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Risk Analysis and Assessment

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ASOP 51: Disclosure of Risk

- We are currently working on full risk assessment studies for both TRS and PERS for delivery in early February
- The information of the following pages are not specific to TRS or PERS but are intended to demonstrate areas of risk that we will focus on in order to exploit any weaknesses that may exist in the funding of the Systems
- The example on the following pages are not comprehensive as we may analyze additional risk factors not demonstrated in this presentation

ASOP 51

- Actuarial Standards of Practice (ASOPs) identify what the actuary should consider, document and disclose when performing an actuarial assignment

- Credentialed actuaries must follow the ASOPs

- New ASOP on *Assessment and Disclosure of Risk*
  - Applies to funding valuations (not GASB) and pricing of proposed plan changes
  - Effective for work products with measurement date on/after November 1, 2018 (so 6/30/19 valuation)
  - **"Risk"** is defined as the potential of actual future measurements deviating from expected results due to actual experience that is different than the actuarial assumptions

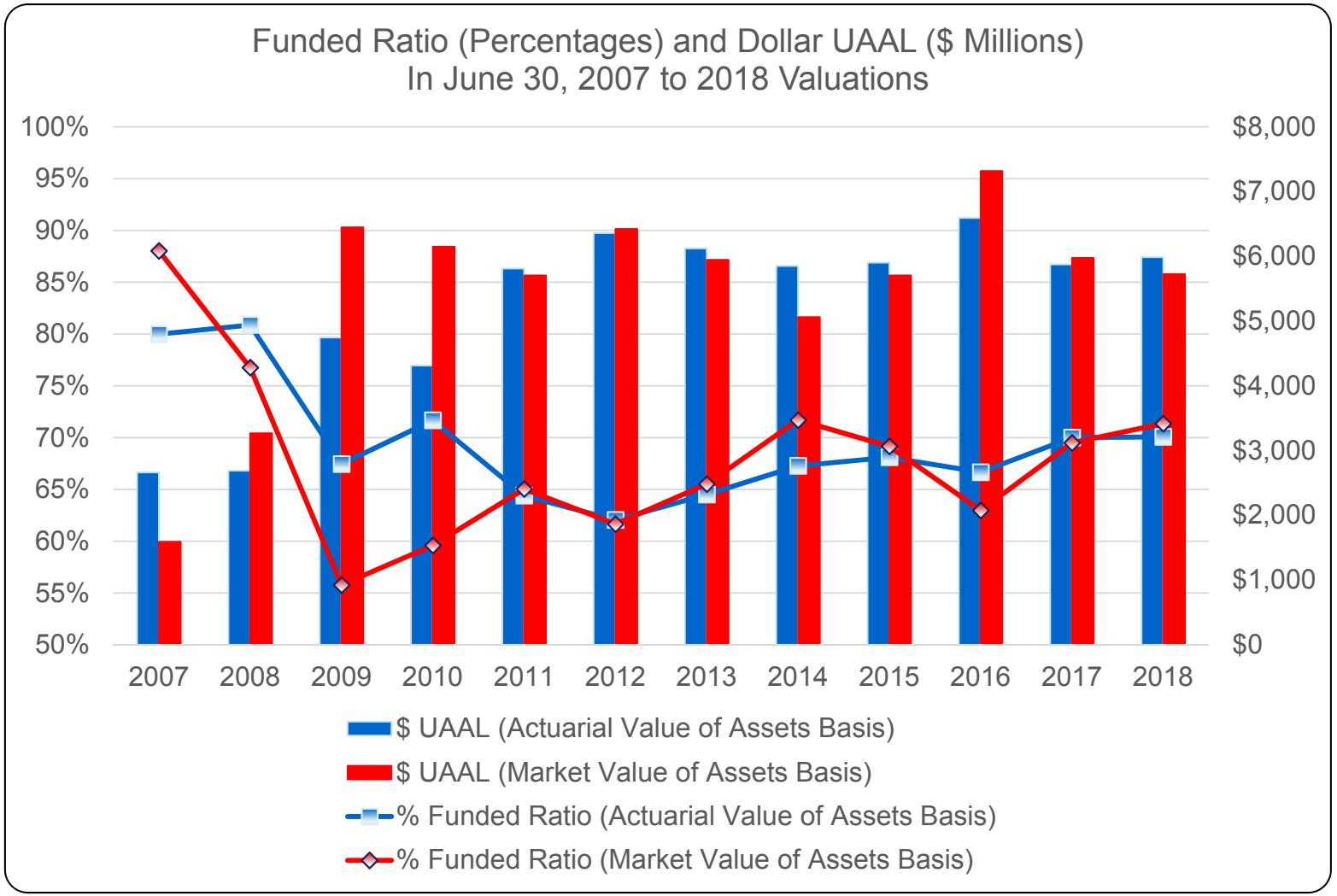
ASOP 51

- Actuary is to identify risks that may affect the Plan's future financial condition
- Examples in ASOP 51 that are relevant for most public plans
  - ***Investment risk***: potential that return will be different than expected
  - ***Longevity risk***: potential that mortality experience will be different than expected
  - ***Covered payroll risk***: potential that covered payroll will not increase as assumed (especially important if UAL is amortized as level percent of payroll)
  - ***Active population risk***: potential for number of active members to decline or plan closed to new entrants
  - ***Contribution rate risk***: potential for contribution rates to be too high for the plan sponsor/employer to pay

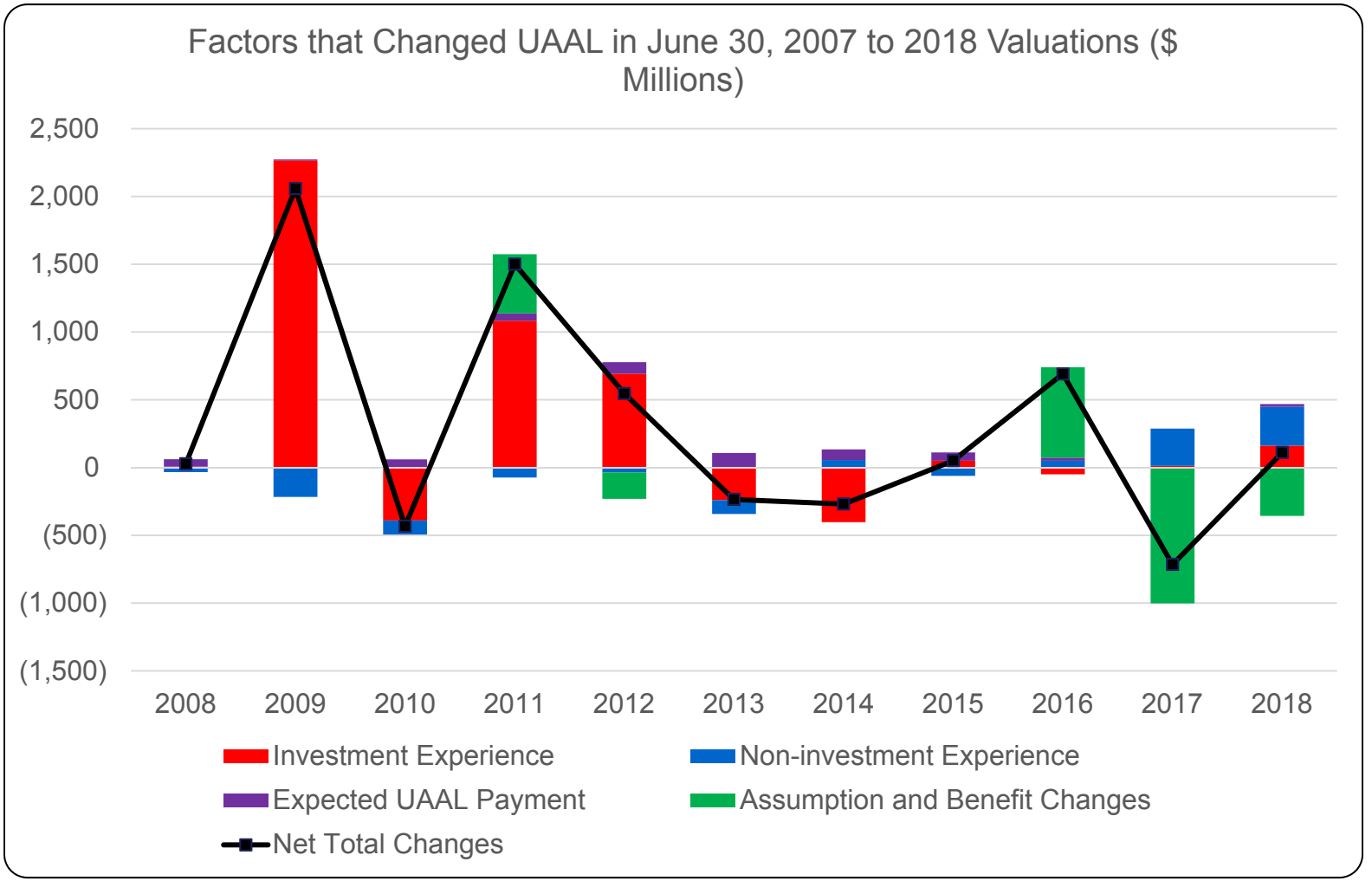
ASOP 51: Disclosure of Risk

- Plan maturity measurements – actuary should calculate and disclose plan maturity measures, *which in the actuary's professional judgment*, are significant to understanding the risks associated with the Plan
- These are important, and have previously been discussed in the valuation presentation
  - Ratio of market value of assets to payroll (called the asset volatility ratio)
  - Ratio of net cash flow to market value of assets
  - Ratio of retired liability to total liability
  - Ratio of actives to retirees
- This presentation will focus on the new material

ASOP 51: Disclosure of Risk



ASOP 51: Disclosure of Risk

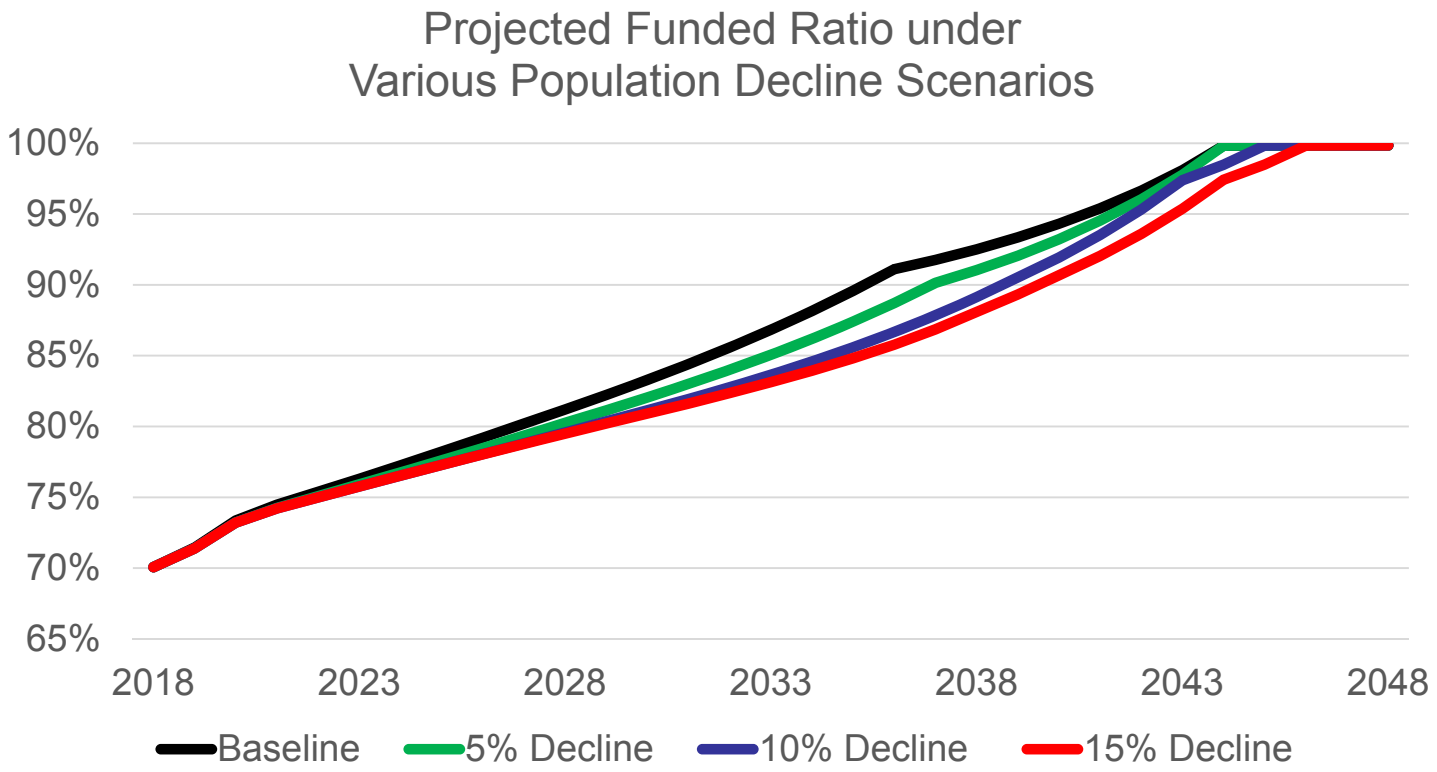


Qualitative Assessment

- Amortization policy
- Size of active membership and growth in total covered payroll
- Funding Policy

Stress Testing: Population Decline

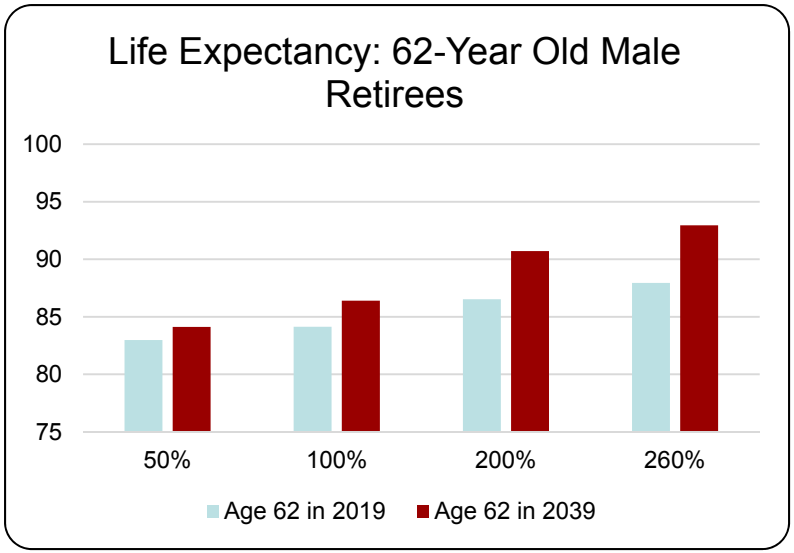
A reduction in population will result in a reduction in covered payroll which will reduce the funding available to the System since employer contributions are limited to 14% of payroll which will ultimately increase the amount of time necessary to completely amortize the unfunded liability



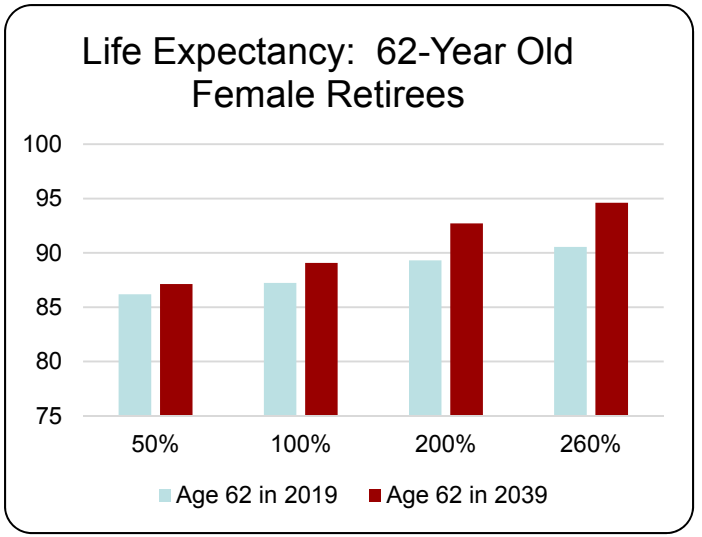
Quantitative Analysis

- Mortality Risk: changes in longevity
  - Valuation assumption anticipates small, continuous improvements in mortality each year in the future (generational mortality)
  - This assumption is reviewed and evaluated in each experience study
  - Risk is the possibility of a sudden shift and longer life expectancy
  - Recent experience represents about 1% improvement per year

Mortality Improvement Scale
Life Expectancy at Age 62



These charts show the effect on life expectancy if future mortality improvement is halved or doubled.



Usefulness of Models In Risk Assessment

- "Prediction" is not the goal of modeling. Models are beneficial for:
  - Identifying interactions between inputs that are not self-evident
  - Communicating uncertainties using simple examples or graphs
  - Answering "what if" or comparative questions
  - Identifying sensitivities of outputs to particular inputs, providing guidance on areas that require additional analysis
  - Revealing inconsistencies, discrepancies, or limitations in other types of analysis
- Models are useful as a tool for analyzing the system's objectives and strategies as well as effective as a decision-making tool

Limitations of Modeling

- All models are simplifications of how experience will unfold in the real world
- Actual experience will almost certainly be different and more complex than any scenarios modeled
- Be careful to understand what a model is intended to communicate

Sensitivity Analysis

- **Sensitivity analysis**: an analysis or simulation designed to illustrate the range of potential results when actual experience is different than expected, based on assumptions
  - Vary the rate of return incrementally over specified time period (heat map)
  - Compare results under better/worse than expected scenarios, e.g., current investment return assumption plus scenarios of +1% and -1% returns
  - Compare results under different sets of assumptions

Sensitivity Analysis

Note: investment return assumption is not changed. Actual returns are assumed to be the rate shown over the 10 year period.

Funded Ratio at June 30 Valuation

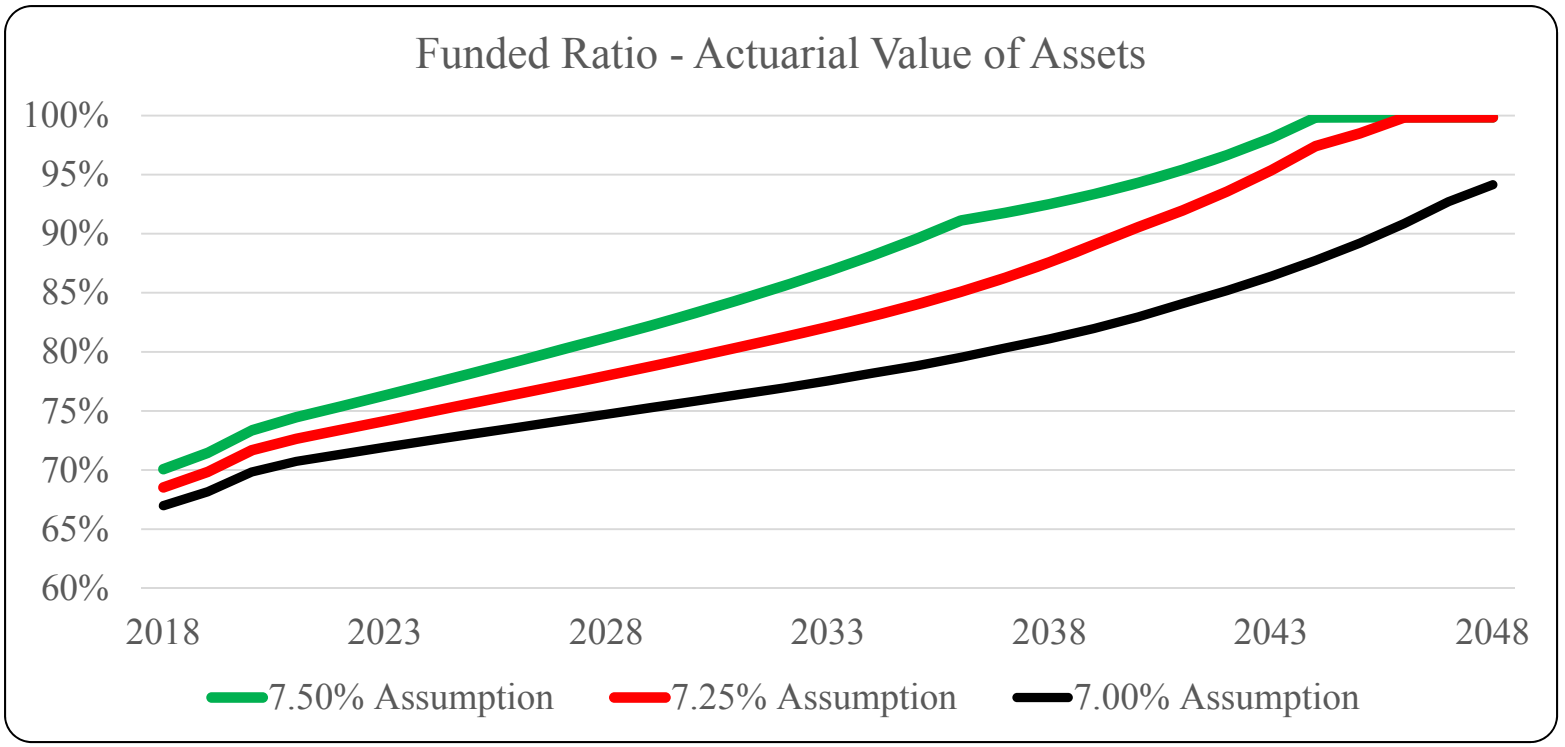
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
5.00%	71%	72%	72%	71%	69%	68%	67%	66%	65%	63%	62%	61%
5.25%	71%	72%	72%	71%	70%	69%	68%	67%	66%	65%	64%	63%
5.50%	71%	72%	72%	71%	71%	70%	69%	68%	67%	66%	66%	65%
5.75%	71%	72%	72%	72%	71%	71%	70%	70%	69%	68%	68%	67%
6.00%	71%	73%	73%	72%	72%	72%	71%	71%	70%	70%	70%	69%
6.25%	71%	73%	73%	73%	73%	73%	72%	72%	72%	72%	72%	72%
6.50%	71%	73%	73%	73%	74%	74%	74%	74%	74%	73%	74%	74%
6.75%	71%	73%	74%	74%	74%	74%	75%	75%	75%	75%	76%	76%
7.00%	71%	73%	74%	74%	75%	75%	76%	76%	77%	77%	78%	78%
7.25%	71%	73%	74%	75%	76%	76%	77%	78%	78%	79%	80%	81%
7.50%	71%	73%	74%	75%	76%	77%	78%	79%	80%	81%	82%	83%
7.75%	71%	74%	75%	76%	77%	78%	79%	81%	82%	83%	85%	86%
8.00%	72%	74%	75%	76%	78%	79%	81%	82%	84%	85%	87%	88%

Uses actuarial value of assets so smoothing of returns is reflected.

Investment Risk: Sensitivity Analysis

Change in Investment Return Assumption

The 7.5% assumption (green line) has the highest funded ratio because liabilities/costs are lowest and assets grow more quickly than in the other two scenarios.



Stress Testing

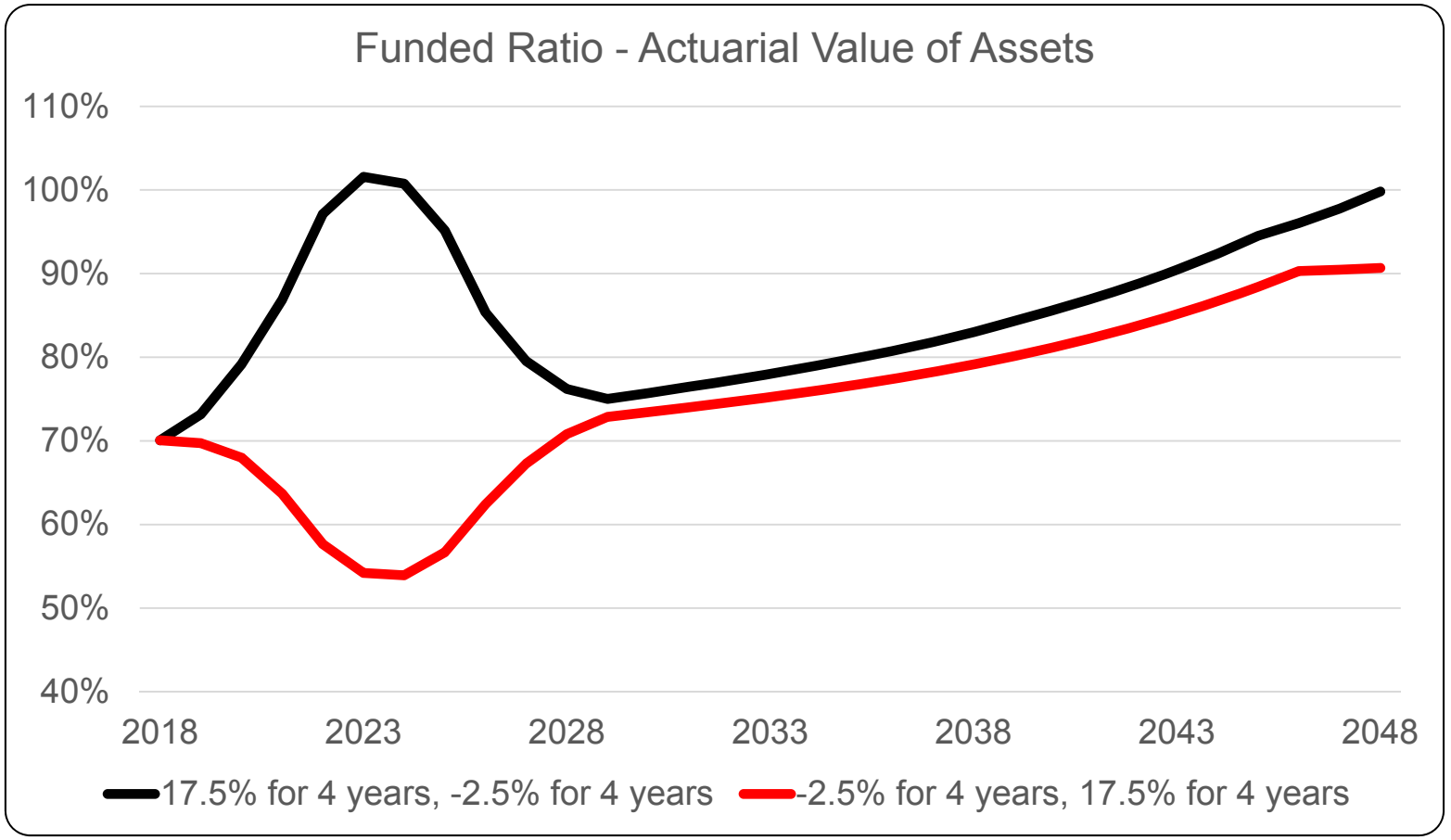
- **Stress test**: an analysis or simulation designed to determine the ability of a financial institution to manage an economic crisis or certain stressors

- **Purpose** is to **identify the stressors** to the System and **optimize policies and procedures** (assumptions, funding policy, and perhaps benefits) in order to **improve sustainability** and **educate stakeholders** of potential risks
  - Focus should be on the decisions to be considered based on the outcomes of the test

Typical Procedure for Stress Test

- Project historical crisis data into the future and simulate what would happen to system's funding
- Deterministic projections using one set of assumed returns
- Take several sets of economic scenarios and project and compare key actuarial metrics

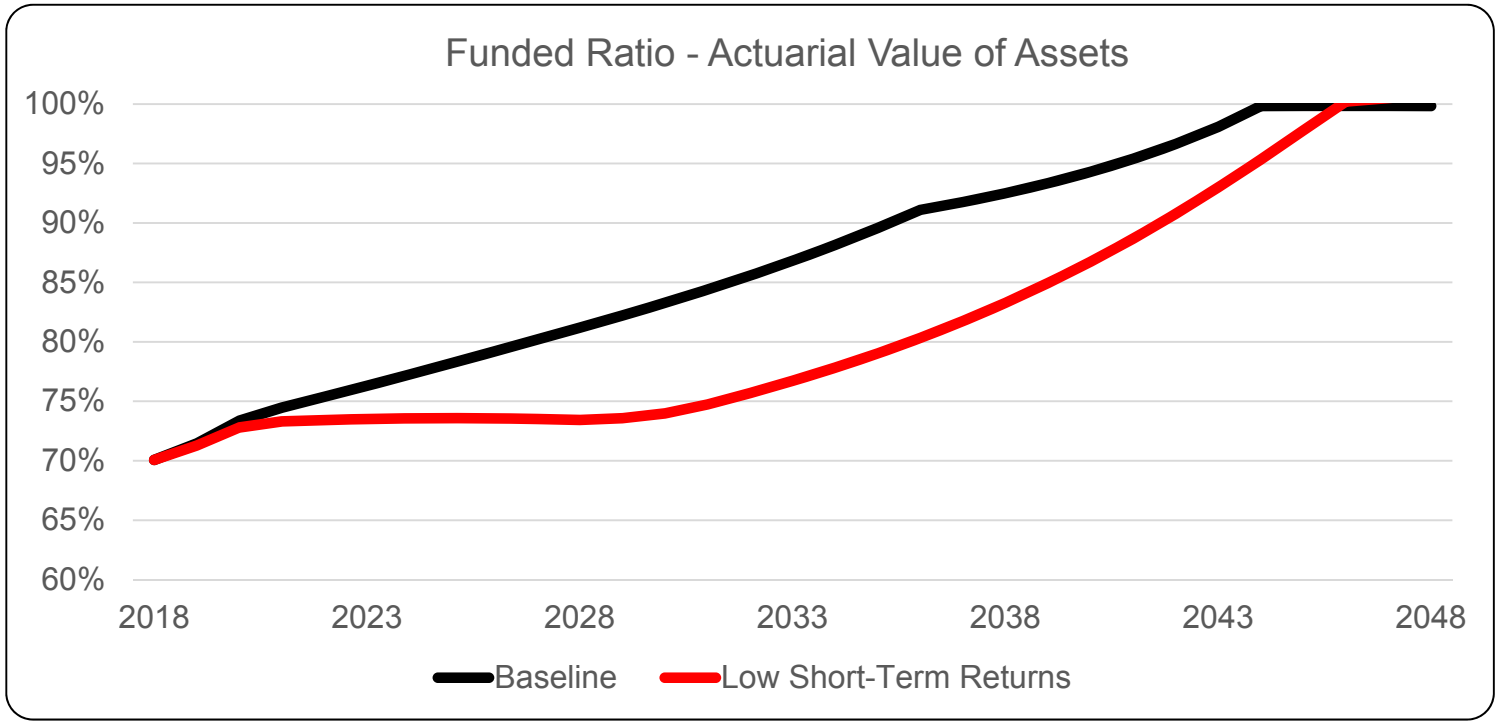
Stress Testing: Order of Returns



The same geometric return occurs over this period, but when low returns occur first, it results in a difference of $4.0 billion in asset value.

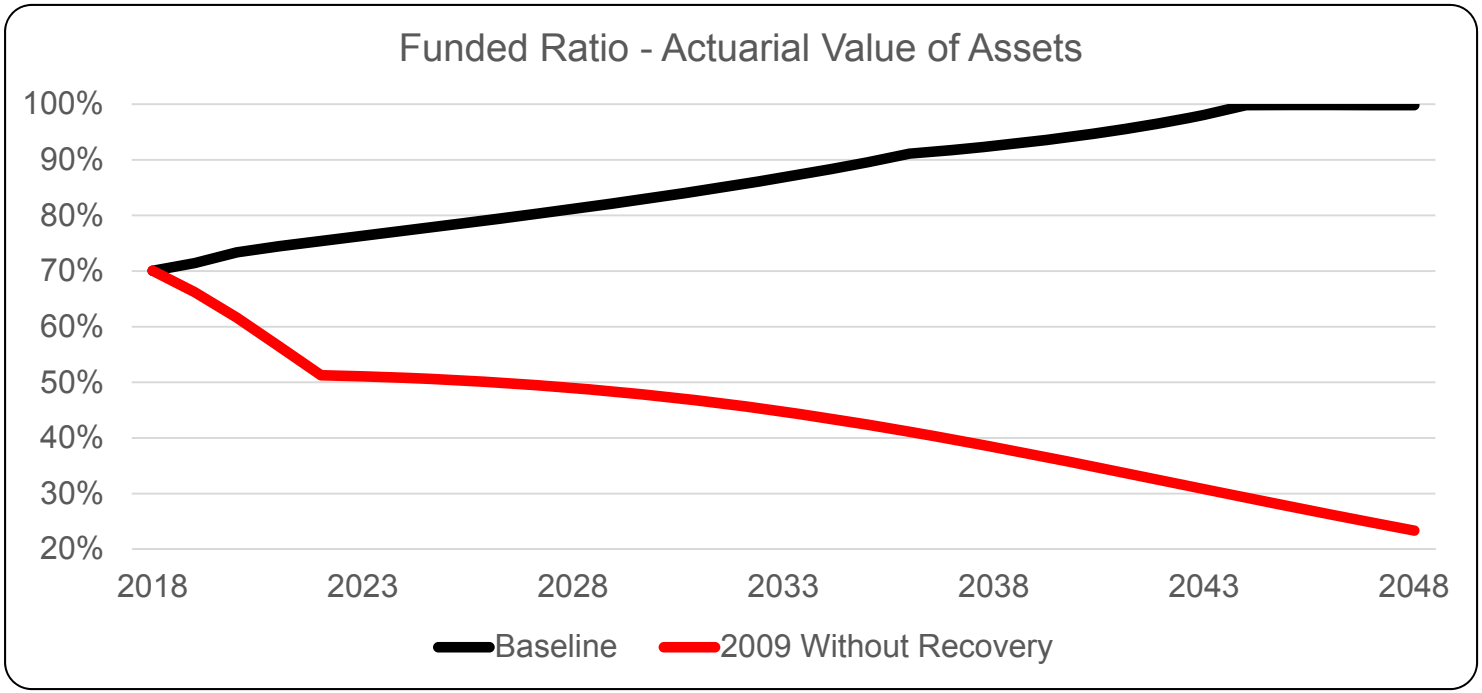
Stress Testing
Low Returns for Sustained Period

Low returns over the next 10 years reduce the funded ratio until 2030. Ultimately, the difference is eliminated and reversed as the higher investment returns result in a higher funded ratio at the end of the period.



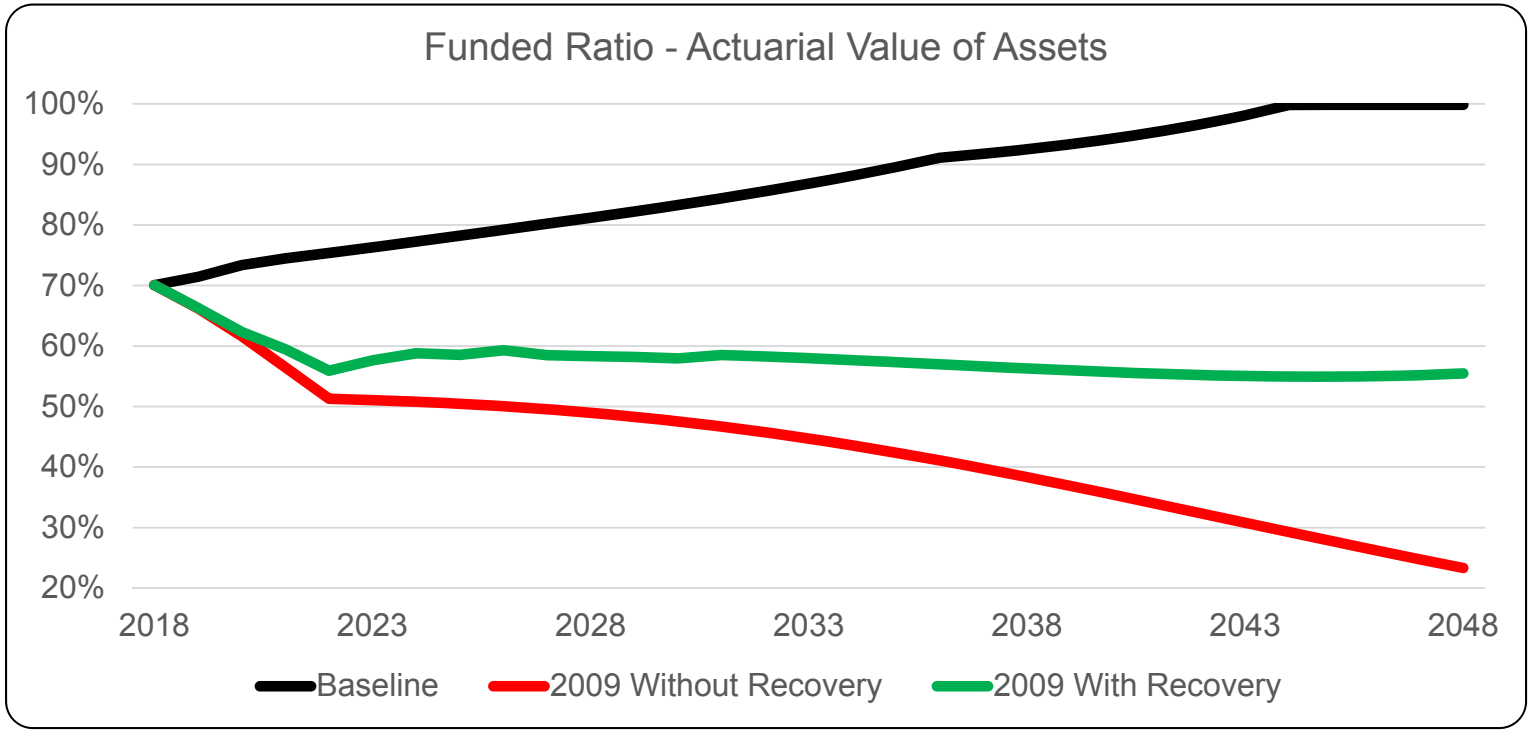
Stress Testing: Shock Return

Without the recovery, the funded ratio drops for the entire period projection period.



Stress Testing: Shock Return

The green line shows that the recovery in the financial markets helps to reverse the declining funded ratio but still does not produce an ideal result in which the funded ratio begins to improve.



Stochastic Analysis

- Stochastic modeling is the most sophisticated analysis available for investment return impact
- Produces a distribution of possible returns, directly reflecting the impact of investment return volatility on pension funding over time
- Often used by investment consultants in asset/liability studies
- More complex and, therefore, more difficult to understand

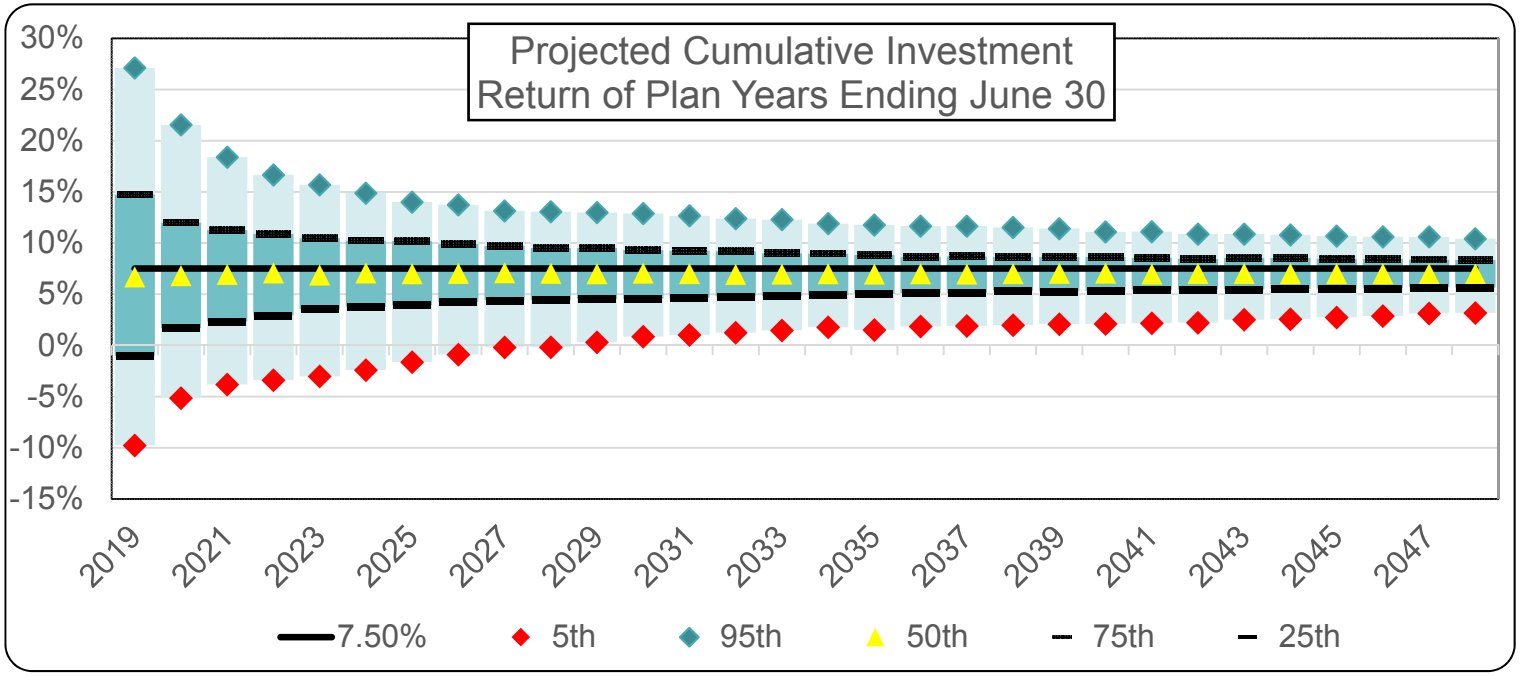
Stochastic Analysis

Probability of funded ratio being lower than a certain threshold at any time during the projection period.

	Ratio <40%	Ratio <50%	Ratio <60%	Ratio <70%	Ratio <80%
2018 – 2023	0%	2%	13%	33%	61%
2018 – 2028	5%	13%	24%	38%	51%
2018 – 2033	13%	21%	31%	41%	52%

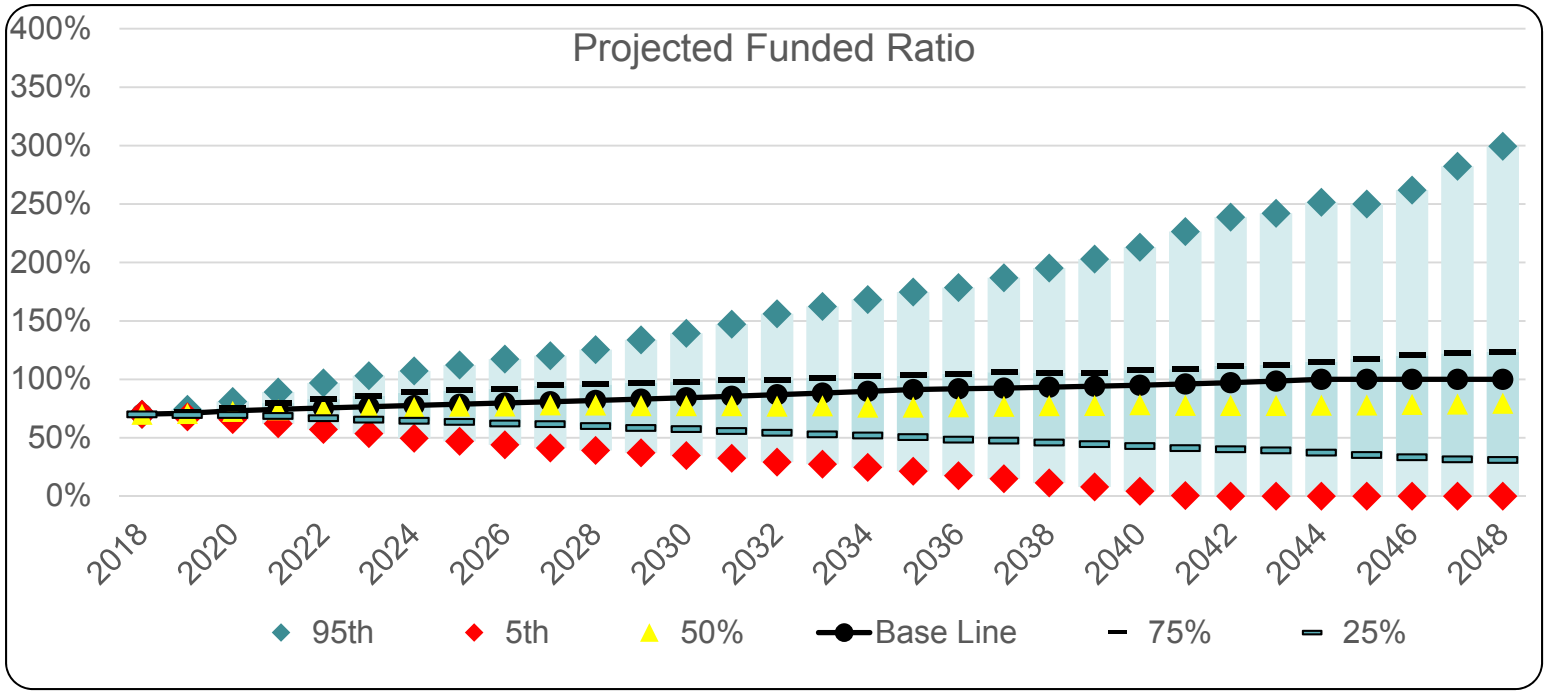
Stochastic Analysis

The chart below is based on the capital market assumptions of the investment professionals serving the System. We utilize those assumptions to produce the percentile ranks of expected returns over 30 years. The analysis indicates that over the next 30 years there is a 50% chance the cumulative market returns over the next 30 years will be between 5.64% and 8.36%.



Stochastic Analysis

The median funded ratio tends to remain less than baseline deterministic scenario over the projection period. If the period was extended past 30 years, the 50th percentile would most likely achieve the same pattern as the baseline deterministic projection. This graph indicates that in 10 years, the middle 50% of possible outcomes are between 75% and 109% funded. There is a 5% chance of being more than 138% funded, and a 5% chance of being less than 56% funded.



Stochastic Analysis

The median negative cash flow tends to -5.0% over the next 30 years. This is a contributing factor to the fact that the median funded ratio is 80% in the projected funded ratio chart on the previous page.