	0.23	0.24
Inflation		2.1%	-	-	-	-	-	-

Investors wishing to produce expected geometric return forecasts for their portfolios should use the arithmetic return forecasts provided here as inputs into that calculation, rather than the single-asset-class geometric return forecasts. This is the industry standard approach, but requires a complex explanation only a heavy quant could love, so we have chosen not to provide further details in this document – we will happily provide those details to any readers of this who are interested.

Range of likely 10 year outcomes

10 YEAR RETURN 90% CONFIDENCE INTERVAL



Asset mixes

	Policy	Current	7.25% Mix	80/20	70/30	60/40	50/50	Return (g)	Standard Deviation
US Large	15.0	15.3	0.0	0.0	0.0	0.0	0.0	4.5	15.7
US Small	4.0	4.6	0.0	0.0	0.0	0.0	0.0	4.4	21.5
Total Domestic Equity	19.0	19.9	0.0	0.0	0.0	0.0	0.0		
International Developed	8.0	11.3	0.0	0.0	0.0	0.0	0.0	8.6	18.1
Emerging Markets	4.0	4.7	0.0	0.0	0.0	0.0	0.0	7.3	26.6
Total Int'l Equity	12.0	16.0	0.0	0.0	0.0	0.0	0.0		
Global Equity	6.0	5.5	0.0	80.0	70.0	60.0	50.0	6.3	17.5
Total Equity	37.0	41.4	0.0	80.0	70.0	60.0	50.0		
Core Fixed Income	19.0	24.8	0.0	20.0	30.0	40.0	50.0	2.9	6.4
US Treasury	0.0	0.0	2.6	0.0	0.0	0.0	0.0	2.4	6.8
High Yield Corp. Credit	6.0	7.1	0.0	0.0	0.0	0.0	0.0	3.7	11.6
Emerging Market Debt (Local)	4.0	4.3	0.0	0.0	0.0	0.0	0.0	5.8	12.1
Total Fixed Income	29.0	36.2	2.6	20.0	30.0	40.0	50.0		
Commodities	4.0	4.1	0.0	0.0	0.0	0.0	0.0	4.3	15.9
Core Real Estate	5.0	4.1	0.0	0.0	0.0	0.0	0.0	6.0	12.7
Value Add Real Estate	5.0	1.4	0.0	0.0	0.0	0.0	0.0	8.0	19.5
Opportunistic Real Estate	0.0	0.0	15.1	0.0	0.0	0.0	0.0	10.0	26.0
Total Real Assets	14.0	9.6	15.1	0.0	0.0	0.0	0.0		
Hedge Funds	10.0	8.8	0.0	0.0	0.0	0.0	0.0	4.0	7.9
Risk Parity	0.0	0.0	45.6	0.0	0.0	0.0	0.0	7.2	10.0
Private Equity	5.0	2.5	0.0	0.0	0.0	0.0	0.0	6.4	25.8
Private Credit	5.0	1.1	21.8	0.0	0.0	0.0	0.0	6.9	10.5
Total Non-Public Investments	20.0	12.4	67.4	0.0	0.0	0.0	0.0		
Cash	0.0	0.4	14.9	0.0	0.0	0.0	0.0	2.2	1.2
Total Allocation	100.0	100.0	100.0	100.0	100.0	100.0	100.0		

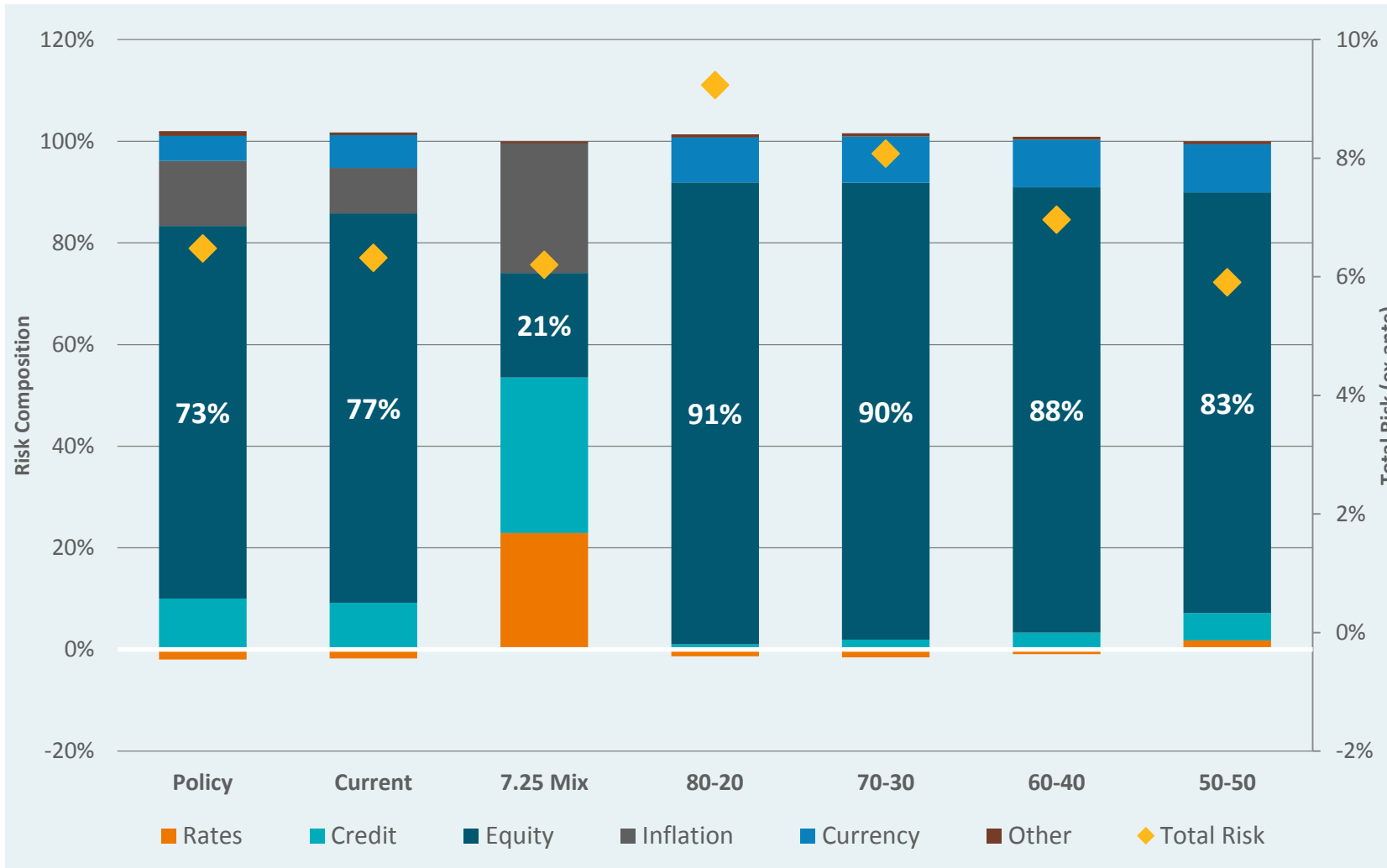
Source: MPI, Verus

Mean-variance analysis

	Policy	Current	7.25% Mix	80/20	70/30	60/40	50/50
Mean Variance Analysis							
<i>Forecast 10 Year Return</i>	<i>5.7</i>	<i>5.4</i>	<i>7.2</i>	<i>5.8</i>	<i>5.6</i>	<i>5.3</i>	<i>4.9</i>
Standard Deviation	10.8	10.6	7.3	14.4	12.8	11.3	9.8
<i>Return/Std. Deviation</i>	<i>0.5</i>	<i>0.5</i>	<i>1.0</i>	<i>0.4</i>	<i>0.4</i>	<i>0.5</i>	<i>0.5</i>
<i>1st percentile ret. 1 year</i>	<i>-20.5</i>	<i>-22.2</i>	<i>-15.9</i>	<i>-37.4</i>	<i>-33.0</i>	<i>-28.6</i>	<i>-23.6</i>
Sharpe Ratio	0.38	0.35	0.73	0.32	0.32	0.33	0.33

Source: MPI, Verus

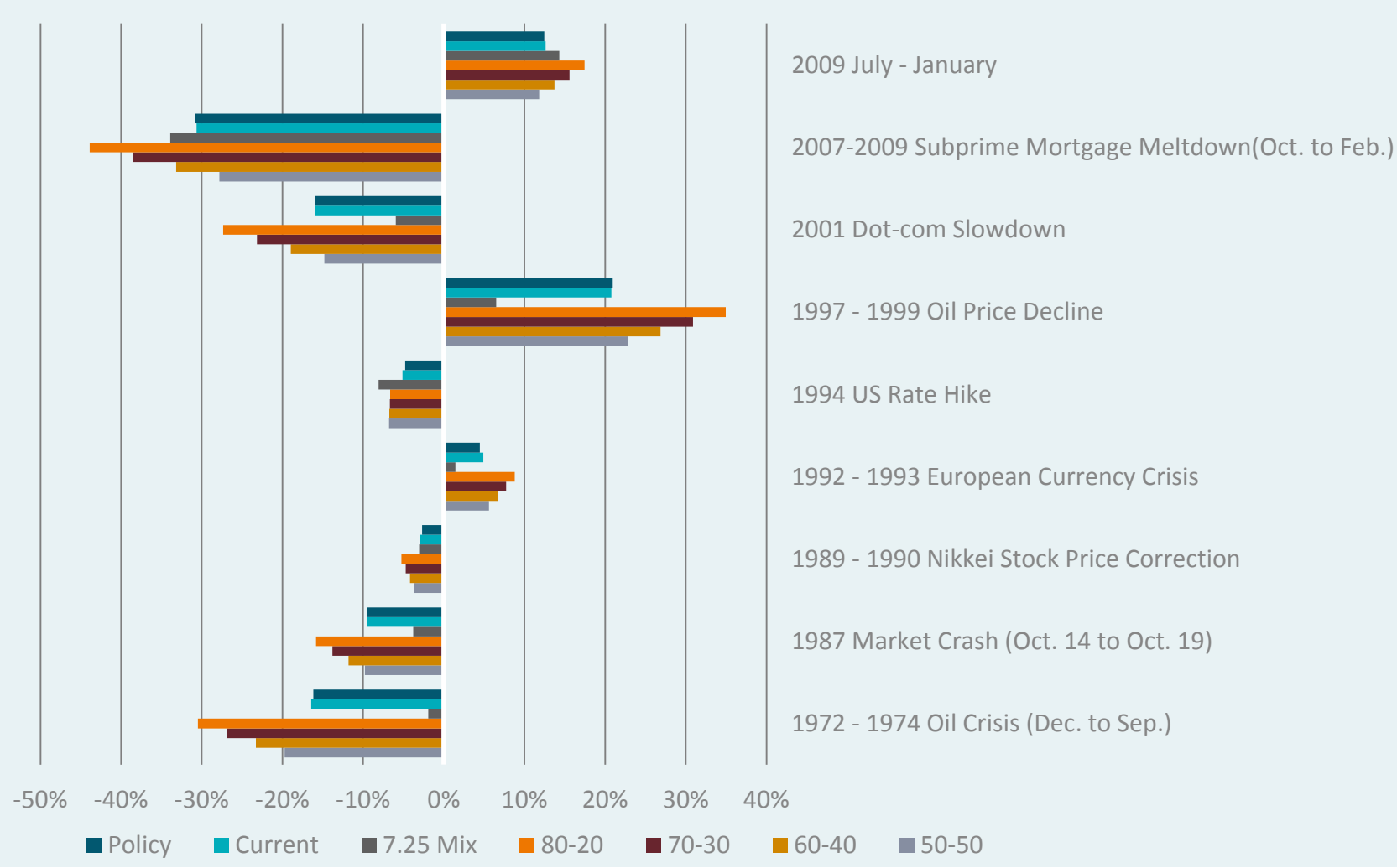
Risk decomposition



The equity risk factor dominates most portfolios.

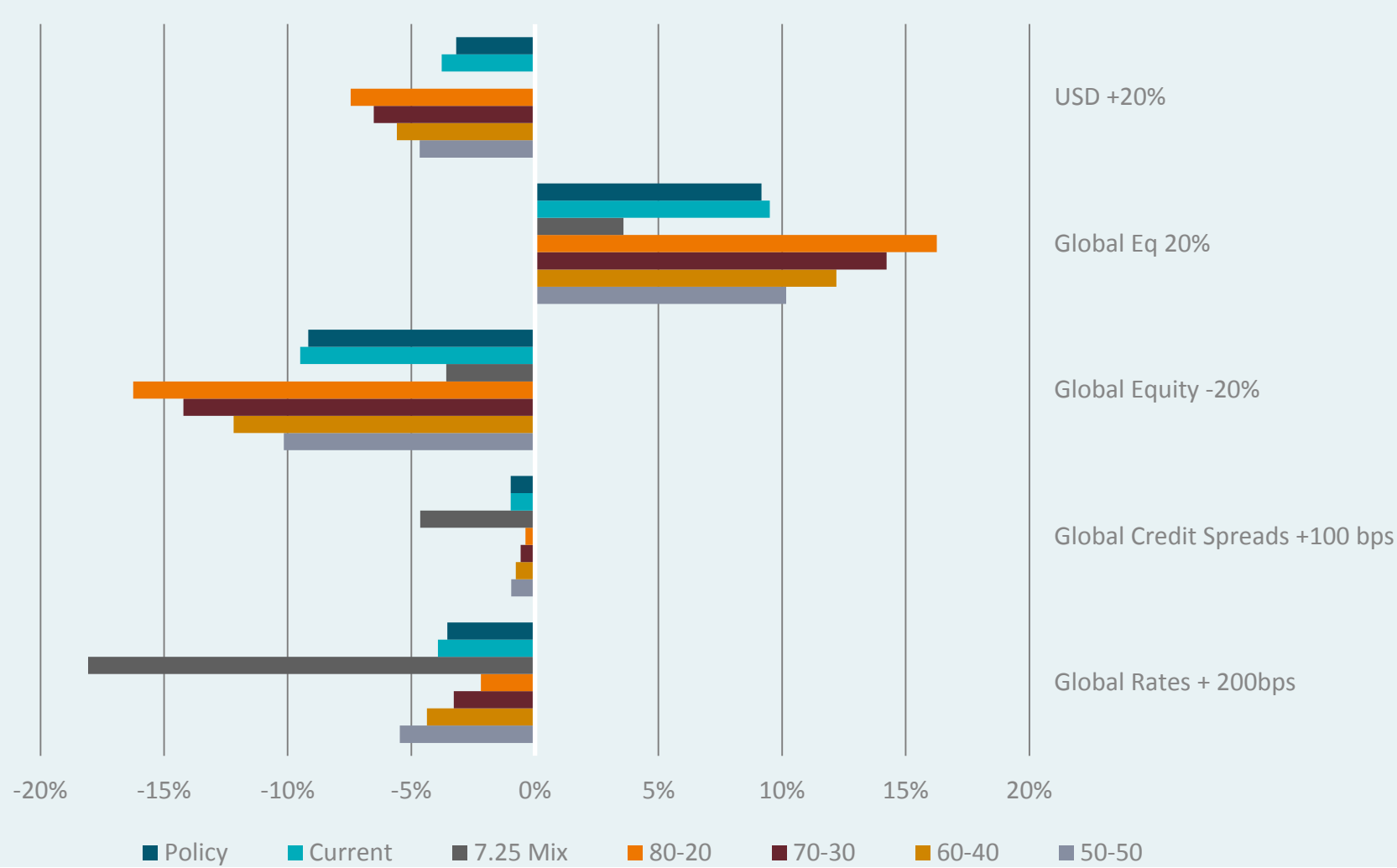
Source: Barra, Ex-Ante Volatility

Scenario analysis



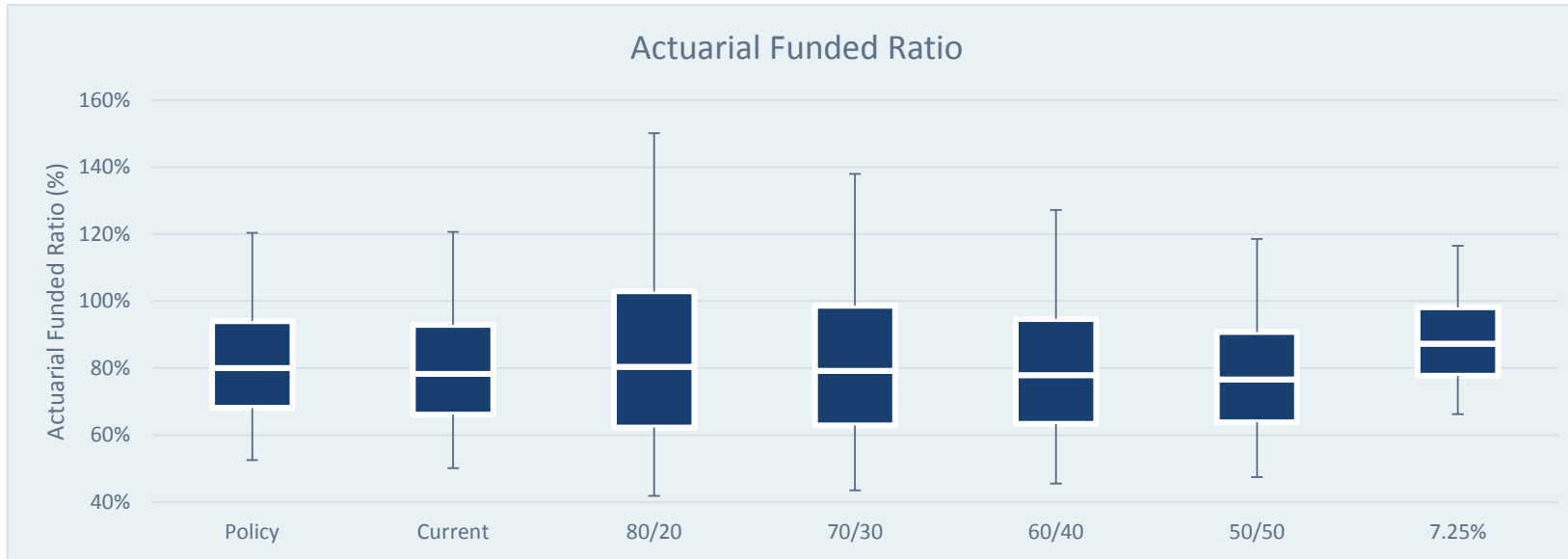
Source: Barra

Stress tests



Source: Barra

Funded status: 10 year forecast

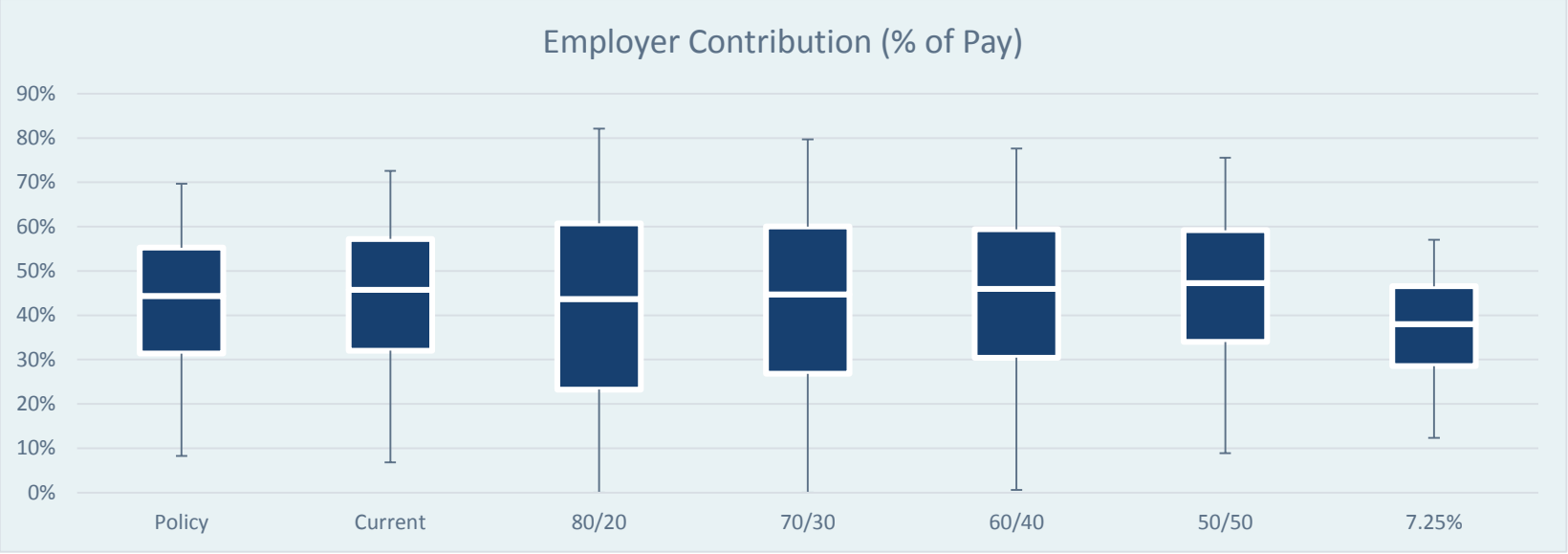


FUNDED STATUS – STOCHASTIC OUTCOMES IN 10 YEARS

	Policy	Current	80/20	70/30	60/40	50/50	7.25%
Best Case (95%)	120.38%	120.64%	150.13%	138.00%	127.18%	118.54%	116.47%
Median Outcome (50%)	79.95%	78.22%	80.32%	79.20%	77.90%	76.58%	87.29%
Worst Case (5%)	52.53%	50.14%	41.80%	43.43%	45.47%	47.40%	66.25%
CVAR (5%)	46.2%	43.2%	33.1%	35.5%	37.7%	39.6%	61.8%

Source: ProVal, Verus

Employer contributions: 10 year forecast



EMPLOYER CONTRIBUTIONS – STOCHASTIC OUTCOMES IN 10 YEARS

	Policy	Current	80/20	70/30	60/40	50/50	7.25%
Best Case (95%)	8.3%	6.8%	0.0%	0.0%	0.6%	8.91%	12.33%
Median Outcome (50%)	44.4%	45.8%	43.7%	44.7%	46.0%	47.28%	37.99%
Worst Case (5%)	69.7%	72.6%	82.1%	79.7%	77.6%	75.54%	57.04%
CVAR (5%)	76.8%	79.8%	90.8%	88.2%	85.7%	83.6%	61.6%

Source: ProVal, Verus

Heat map

Selection Criteria	Policy	Current	7.25% Mix	80/20	70/30	60/40	50/50
Risk/Return Metrics							
Expected Return	5.7%	5.4%	7.2%	5.8%	5.6%	5.3%	4.9%
% chance of meeting 7.25%	33.3	30.7	49.9	37.6	33.7	28.9	23.0
Volatility	11.4	11.4	7.3	14.4	12.8	11.3	9.8
Sharpe Ratio	0.4	0.3	0.7	0.3	0.3	0.3	0.3
Daily VaR (95% confidence, \$MM)	\$10.7	\$11.2	\$6.5	\$19.6	\$16.9	\$14.3	\$11.5
Daily CVaR (95% confidence, \$MM)	\$19.4	\$20.8	\$12.3	\$26.8	\$24.0	\$21.2	\$18.5
2007-2009 Drawdown (Simulation)	-30.8%	-30.6%	-33.9%	-43.9%	-38.5%	-33.2%	-27.8%
1st Percentile (1 Year)	-23.4%	-25.8%	-15.9%	-37.4%	-33.0%	-28.6%	-23.6%
Other Key Metrics (Expected Yr. 10)							
% of Pay Cont. - Employer	44.4%	45.8%	38.0%	43.7%	44.7%	46.0%	47.3%
Funded Ratio	80.0%	78.2%	87.3%	80.3%	79.2%	77.9%	76.6%
Risk Factors							
Portfolio Complexity	med	med	high	low	low	low	low
Leverage	med	med	high	low	low	low	low
Peer Risk	med	med	high	high	high	med	high
Liquidity Risk	med	med	med	low	low	low	low
Tail Risk	med	med	low	high	high	med	med
Equity Risk Allocation	med	med	low	high	high	med	med

Source: MPI, Barra, ProVal, Verus

Appendix

Notes

- Assumed return: 7.25%
 - 3.0% inflation
 - 4.25% real return
- Plan projections assume constant population (zero plan growth)
- COLA: Plan contains a COLA which changes based on the CPI on maximums which differ based on benefit tier.
 - Currently illustrated at 2.5%
- Amortization: fixed period of 18 years, period type is closed (every year debt is re-evaluated and amortized over 18 years).
- Asset growth projections are supplied by Verus' 2018 Capital Market Assumptions