State of Wisconsin Investment Board (SWIB)

Wisconsin Retirement System
Actuarial Overview and Stress Testing Scenarios

October 2025

Topics

SECTION 1

WRS – The Big Picture

Objectives of this Presentation

- Provide an overview of the WRS
  - Relationship of Investment Return to Success Measures
  - Effects of bad outcomes
- Evaluate several points along the asset allocation spectrum against the measures of success
  - Deterministic stress tests
  - Stochastic simulations
- Find the “Sweet Spot” if it exists

All Participants at December 31, 2024

Active Lives Valuation

Valuation Group	Number	Average Annual Earnings/Benefits[1]
Actives	268,245	$68,483
Inactives	190,051	$22,901
Retirees & Beneficiaries	242,226	$30,993
Total Participants	**700,522**	

Retired Lives Valuation

[1] *For inactives, average money purchase balance.*

WRS Benefits

- Defined Benefit Plan:
  - 1.6% x Final Average Compensation x Service (most participants)
  - Different benefits for protective occupations
  - Provides benefits in the case of death or disability prior to retirement

WRS Investments

- Core Fund (Most Assets)
  - Diversified portfolio with results smoothed for WRS purposes via the Market Recognition Account (MRA)
- Variable Fund (Some Assets)
  - 100% Common Stock -- no smoothing of results
  - Participants can choose to invest up to half of their own contributions in this fund
    - They bear the risks and reap the rewards of this choice

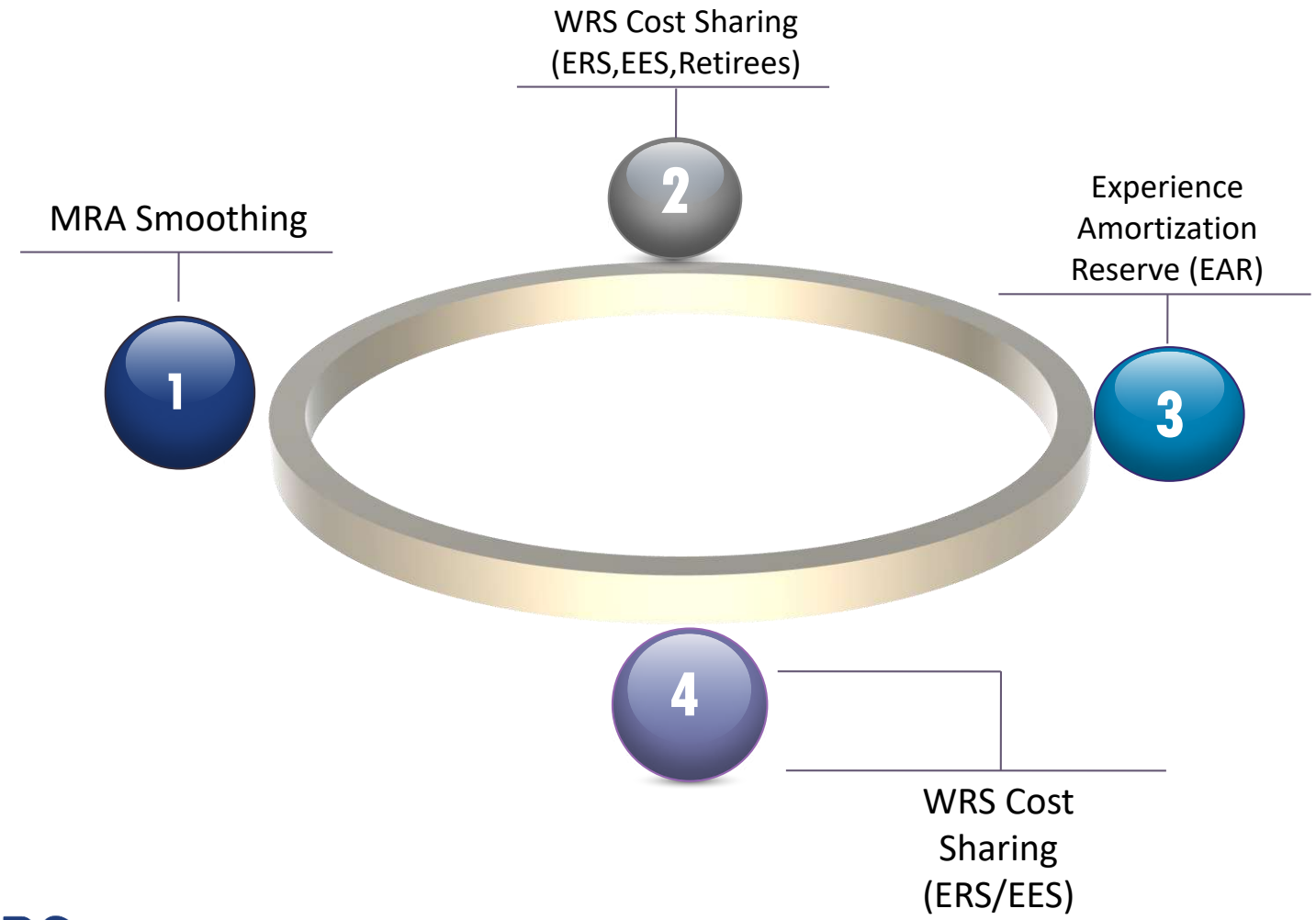
WRS Actuarial Assumptions

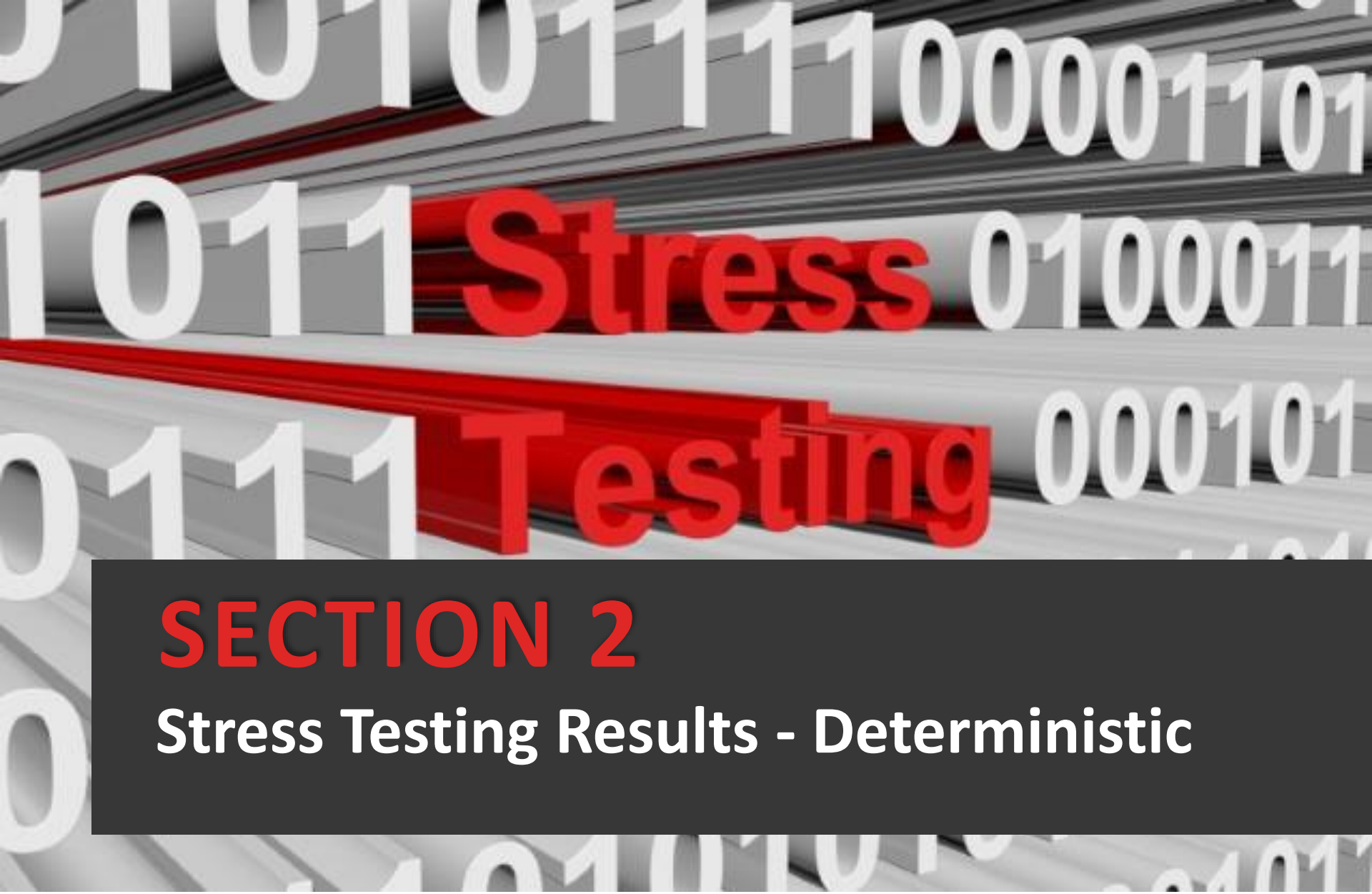
- Non-Retired Assets: 6.8%
- Retired Assets: 5%
  - A statutory assumption that is really a benefit condition
- Other assumptions relate to active participants salary, rates of turnover, disability, mortality, etc.
- Investment return assumption (6.8%) is the most important

WRS Risk Sharing

- Investment earnings increase (or decrease) active and inactive member account balances
  - Potentially affects their benefits when they retire via the operation of the Money Purchase Minimum benefit (MPM)
- Investment earnings (smoothed) above or below 5% affect dividends paid to retirees
- Active members and employers share in contribution rate changes

The “Magic” of WRS Financing





SECTION 2

Stress Testing Results - Deterministic

Deterministic Stress Testing

- Stress testing provides insight into how the System would respond to severely unfavorable markets
- For WRS, stress testing can answer questions:
  - What would it take to deplete the dividend liability?
  - What would it take to increase contribution rates 25%?

Dividend Liability and Retiree Funded Status

- Definitions
  - Dividend Liability (17.2B) = Total Retiree Liability (w/div.) less Base Benefit Liability (w/o div.)
  - Retiree Funded Status (128%) = Total Retiree Liability (w/div.) / Base Benefit Liability (w/o div.)

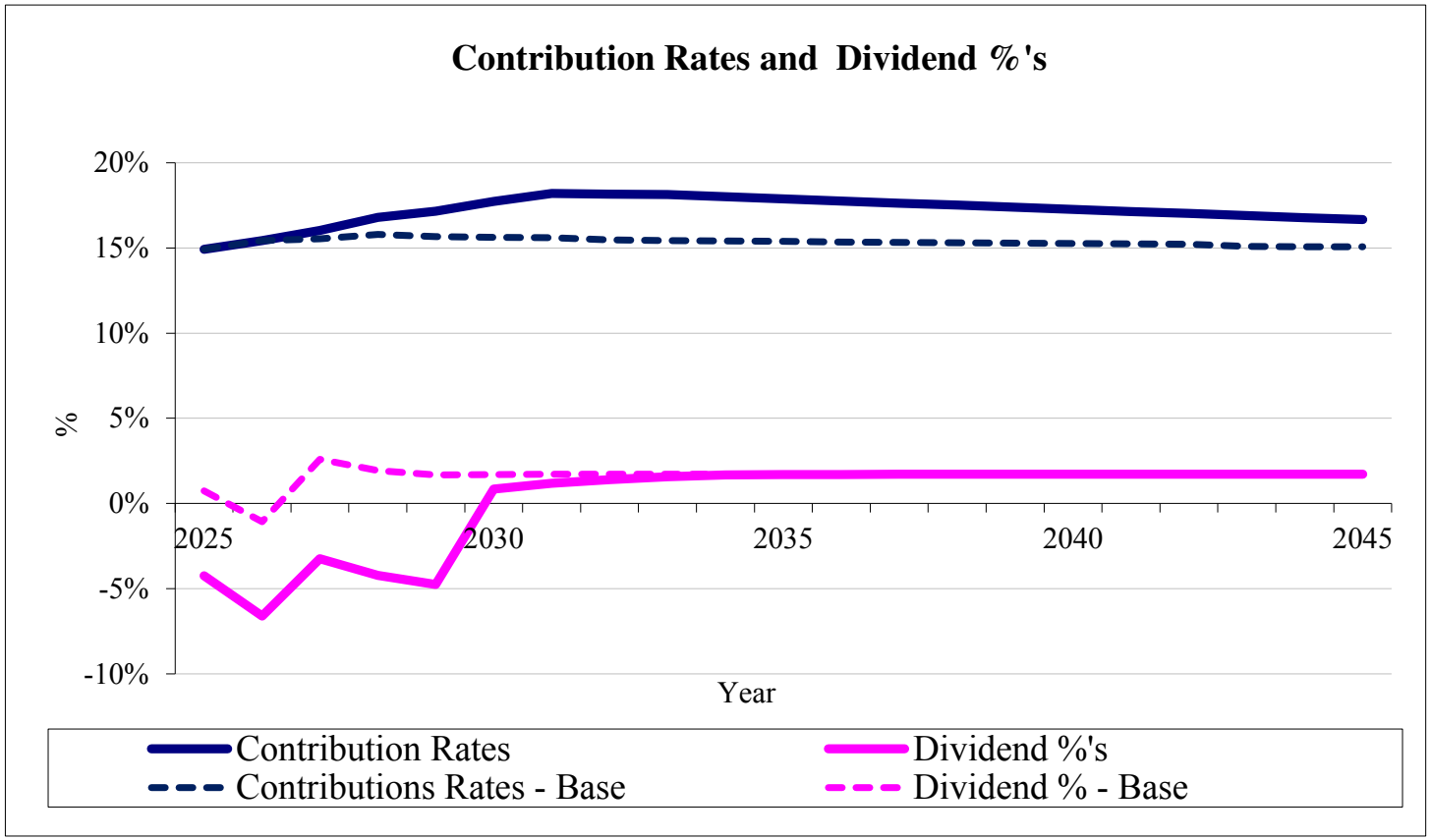
Deterministic Stress Testing

- Deterministic stress tests studied herein:

Stress Test	Asset Return Year 1	Asset Return Year 2	Asset Return Thereafter
1	-20%	6.8%	6.8%
2	-25%	6.8%	6.8%
3 Bounce Back	-25%	25%	6.8%
4	-30%	6.8%	6.8%

Underlying valuation assumptions held constant, including 6.8% investment return and 3.0% wage inflation assumptions

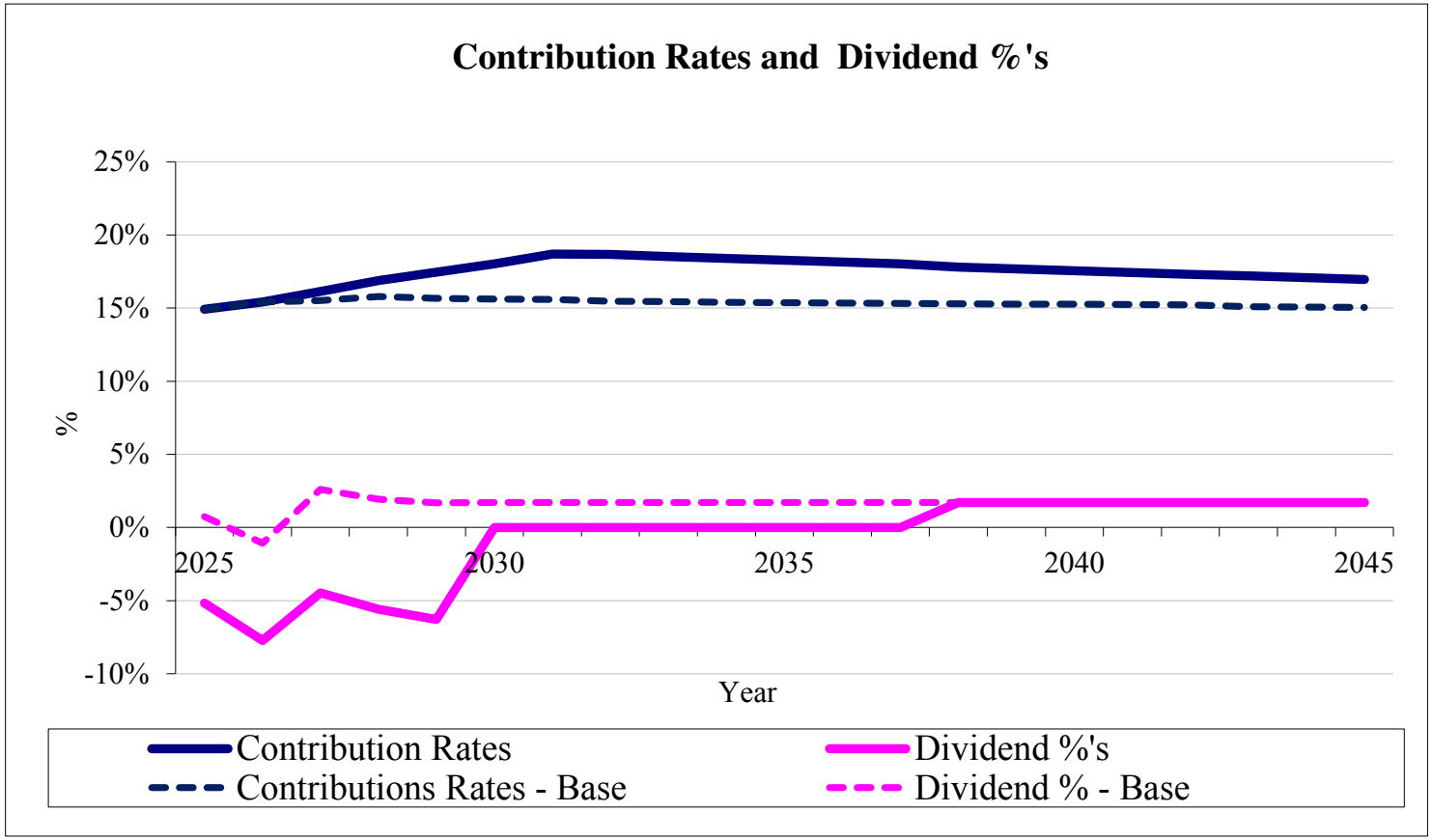
Stress Test 1 – Negative 20% Return in 2025 Followed by 6.8% Thereafter



Stress Test 1 – Negative 20% Return in 2025 Followed by 6.8% Thereafter

- Dividend Liability is depleted by 2029
- There will be a series of negative dividends, until most people are at the floor
- Positive dividends would resume in 2030
- Contribution Rate gradually increases by about 2.8% of payroll in year 5 and slowly declines thereafter

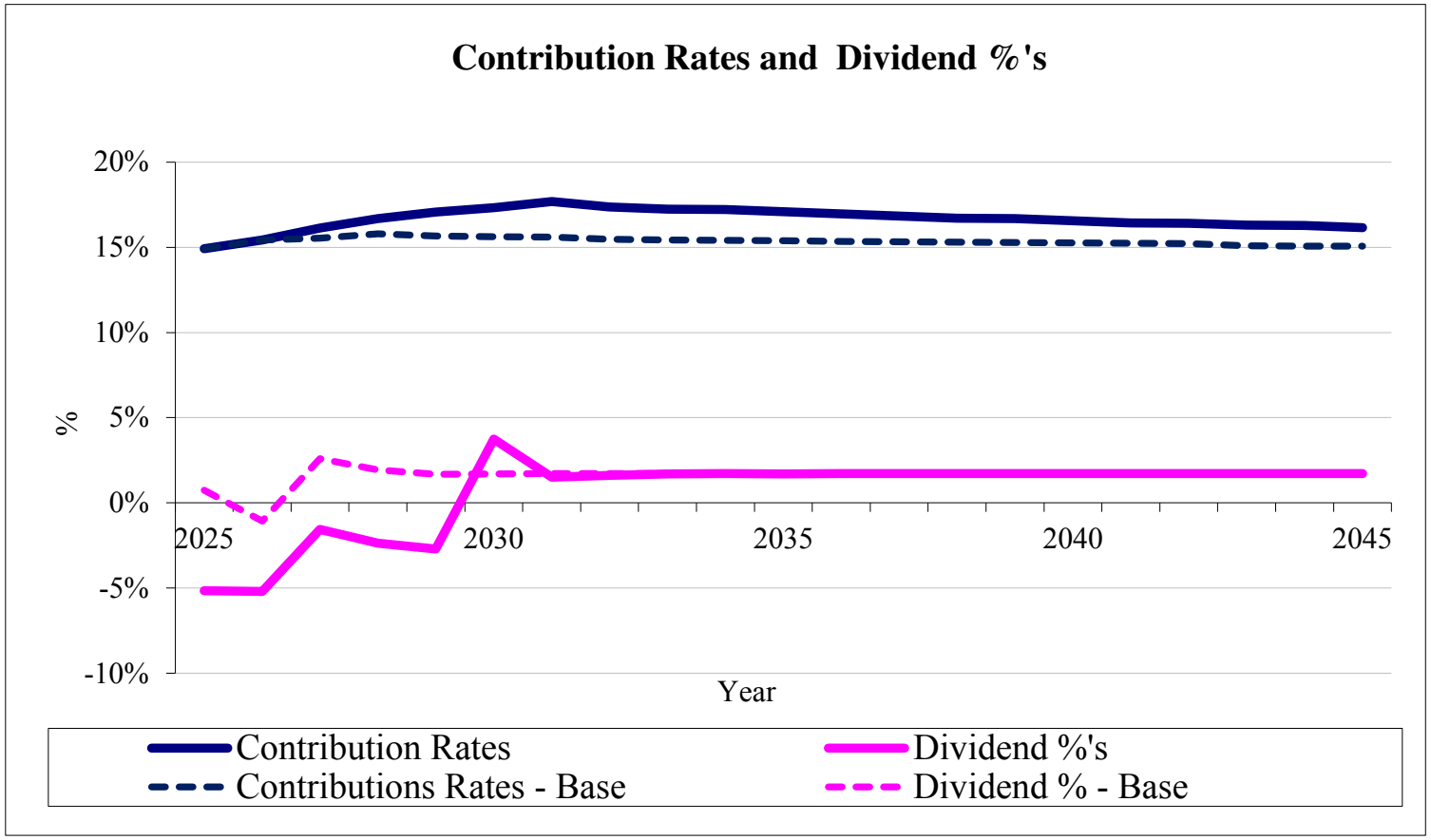
Stress Test 2 – Negative 25% Return in 2025 Followed by 6.8% Thereafter



Stress Test 2 – Negative 25% Return in 2025 Followed by 6.8% Thereafter

- Dividend Liability is depleted by 2029
- Retiree Liability becomes underfunded
- There will be a series of negative dividends, until all retirees are at the floor, followed by an extended period of no dividends
- Dividends could resume in 2038
- Contribution Rate gradually increases by about 3.3% of payroll in year 5 and slowly declines thereafter

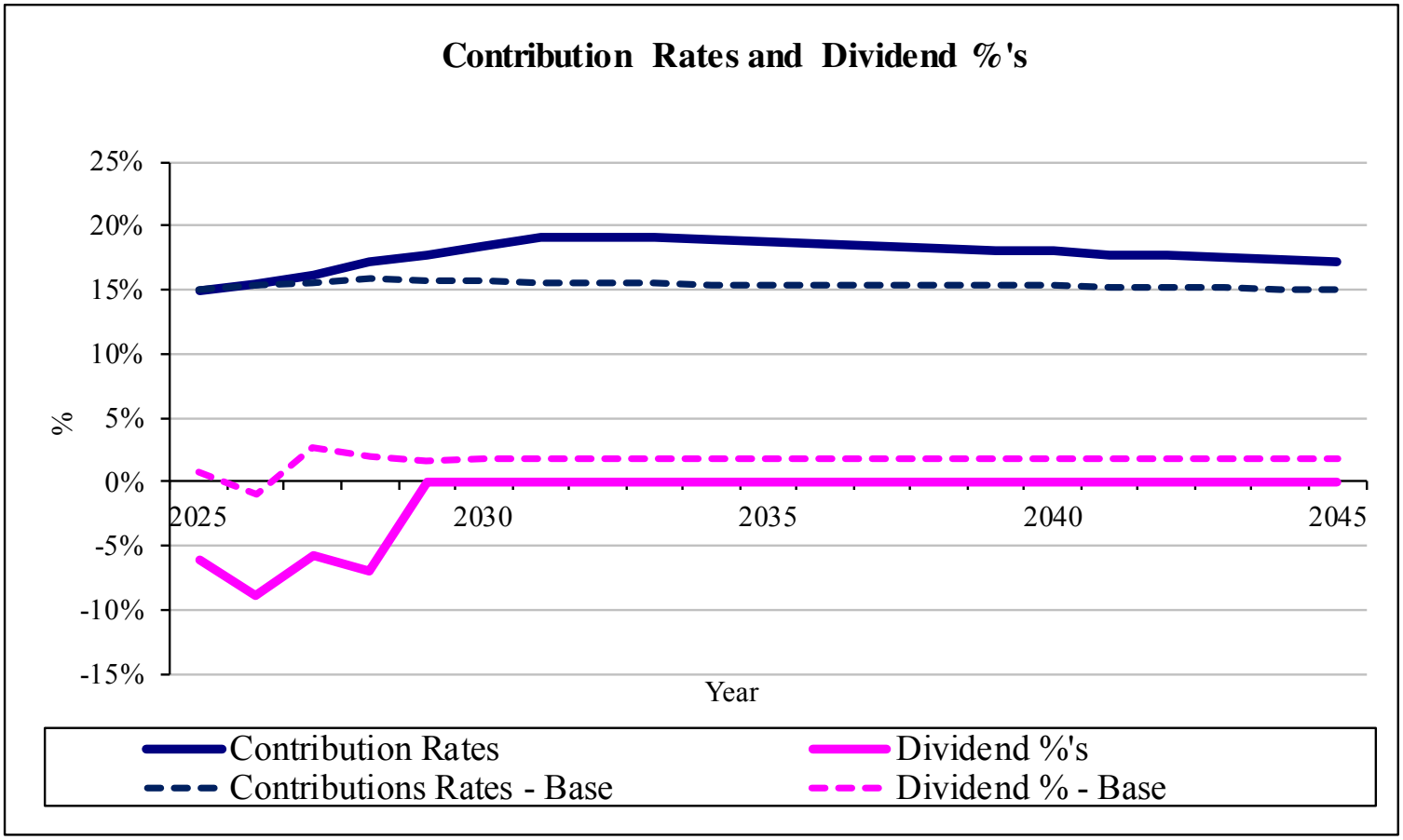
Stress Test 3 – Negative 25% Return in 2025, Positive 25% in 2026 and 6.8% Thereafter



Stress Test 3 – Negative 25% Return in 2025, Positive 25% in 2026 and 6.8% Thereafter

- Dividend Liability is not depleted, but Dividend Liability "cushion" falls to 6% in 2029
- There will be a series of negative dividends, pushing some retirees to the floor, followed by a rebuild of dividends for all retirees
- Contribution Rate gradually increases by about 1.5% of payroll in year 5 and slowly declines thereafter

Stress Test 4 – Negative 30% Return in 2025 Followed by 6.8% Thereafter



Stress Test 4 – Negative 30% Return in 2025 Followed by 6.8% Thereafter

- Dividend Liability is depleted by 2028
- Retiree Liability becomes underfunded
- There will be a series of negative dividends, until all people are at the floor, followed by a long period of no dividends
- Dividends could resume in 2046
- Contribution Rate gradually increases by about 4% of payroll in year 6 and slowly declines thereafter

Deterministic Stress Test Summary

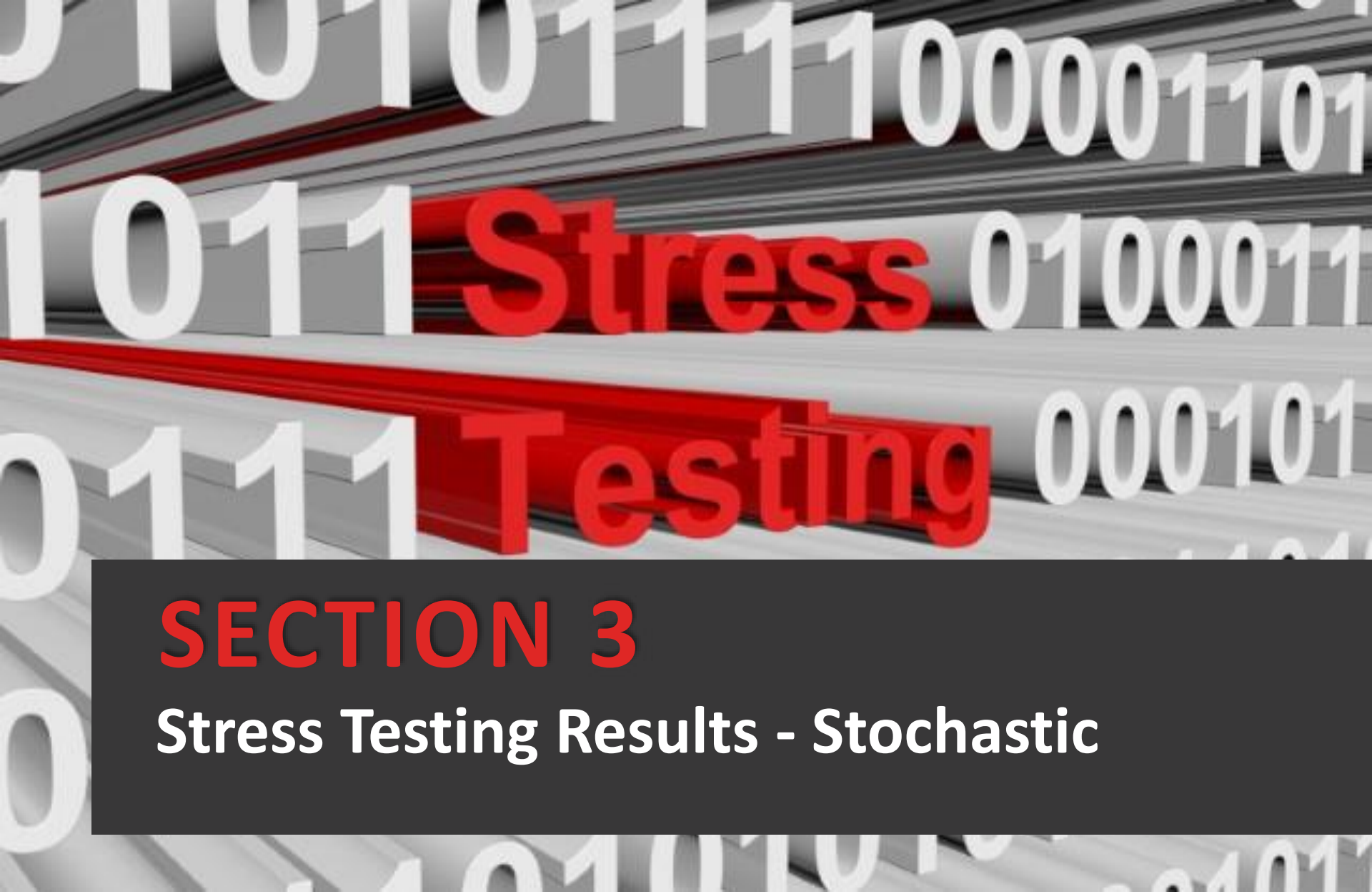
All tests show a 4-year negative dividend period

Stress Test/MVA Return	Year Dividend Liability Depleted	Year Positive Dividends Resume	Retiree Liability Underfunded	Year 5 Projected Contribution Rate Increase
1/-20%	2029	2030	No	2.8% of Payroll
2/-25%	2029	2038	Yes	3.3% of Payroll
3/-25% +25%	N/A	2028	No	1.5% of Payroll
4/-30%	2028	2046	Yes	4.2% of Payroll

Given all assumptions are met, including 6.8% return after shocks and bounceback

Stress Test Observations

- Contribution rates are generally more stable than dividend rates
- A large negative return would be detrimental to retirees (dividends are depleted)
- Retiree assets are 61% of total assets
- Proportions allocated to retiree reserve, money purchase minimum and EAR evolve over time



SECTION 3

Stress Testing Results - Stochastic

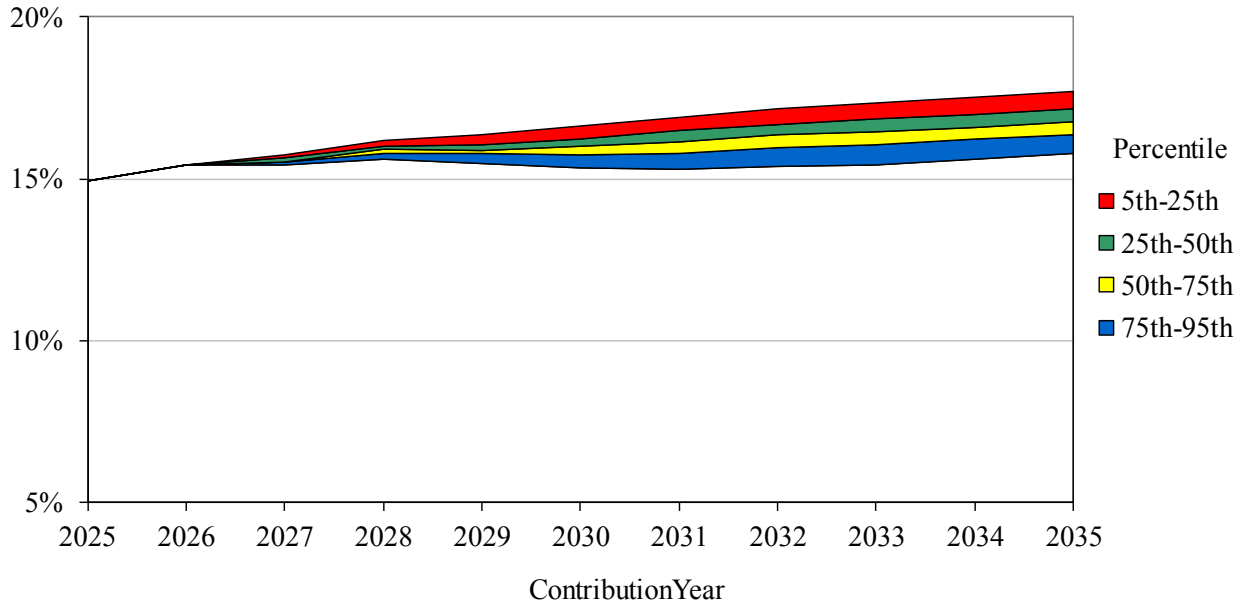
Monte Carlo Simulations

- Based on 10,000 random trials (normal distribution)
- Valuation Assumptions held constant
- Assumes nine sets of expected return/standard deviations (provided by NEPC)

Actuarial Rate 6.8%

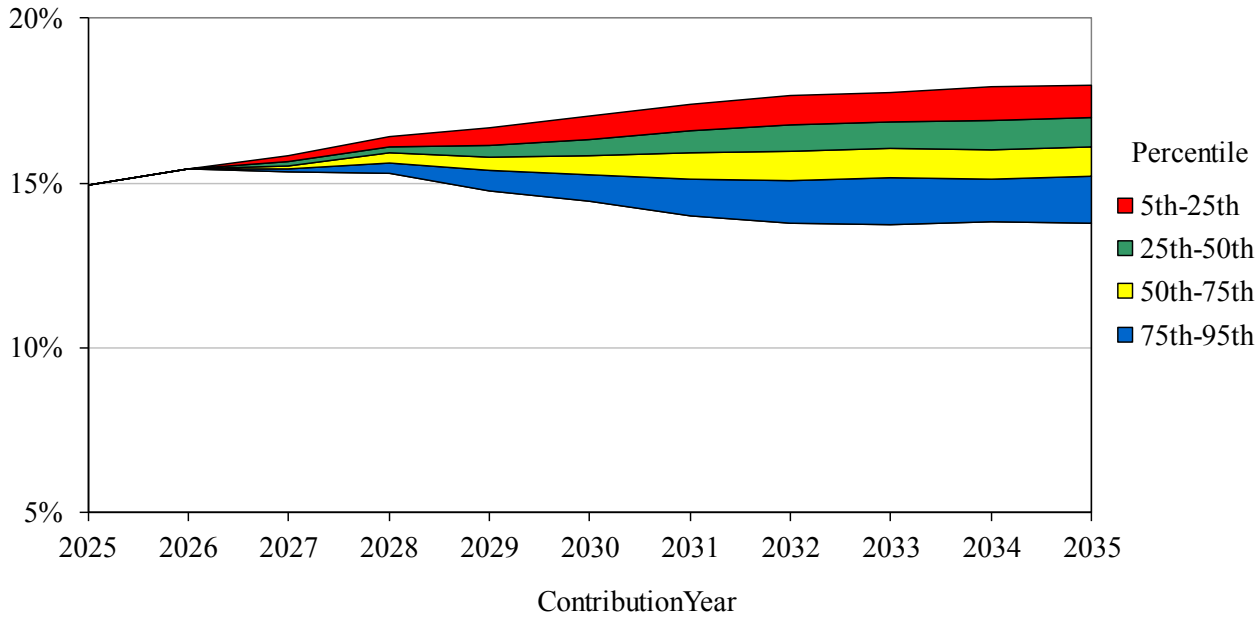
	Expected Return		Standard Deviation	
	Geometric	Arithmetic	2025	2023
Scenario 1	4.5%	4.5%	2.2%	N/A
Scenario 2	5.0%	5.1%	4.1%	4.6%
Scenario 3	5.5%	5.7%	6.2%	5.5%
Scenario 4	6.0%	6.3%	8.2%	9.4%
Scenario 5	6.5%	7.0%	10.7%	12.9%
Scenario 6	7.0%	7.9%	14.0%	13.6%
Scenario 7	7.5%	8.7%	16.9%	17.1%
Scenario 8	8.0%	10.1%	22.3%	22.4%
Scenario 9	8.5%	11.8%	28.3%	N/A

Contribution as a % of Payroll
Scenario 2 – 5.0% Return, 4.1% Volatility



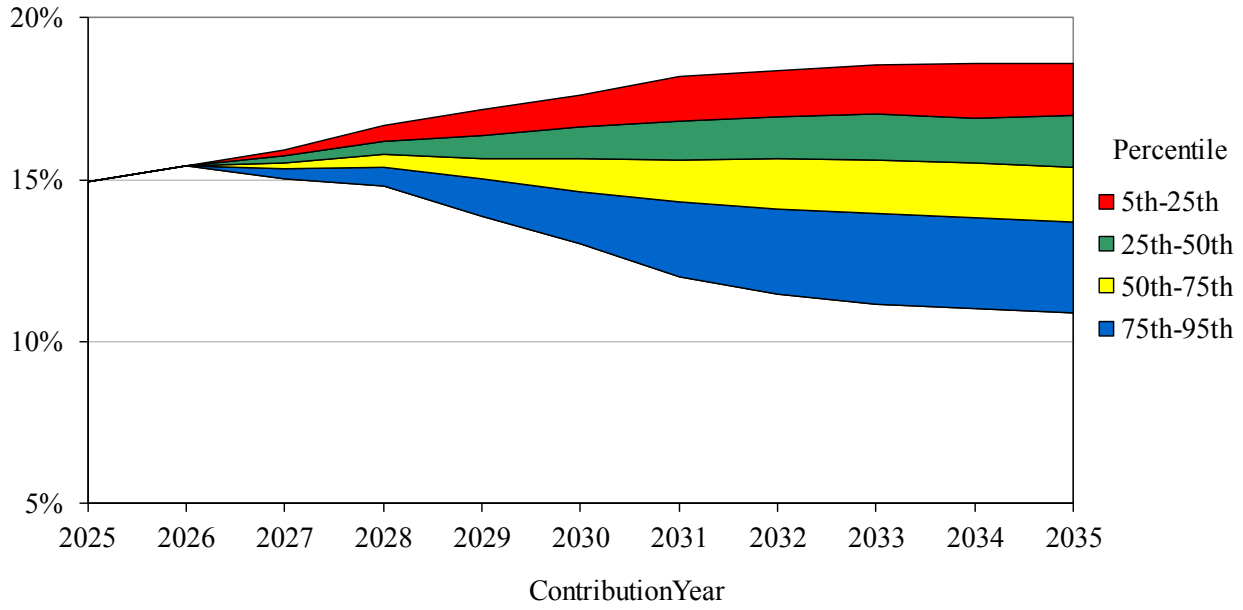
5th Percentile	14.9%	15.4%	15.7%	16.2%	16.4%	16.6%	16.9%	17.2%	17.3%	17.5%	17.7%
25th Percentile	14.9%	15.4%	15.6%	16.0%	16.1%	16.2%	16.5%	16.7%	16.8%	17.0%	17.2%
Median	14.9%	15.4%	15.5%	15.9%	15.9%	16.0%	16.1%	16.4%	16.4%	16.6%	16.8%
75th Percentile	14.9%	15.4%	15.5%	15.8%	15.8%	15.7%	15.8%	15.9%	16.0%	16.2%	16.4%
95th Percentile	14.9%	15.4%	15.4%	15.6%	15.5%	15.3%	15.3%	15.4%	15.4%	15.6%	15.8%

Contribution as a % of Payroll
Scenario 4 – 6.0% Return, 8.2% Volatility



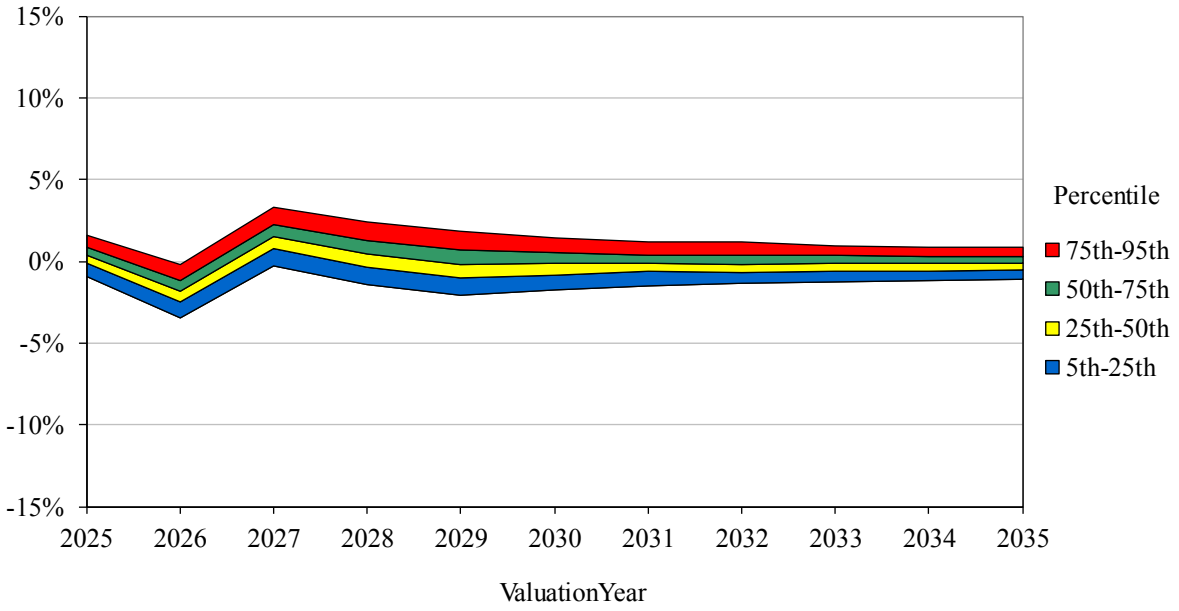
5th Percentile	14.9%	15.4%	15.8%	16.4%	16.7%	17.0%	17.4%	17.7%	17.7%	17.9%	18.0%
25th Percentile	14.9%	15.4%	15.6%	16.1%	16.2%	16.3%	16.6%	16.8%	16.8%	16.9%	17.0%
Median	14.9%	15.4%	15.5%	15.9%	15.8%	15.8%	15.9%	16.0%	16.0%	16.0%	16.1%
75th Percentile	14.9%	15.4%	15.4%	15.6%	15.4%	15.2%	15.1%	15.1%	15.1%	15.1%	15.2%
95th Percentile	14.9%	15.4%	15.3%	15.3%	14.8%	14.4%	14.0%	13.8%	13.7%	13.8%	13.8%

Contribution as a % of Payroll
Scenario 6 – 7.0% Return, 14.0% Volatility



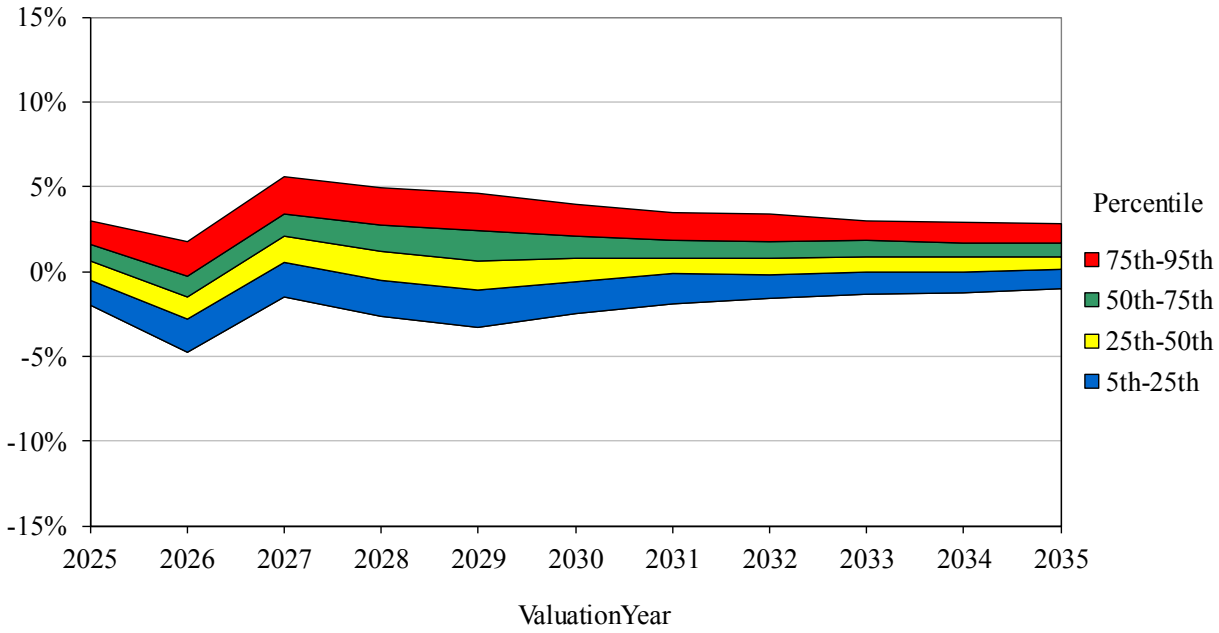
5th Percentile	14.9%	15.4%	15.9%	16.7%	17.2%	17.6%	18.2%	18.4%	18.5%	18.6%	18.6%
25th Percentile	14.9%	15.4%	15.7%	16.2%	16.4%	16.6%	16.8%	17.0%	17.0%	16.9%	17.0%
Median	14.9%	15.4%	15.5%	15.8%	15.7%	15.6%	15.6%	15.7%	15.6%	15.5%	15.4%
75th Percentile	14.9%	15.4%	15.3%	15.4%	15.0%	14.6%	14.3%	14.1%	13.9%	13.8%	13.7%
95th Percentile	14.9%	15.4%	15.0%	14.8%	13.9%	13.0%	12.0%	11.5%	11.1%	11.0%	10.9%

Dividend Rates
Scenario 2 – 5.0% Return, 4.1% Volatility



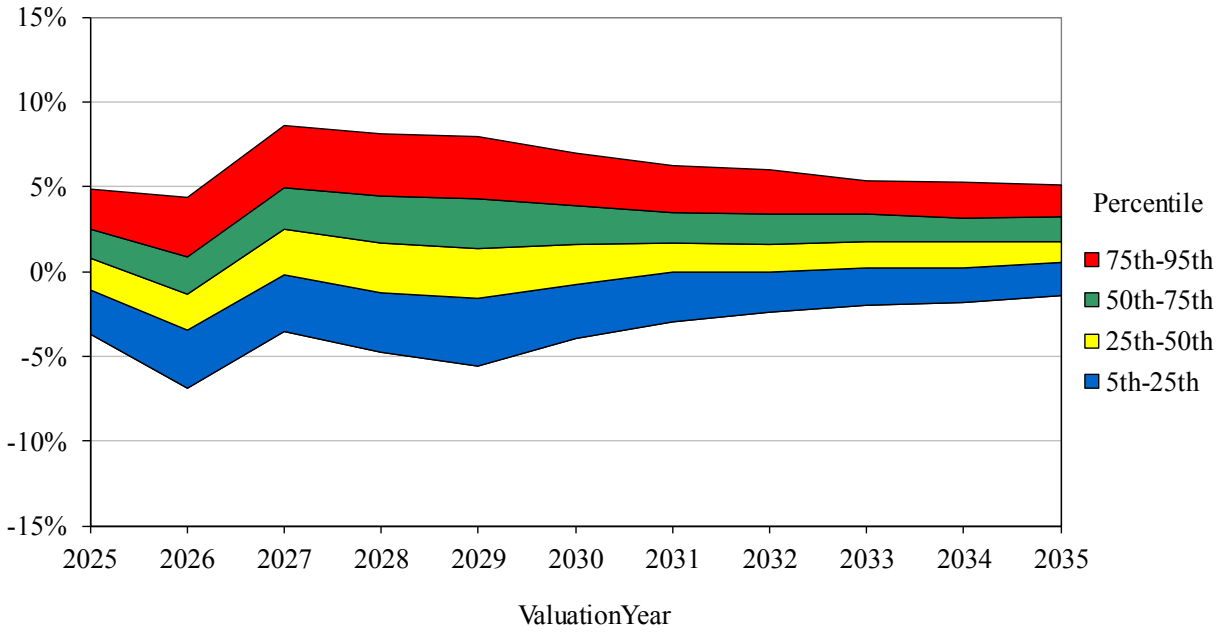
5th Percentile	-0.9%	-3.4%	-0.2%	-1.4%	-2.1%	-1.7%	-1.5%	-1.3%	-1.2%	-1.2%	-1.1%
25th Percentile	-0.1%	-2.4%	0.8%	-0.4%	-1.0%	-0.8%	-0.6%	-0.7%	-0.6%	-0.6%	-0.5%
Median	0.4%	-1.8%	1.5%	0.5%	-0.2%	-0.1%	-0.1%	-0.2%	-0.1%	-0.1%	-0.1%
75th Percentile	0.9%	-1.2%	2.2%	1.3%	0.7%	0.5%	0.4%	0.4%	0.3%	0.3%	0.3%
95th Percentile	1.6%	-0.2%	3.3%	2.4%	1.9%	1.5%	1.2%	1.2%	0.9%	0.9%	0.8%

Dividend Rates
Scenario 4 – 6.0% Return, 8.2% Volatility



5th Percentile	-2.0%	-4.8%	-1.5%	-2.6%	-3.3%	-2.4%	-1.9%	-1.6%	-1.3%	-1.2%	-1.0%
25th Percentile	-0.5%	-2.8%	0.5%	-0.5%	-1.0%	-0.6%	-0.1%	-0.2%	0.0%	0.0%	0.1%
Median	0.6%	-1.5%	2.1%	1.2%	0.7%	0.8%	0.8%	0.8%	0.9%	0.8%	0.8%
75th Percentile	1.6%	-0.3%	3.4%	2.8%	2.4%	2.1%	1.9%	1.8%	1.8%	1.7%	1.7%
95th Percentile	3.0%	1.7%	5.6%	5.0%	4.6%	4.0%	3.5%	3.4%	3.0%	2.9%	2.8%

Dividend Rates
Scenario 6 – 7.0% Return, 14.0% Volatility



5th Percentile	-3.7%	-6.8%	-3.5%	-4.8%	-5.5%	-4.0%	-3.0%	-2.4%	-2.0%	-1.8%	-1.4%
25th Percentile	-1.1%	-3.4%	-0.2%	-1.2%	-1.6%	-0.7%	0.0%	-0.1%	0.2%	0.3%	0.6%
Median	0.8%	-1.3%	2.5%	1.7%	1.3%	1.6%	1.7%	1.6%	1.8%	1.8%	1.8%
75th Percentile	2.5%	0.8%	4.9%	4.5%	4.3%	3.9%	3.5%	3.4%	3.4%	3.2%	3.3%
95th Percentile	4.9%	4.4%	8.7%	8.2%	8.0%	7.0%	6.2%	6.0%	5.4%	5.3%	5.1%

Stress Testing Dividend Depletion and Retiree Funded Status

- Definitions
  - Dividend Liability (17.2B) = Total Retiree Liability (w/div.) less Base Benefit Liability (w/o div.)
  - Retiree Funded Status (128%) = Total Retiree Liability (w/div.) / Base Benefit Liability (w/o div.)
- Dividend Stress Test studied
  - Probability that dividend liability will be depleted
  - Number of paths leading to Dividend Depletion
  - Worst case scenario of Retiree Funded Status
  - Depletion Severity measure

Stress Testing Dividend Depletion and Retiree Funded Status

Probability {Dividend Depletion in Year i}

Represents the number of times the Retiree Funded Status is less than 1 in year i divided by 10,000 (allows for recovery in future years)

Dividend Stress Test

Probability That Dividend Liability Will Be Depleted in Year (Allows for Recovery in Future Year)

Scenario	Expected RoR	Standard Deviation	Year				
			1	5	10	20	50
1	4.5%	2.2%	0%	0%	0%	6%	100%
2	5.0%	4.1%	0%	0%	0%	3%	49%
3	5.5%	6.2%	0%	0%	1%	2%	7%
4	6.0%	8.2%	0%	1%	2%	2%	2%
5	6.5%	10.7%	0%	3%	4%	3%	1%
6	7.0%	14.0%	0%	6%	7%	4%	1%
7	7.5%	16.9%	0%	9%	10%	5%	1%
8	8.0%	22.3%	0%	16%	15%	9%	2%
9	8.5%	28.3%	0%	22%	22%	13%	3%

Actuarial Rate 6.8% →

Stress Testing Dividend Depletion and Retiree Funded Status

Percentage of Paths Leading to Dividend Depletion on or before i

Counts the number of times on or before year i the Retiree Funded Status is less than 1 (does not allow for recovery in future years)

Dividend Stress Test

Percentage of Paths Leading to Dividend Depletion on or before Year i

Scenario	Expected RoR	Standard Deviation	Year				
			1	5	10	20	50
1	4.5%	2.2%	0%	0%	0%	6%	100%
2	5.0%	4.1%	0%	0%	0%	3%	50%
3	5.5%	6.2%	0%	0%	1%	3%	10%
4	6.0%	8.2%	0%	1%	3%	4%	5%
5	6.5%	10.7%	0%	3%	5%	6%	6%
6	7.0%	14.0%	0%	6%	9%	11%	11%
7	7.5%	16.9%	0%	9%	14%	15%	15%
8	8.0%	22.3%	0%	16%	21%	23%	24%
9	8.5%	28.3%	0%	22%	28%	29%	30%

Actuarial Rate 6.8%

Stress Testing Dividend Depletion and Retiree Funded Status

Worst Case Scenario of Retiree Funded Status

Finds the 5th percentile of retiree funded status for any given year in any given scenario (very unlikely scenario)

Dividend Stress Test

Worst Case Scenario of Retiree Funded Status (% of Floor Benefit That is Funded)

Scenario	Expected RoR	Standard Deviation	Year				
			1	5	10	20	50
1	4.5%	2.2%	127%	120%	112%	100%	72%
2	5.0%	4.1%	127%	116%	110%	103%	86%
3	5.5%	6.2%	126%	113%	108%	104%	98%
4	6.0%	8.2%	125%	110%	106%	107%	113%
5	6.5%	10.7%	124%	105%	103%	106%	129%
6	7.0%	14.0%	123%	100%	96%	103%	137%
7	7.5%	16.9%	122%	94%	91%	101%	153%
8	8.0%	22.3%	120%	82%	79%	88%	141%
9	8.5%	28.3%	118%	70%	66%	72%	121%

Actuarial Rate 6.8% →

Worst Case Scenario based on 5th percentile (i.e., 5% probability)

Stress Testing Dividend Depletion and Retiree Funded Status

Depletion Severity Measure

Of the stress test simulations that result in a Retiree Funded Status of less than 1, finds the average Retiree Funded Status (or degree of depletion)

Dividend Stress Test
Depletion Severity Measure

Average Retiree Funded Status for Depletion Scenarios

Scenario	Expected RoR	Standard Deviation	Year				
			1	5	10	20	50
1	4.5%	2.2%	N/A	N/A	N/A	98%	79%
2	5.0%	4.1%	N/A	N/A	N/A	97%	93%
3	5.5%	6.2%	N/A	97%	97%	96%	93%
4	6.0%	8.2%	N/A	96%	94%	95%	95%
5	6.5%	10.7%	N/A	94%	92%	93%	94%
6	7.0%	14.0%	N/A	90%	89%	88%	92%
7	7.5%	16.9%	N/A	89%	87%	85%	90%
8	8.0%	22.3%	N/A	85%	81%	81%	81%
9	8.5%	28.3%	N/A	80%	75%	75%	70%

Actuarial Rate 6.8% →

Dividend Stress Test Observations

- The low risk scenarios are actually risky in the sense that, for example, 4.5% and 5% expected return has a much higher chance of dividend depletion in later years than higher risk scenarios
- Must balance short and long term volatility
- Consider probability of dividend depletion
- Consider level of worst case scenario that is acceptable

Combination of All Scenarios

2035 Results by Percentile of Investment Return Outcomes										
Scenario	Expected RoR	Standard Deviation	Contribution Rates			Dividend Rates			Highest Div. Dep. PRB	Worst Retiree Funded %
			95th	50th	5th	95th	50th	5th		
1	4.5%	2.2%	16.6%	17.1%	17.6%	-0.1%	-0.6%	-1.1%	100%/Year50	72%/Year50
2	5.0%	4.1%	15.8%	16.8%	17.7%	0.8%	-0.1%	-1.1%	50%/Year50	86%/Year50
3	5.5%	6.2%	14.8%	16.4%	17.9%	1.8%	0.4%	-1.1%	10%/Year50	98%/Year50
4	6.0%	8.2%	13.8%	16.1%	18.0%	2.8%	0.8%	-1.0%	5%/Year50	106%/Year10
5	6.5%	10.7%	12.5%	15.8%	18.2%	3.9%	1.3%	-1.1%	6%/Year50	103%/Year10
6	7.0%	14.0%	10.9%	15.4%	18.6%	5.1%	1.8%	-1.4%	11%/Year50	96%/Year10
7	7.5%	16.9%	9.1%	15.1%	19.0%	6.3%	2.3%	-1.6%	15%/Year50	91%/Year10
8	8.0%	22.3%	6.1%	14.8%	19.8%	8.0%	2.7%	-2.5%	24%/Year50	79%/Year10
9	8.5%	28.3%	2.4%	14.7%	20.7%	9.8%	3.0%	-3.5%	30%/Year50	66%/Year10

Actuarial Rate 6.8% →

- Portfolios with lower expected return result in higher expected contributions and lower expected dividends
- Higher assumed rates of return are associated with higher standard deviation (i.e., risk) and 5th percentile scenario for retiree dividend pool falling below 75% (Worst Retiree Funded %)
- Scenarios 4 through 7 represent potential 'Goldilocks Zone'

Goldilocks Zone Guideposts[1]

- Prefer narrow range of potential employer contributions (difference between 95th and 5th percentiles below 10%)
- Prefer some level of meaningful dividends (close to or greater than 1% for 50th percentile)
- Prefer probability of dividend depletion below 20%
- Prefer worst case funded status greater than 80%

[1] Guideposts are not mathematically absolute

2025 Observations

- Changes from 2023 Study
  - Returns over 2023 and 2024 were 11.40% and 8.55%
    - MRA returns of 9.1% and 7.5%
    - 2023 – $7.0B in unrecognized losses, 2025 – $3.4B in unrecognized losses
  - Similar Standard Deviation to 2023 Study
  - Changes in assumptions (primarily salary increases, retirement, turnover)

2025 Observations

- Overall results are similar to 2023 study
  - Probability of depleting dividend liability is somewhat lower due to factors on previous slide
  - Similar range of dividend/contribution results
- 'Goldilocks zone' remains at 6.0% to 7.5%
  - Provides for positive return with appropriate downside protection
  - Potential refinement of 6.5% to 7.5% in future years

Questions

SECTION 4

Appendix 1

Understanding Dividend Liability

- Retirees share in investment gains, but also share in investment losses
  - Prior dividends can be reduced if less than 5% is credited to the Core Annuity Division
- Only dividends can be reduced, the original core benefit is protected
- The present value of the excess of total core benefits over original benefits is called the "Dividend Liability"

Liability Attributable to Dividends – "Dividend Liability"

Valuation	Liability for Dividend Remaining (billions)	Liability for Dividend Adjustment (billions)	Liability after Dividend Adjustment (billions)
12/31/2015	$5.5	$0.2	$5.7
12/31/2016	5.4	1.0	6.4
12/31/2017	6.1	1.3	7.4
12/31/2018	6.9	0.0	6.9
12/31/2019	6.5	1.0	7.5
12/31/2020	7.0	3.1	10.1
12/31/2021	9.4	4.8	14.2
12/31/2022	13.4	1.1	14.5
12/31/2023	13.7	2.7	16.4
12/31/2024	15.4	1.8	17.2

- "Liability for dividend remaining" = value of all previously granted dividends
  - ($9.2 Billion at 12/31/2008 decreasing to $3.0 Billion at 12/31/2013)
- 2025 "liability for dividend remaining" is >2008, BUT as a percentage of total liabilities, it is smaller
- Substantial asset losses could decrease the "liability for dividend remaining" to low levels

Dividend Risk Measure – MRA Basis

- Dividend Liability (after Dividend adjustment in April) / Total Core Retiree Assets
- Example (2024)
  - Dividend Liability = $17.2 billion
  - Total Retiree Assets (Core) = $77.9 billion
  - Dividend Risk Measure = 17.2/77.9 = 22.0%
- In other words, Retiree Assets (after MRA smoothing) would need to decrease by 22.0% to deplete the existing Dividend Liability by year end
- Dividend Risk Measure was 20.1% last study

Dividend Risk Measure – MVA Basis

- However, this is on an MRA (smoothed) basis
- Dividend Liability (MVA basis)
  - Total Retiree Assets (Core MVA) ~ $75.8 billion
  - Dividend Liability (MVA) ~ $15.1 billion
  - Dividend Risk Measure (MVA) % ~ 15.1B/75.8B = 19.9%
- Given all assumptions are met, over time, on a market value basis the cushion will decrease to 19.9% with phase-in of unrecognized losses
- Dividend Risk Measure on a MVA basis was 18.0% last study

Dividend Risk Measure

- On MRA basis, 2025 dividend liability results look better than 2023, however:
  - At 12/31/2022 there were $7.0B in deferred asset losses – looking forward things are worse than they appear
  - At 12/31/2024 there are $3.4B in deferred asset losses – looking forward things are worse than they appear but not as bad as last study

Dividend Risk Measure	2023	2025
MRA basis	20.1%	22.0%
MVA basis	15.3%	19.9%

- The ultimate dividend liability 'cushion' increased from 15.3% to 19.9%

SECTION 5

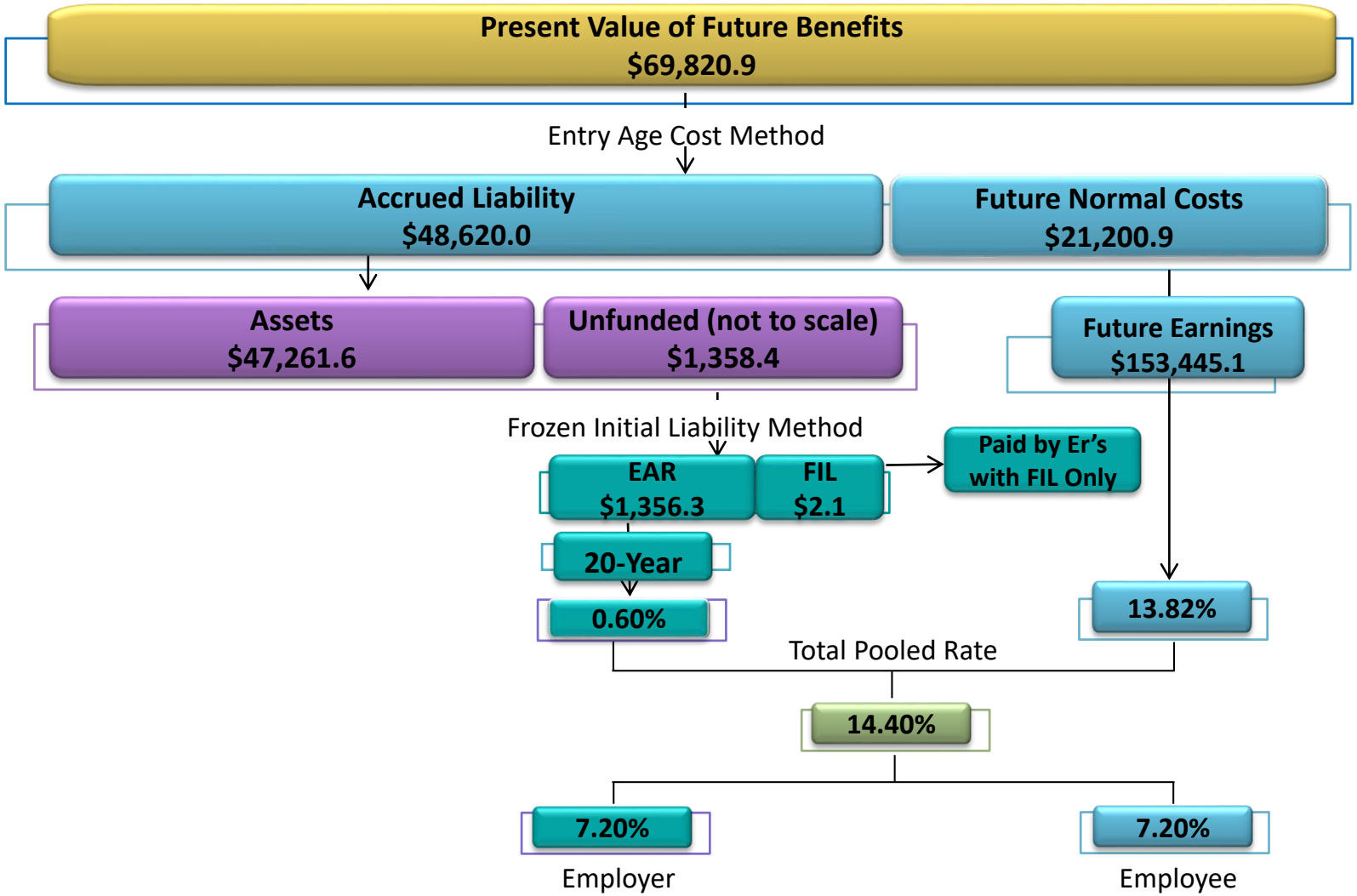
Appendix 2

Operation of Market Recognition Account (MRA) – $ Millions 2024 Valuation

	2024	2025	2026	2027	2028
Actual Investment Return	$ 10,311				
Assumed Investment Return	8,477				
Gain/(Loss) to be phased-in	1,834				
Phased-in recognition					
• Current year	$ 367	?	?	?	?
• First prior year	928	$ 367	?	?	?
• Second prior year	(5,068)	928	$ 367	?	?
• Third prior year	2,495	(5,068)	928	$ 367	?
• Fourth prior year	1,773	2,495	(5,068)	928	$ 367
Total recognized gain (loss)	$ 495	$(1,278)	$ (3,773)	$ 1,295	$ 367

2025-2028: Expect $3.4 billion in deferred asset *LOSSES*
-- Shared by annuitants, actives and employers

Actuarial Valuation Process
Illustration for General/Elected Group ($ Millions)



Comparative Statement of Total Average Contribution Rates

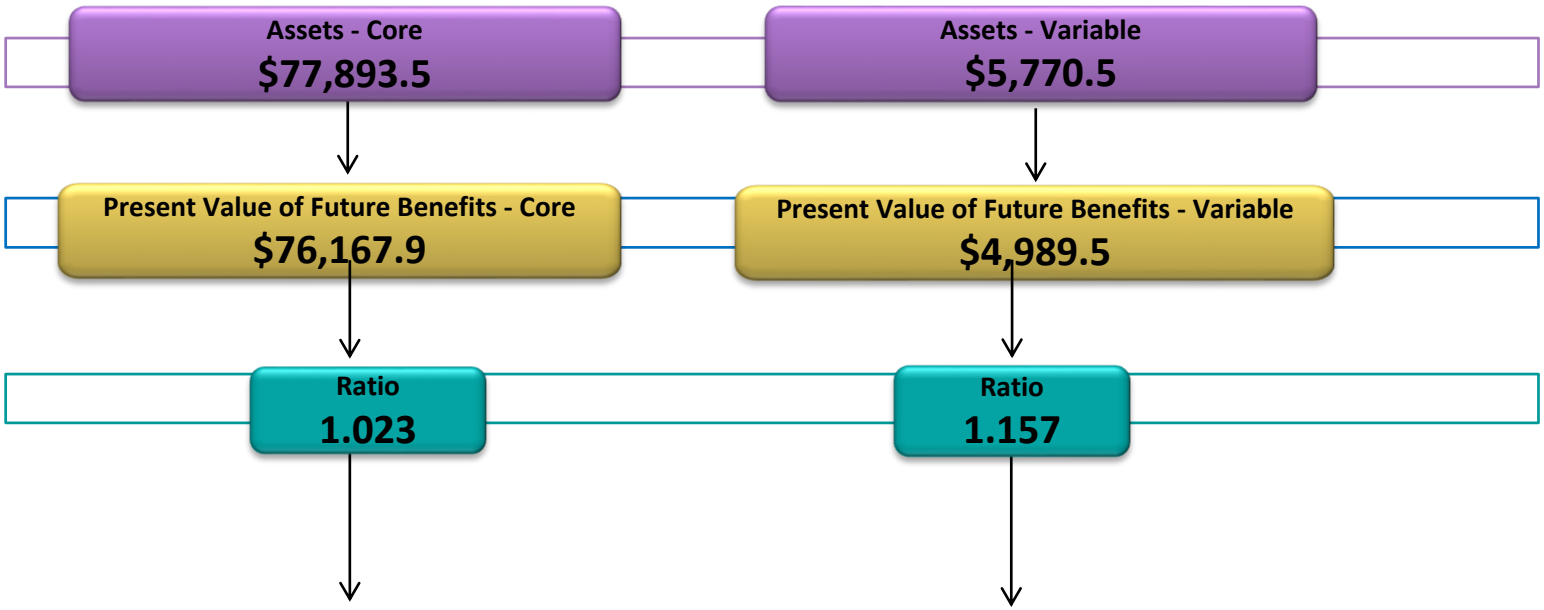
Valuation 12/31	General	Executive & Elected	Protective with Soc. Sec.	Protective without Soc. Sec.
2008	11.15%	11.95%	14.14%	15.46%
2013	13.60%	15.40%	16.30%	20.20%
2018	13.54%	13.54%	18.41%	23.02%
2019	13.53%	13.53%	18.51%	23.11%
2020	13.00%	13.00%	18.52%	23.86%
2021	13.60%	13.60%	20.03%	24.90%
2022	13.81%	13.81%	21.20%	26.00%
2023	13.90%	13.90%	21.90%	25.90%
2024	14.41%	14.41%	21.93%	25.70%

Executive and Elected employee and employer rates for CY 2016 and beyond are made in accordance with the combined General/Exec & Elected results.

GRS

Pages B-5 & B-6

Actuarial Valuation Process – 2024 Retired Lives Valuation
Illustration ($ Millions)



Core effective earnings rate = 7.5%, dividend adjustment = 2.3%.
Variable effective earnings rate = 20.0%, and the variable adjustment = 15.0%.

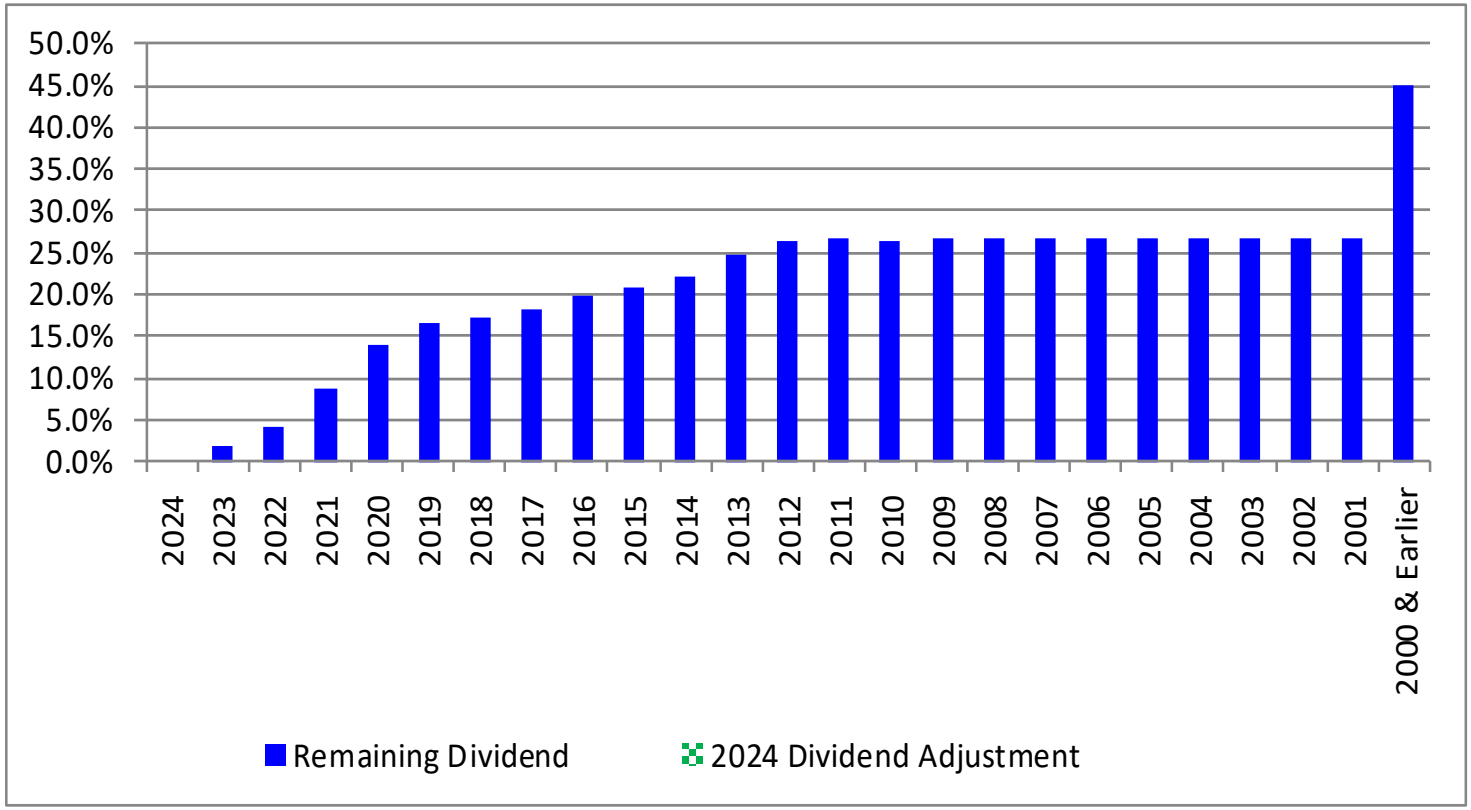
Primary Sources of Core Dividend

	% of APV[(1)]
1. SWIB net of fee investment return	8.55%
2. MRA adjustment	(1.05)%
3. Published effective earnings rate	7.50%
4. Adjustment to relate earnings to average core annuity fund balance	(0.35)%
5. Earnings rate based on average balance	7.15%
6. Expected dividend before adjustments: 1.0715/1.05-1	2.05%
7. Adjustment to relate average asset to ending liability	0.05%
8. Carryover from last year due to timing of dividend, accounting adjustments and rounding	0.16%
9. Experience study adjustment	0.00%
10. Experience and other effects	0.01%
11. Statutory adjustment to round to nearest one-tenth percent	0.03%
12. **Computed average dividend rate: (6)+(7)+(8)+(9)+(10)+(11)**	**2.3%**
13. Adjustment for members at or near the statutory floor	0.0%
14. **Final computed dividend rate: (12)+(13), if greater than 0.5% (or less than -0.5%) of core annuities, otherwise 0%**	**2.3%**

(1) *Actuarial Present Value*

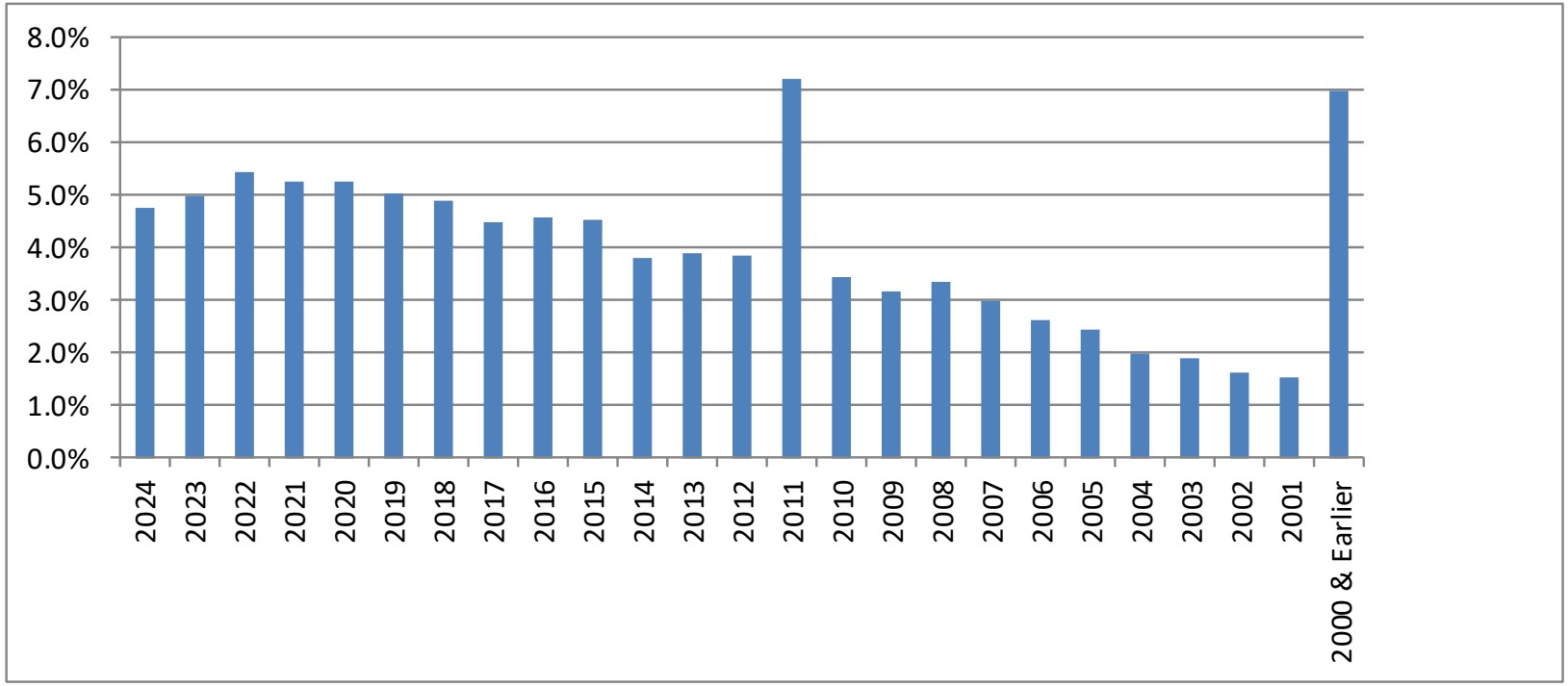
(Report-6)

Dividend Remaining (as a Percentage of Total Benefit) by Year of Retirement



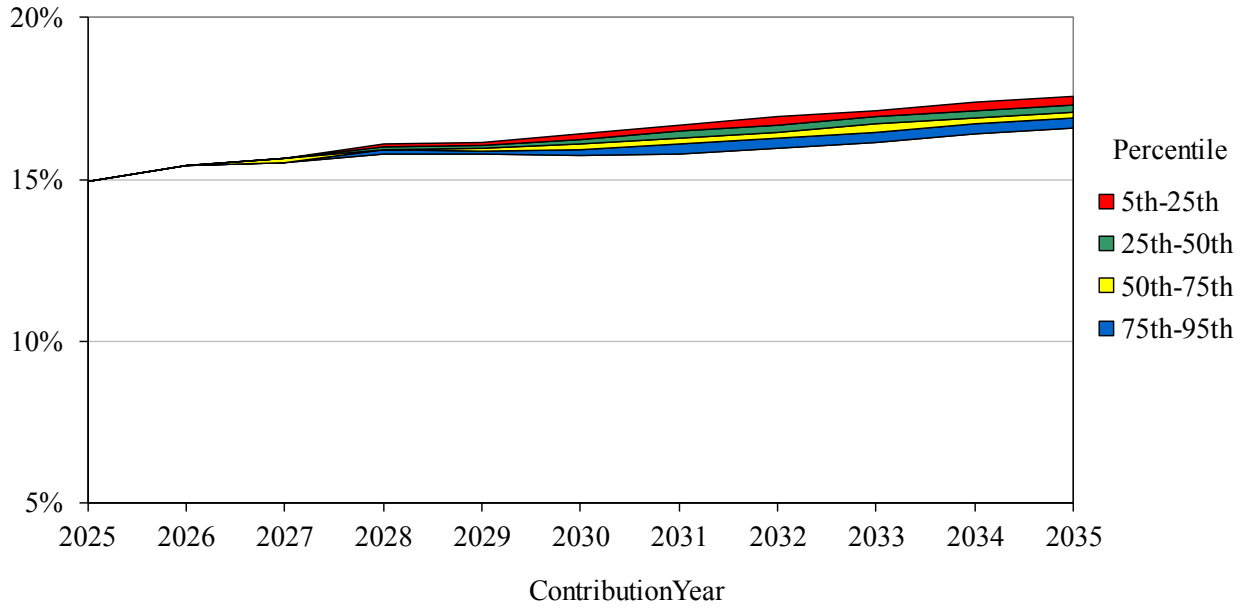
(Report-7)

Liabilities (as a Percentage of Total) by Year of Retirement



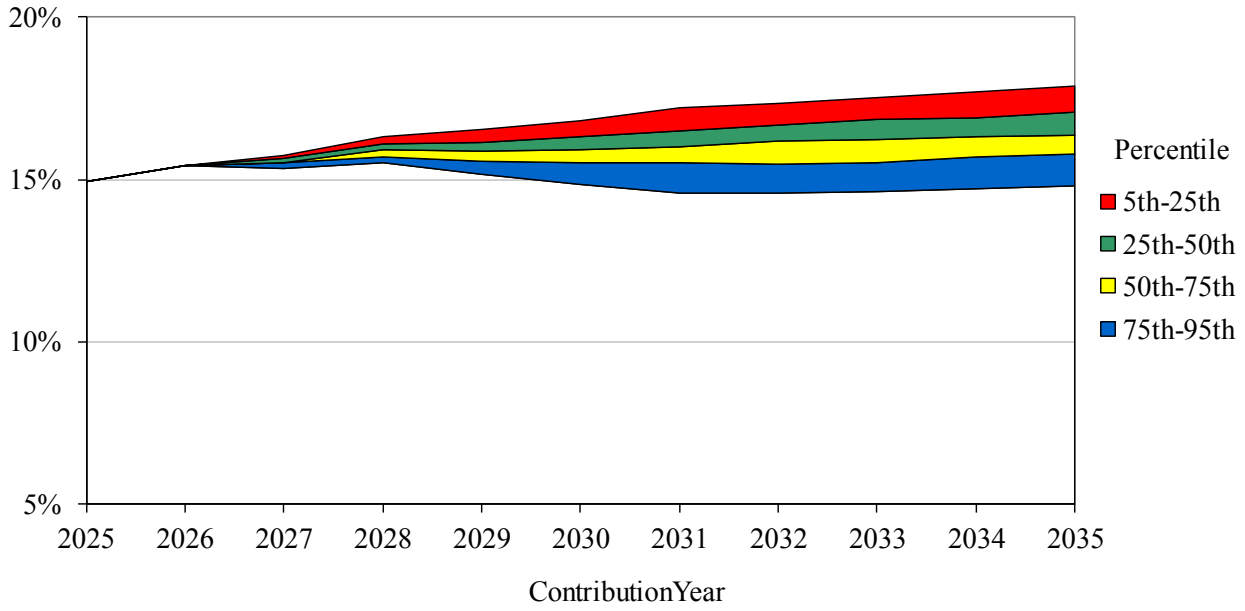
(Report-7)

Contribution as a % of Payroll
Scenario 1 – 4.5% Return, 2.2% Volatility



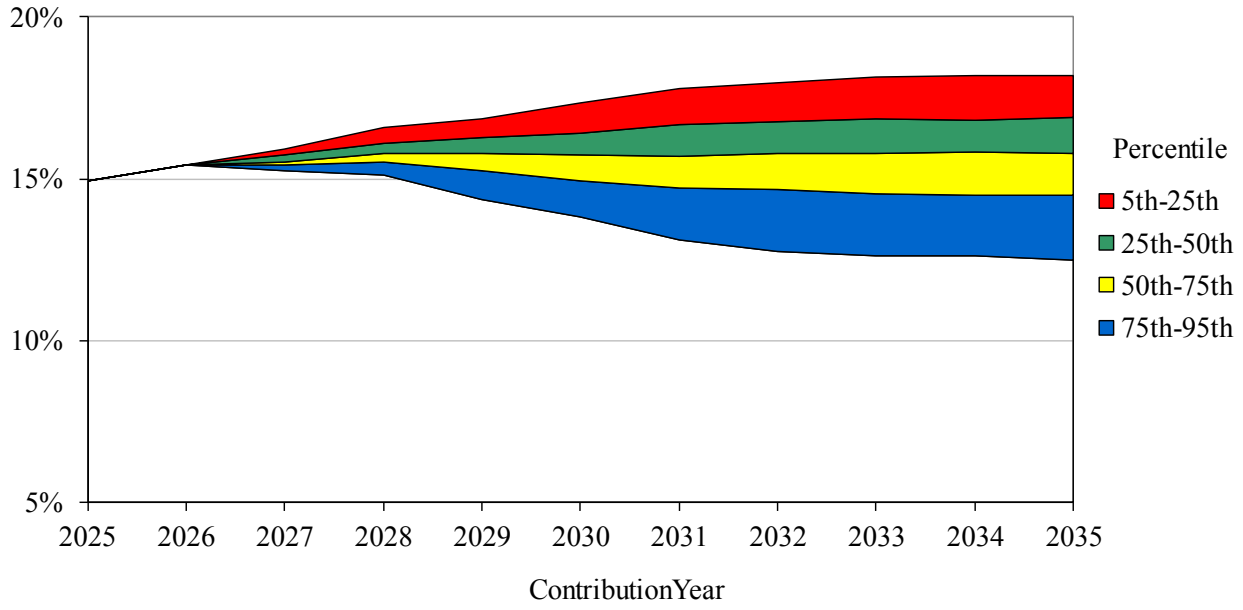
5th Percentile	14.9%	15.4%	15.6%	16.1%	16.2%	16.4%	16.7%	17.0%	17.1%	17.4%	17.6%
25th Percentile	14.9%	15.4%	15.6%	16.0%	16.1%	16.2%	16.5%	16.7%	16.9%	17.1%	17.3%
Median	14.9%	15.4%	15.6%	15.9%	16.0%	16.1%	16.3%	16.5%	16.7%	16.9%	17.1%
75th Percentile	14.9%	15.4%	15.5%	15.9%	15.9%	15.9%	16.1%	16.3%	16.4%	16.7%	16.9%
95th Percentile	14.9%	15.4%	15.5%	15.8%	15.8%	15.7%	15.8%	16.0%	16.1%	16.4%	16.6%

Contribution as a % of Payroll
Scenario 3 – 5.5% Return, 6.2% Volatility



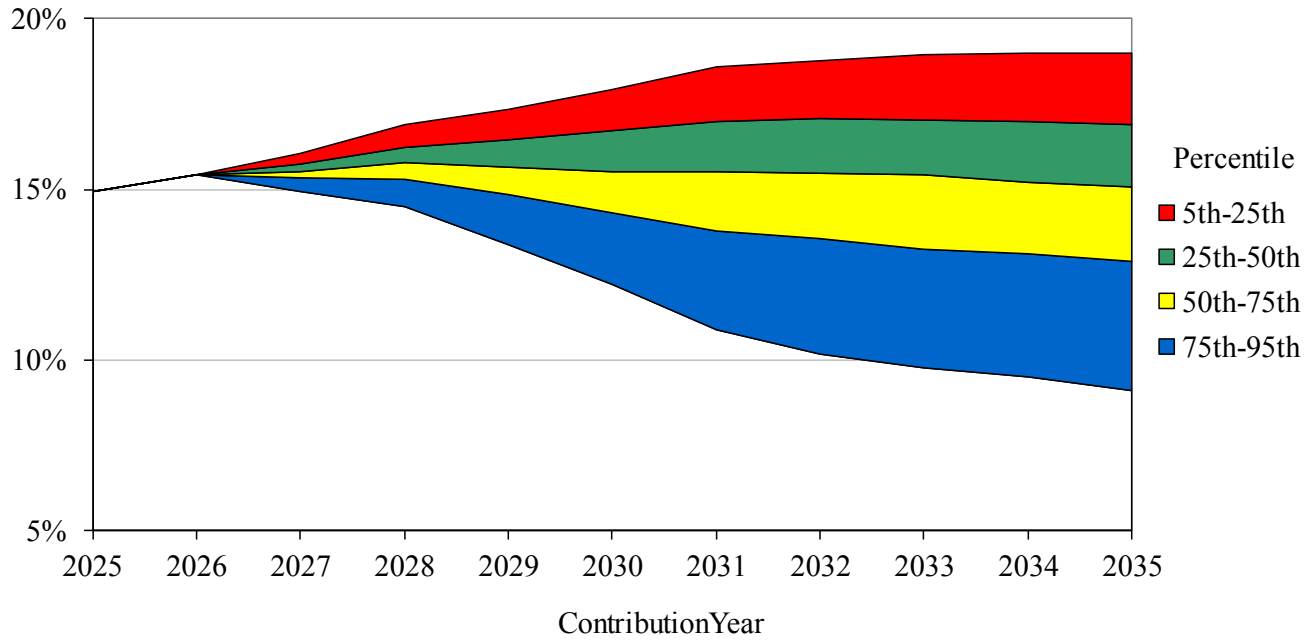
5th Percentile	14.9%	15.4%	15.7%	16.3%	16.6%	16.8%	17.2%	17.4%	17.5%	17.7%	17.9%
25th Percentile	14.9%	15.4%	15.6%	16.1%	16.2%	16.3%	16.5%	16.7%	16.8%	16.9%	17.1%
Median	14.9%	15.4%	15.5%	15.9%	15.9%	15.9%	16.0%	16.2%	16.2%	16.3%	16.4%
75th Percentile	14.9%	15.4%	15.5%	15.7%	15.6%	15.5%	15.5%	15.5%	15.5%	15.7%	15.8%
95th Percentile	14.9%	15.4%	15.3%	15.5%	15.2%	14.8%	14.6%	14.6%	14.6%	14.7%	14.8%

Contribution as a % of Payroll
Scenario 5 – 6.5% Return, 10.7% Volatility



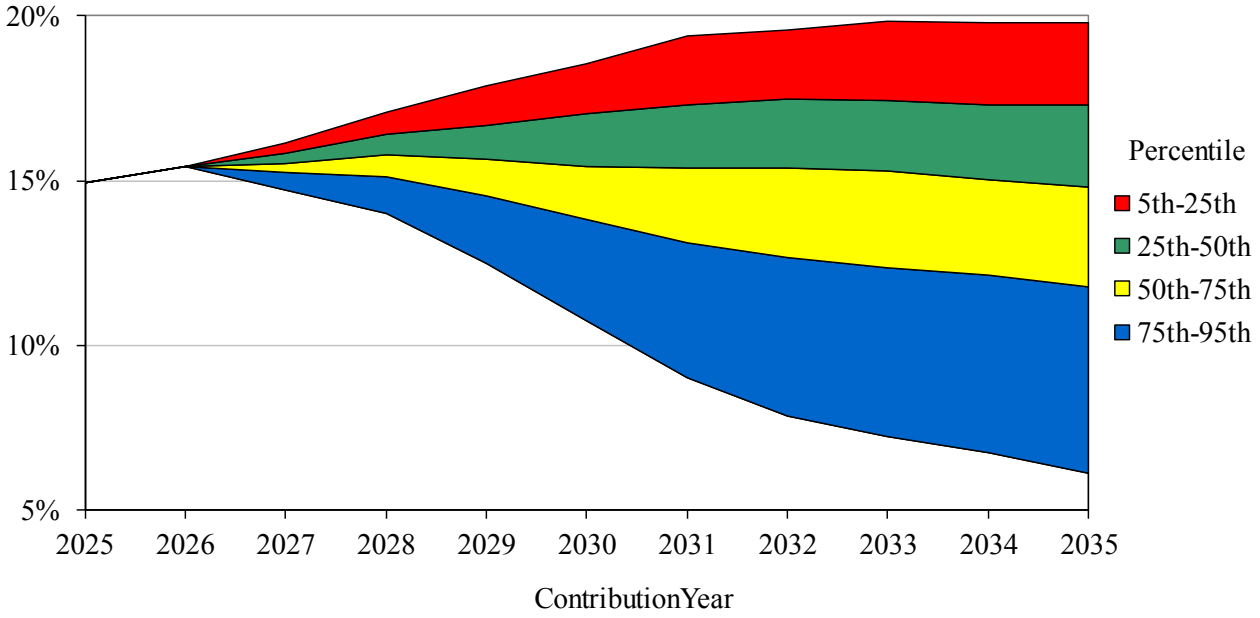
5th Percentile	14.9%	15.4%	15.9%	16.6%	16.9%	17.3%	17.8%	18.0%	18.1%	18.2%	18.2%
25th Percentile	14.9%	15.4%	15.7%	16.1%	16.3%	16.4%	16.7%	16.8%	16.8%	16.8%	16.9%
Median	14.9%	15.4%	15.5%	15.8%	15.8%	15.7%	15.7%	15.8%	15.8%	15.8%	15.8%
75th Percentile	14.9%	15.4%	15.4%	15.5%	15.3%	14.9%	14.7%	14.7%	14.5%	14.5%	14.5%
95th Percentile	14.9%	15.4%	15.2%	15.1%	14.4%	13.8%	13.1%	12.8%	12.6%	12.6%	12.5%

Contribution as a % of Payroll
Scenario 7 – 7.5% Return, 16.9% Volatility



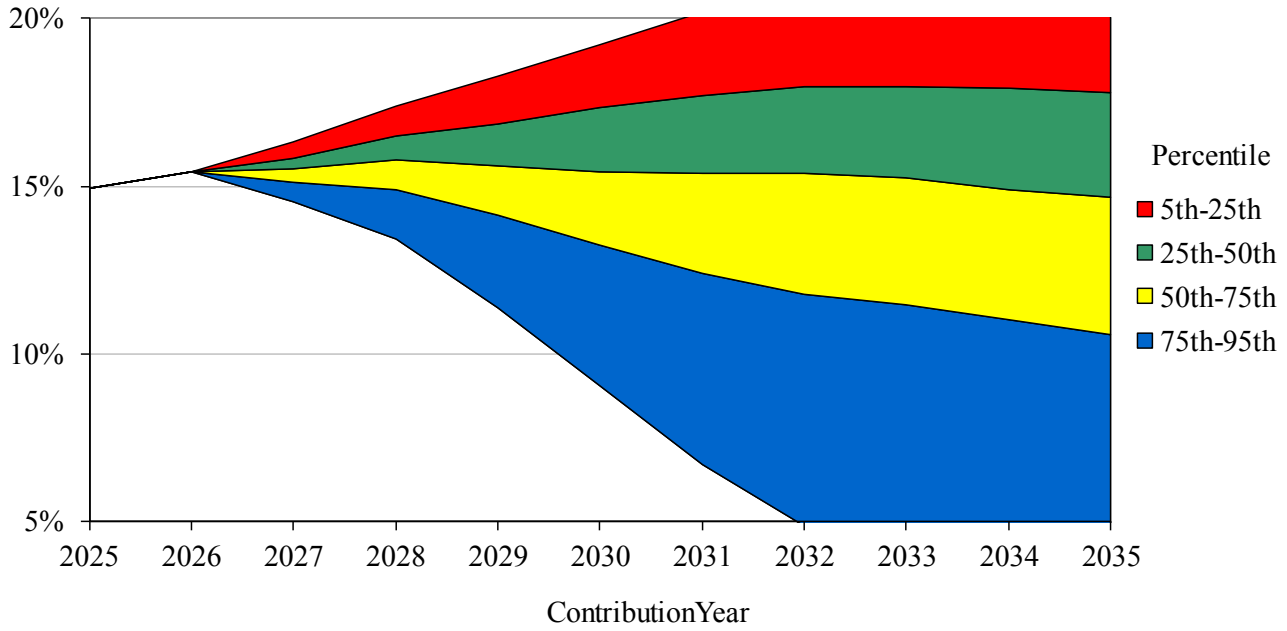
5th Percentile	14.9%	15.4%	16.0%	16.9%	17.4%	17.9%	18.6%	18.8%	18.9%	19.0%	19.0%
25th Percentile	14.9%	15.4%	15.7%	16.2%	16.5%	16.7%	17.0%	17.1%	17.0%	17.0%	16.9%
Median	14.9%	15.4%	15.5%	15.8%	15.7%	15.5%	15.5%	15.5%	15.4%	15.2%	15.1%
75th Percentile	14.9%	15.4%	15.3%	15.3%	14.8%	14.3%	13.8%	13.5%	13.2%	13.1%	12.9%
95th Percentile	14.9%	15.4%	14.9%	14.5%	13.4%	12.2%	10.9%	10.2%	9.7%	9.5%	9.1%

Contribution as a % of Payroll
Scenario 8 – 8.0% Return, 22.3% Volatility



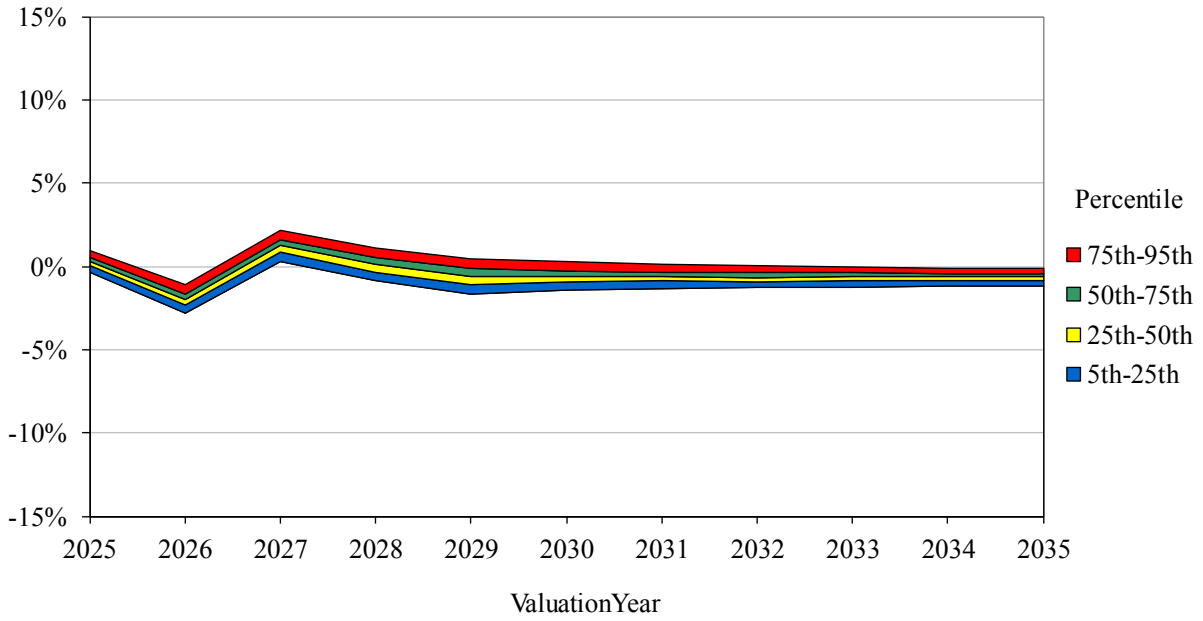
5th Percentile	14.9%	15.4%	16.1%	17.1%	17.9%	18.5%	19.4%	19.6%	19.8%	19.8%	19.8%
25th Percentile	14.9%	15.4%	15.8%	16.4%	16.7%	17.0%	17.3%	17.5%	17.4%	17.3%	17.3%
Median	14.9%	15.4%	15.5%	15.8%	15.7%	15.4%	15.4%	15.4%	15.3%	15.0%	14.8%
75th Percentile	14.9%	15.4%	15.2%	15.1%	14.5%	13.8%	13.1%	12.7%	12.3%	12.1%	11.8%
95th Percentile	14.9%	15.4%	14.7%	14.0%	12.5%	10.7%	9.0%	7.9%	7.2%	6.7%	6.1%

Contribution as a % of Payroll
Scenario 9 – 8.5% Return, 28.3% Volatility



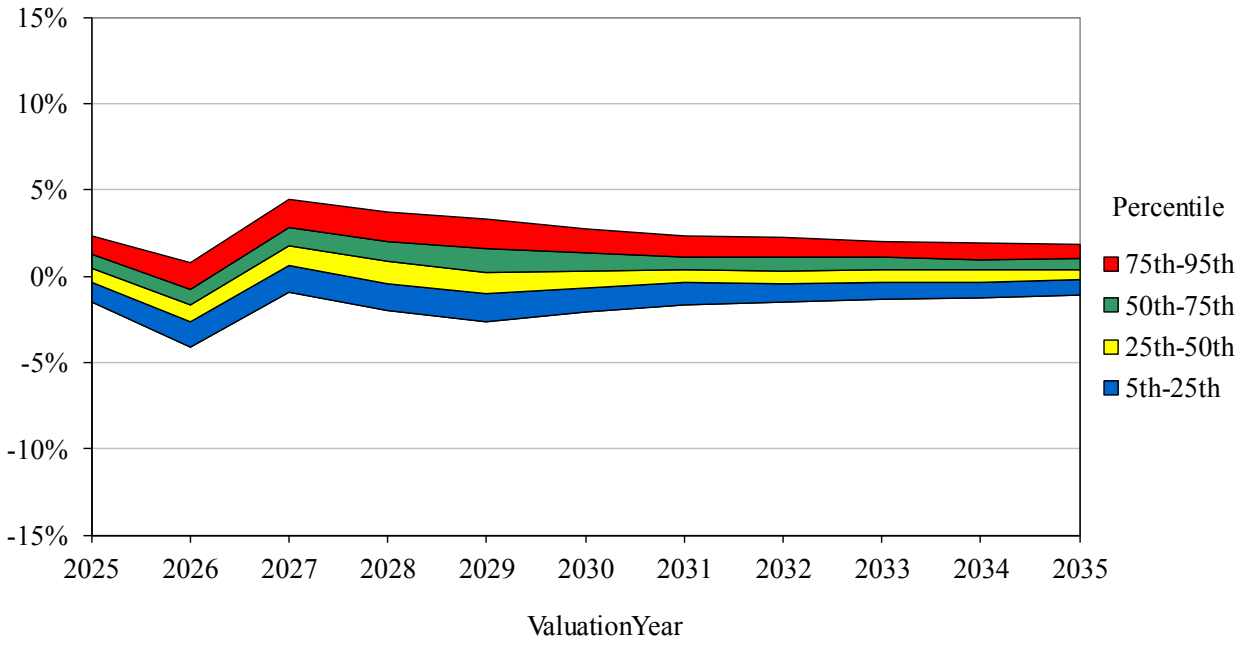
5th Percentile	14.9%	15.4%	16.3%	17.4%	18.3%	19.2%	20.2%	20.5%	20.6%	20.6%	20.7%
25th Percentile	14.9%	15.4%	15.8%	16.5%	16.9%	17.3%	17.7%	18.0%	18.0%	17.9%	17.8%
Median	14.9%	15.4%	15.5%	15.8%	15.6%	15.4%	15.4%	15.4%	15.2%	14.9%	14.7%
75th Percentile	14.9%	15.4%	15.1%	14.9%	14.1%	13.2%	12.4%	11.8%	11.4%	11.0%	10.6%
95th Percentile	14.9%	15.4%	14.5%	13.4%	11.4%	9.0%	6.7%	4.9%	4.0%	3.2%	2.4%

Dividend Rates
Scenario 1 – 4.5% Return, 2.2% Volatility



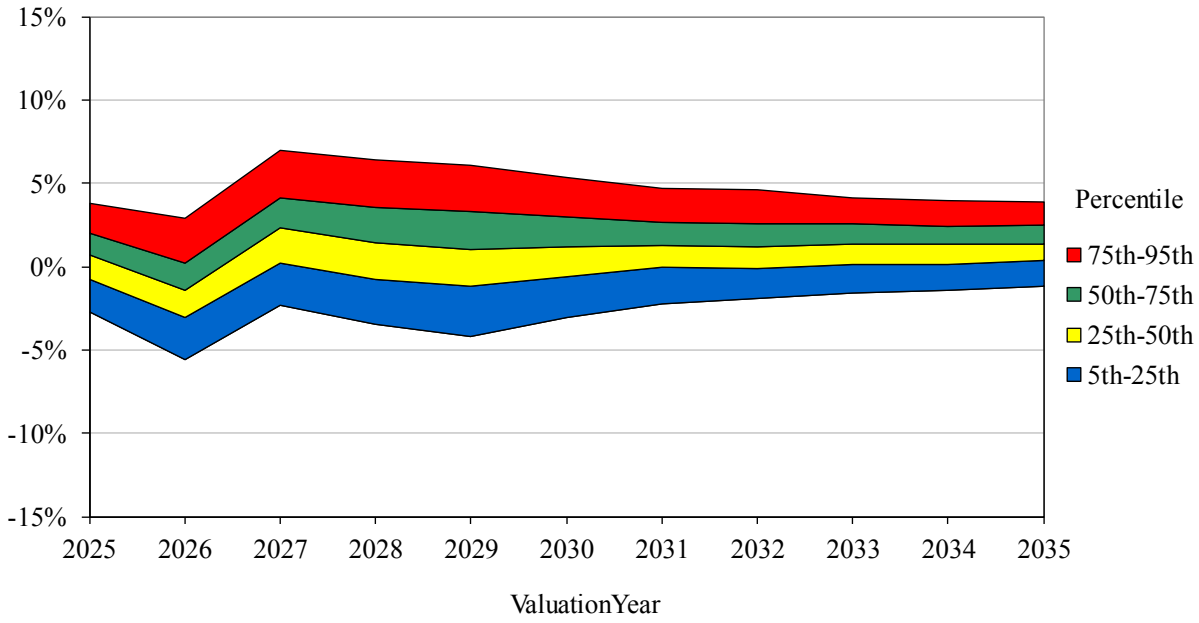
5th Percentile	-0.4%	-2.8%	0.3%	-0.8%	-1.6%	-1.4%	-1.3%	-1.3%	-1.2%	-1.2%	-1.1%
25th Percentile	0.0%	-2.3%	0.9%	-0.3%	-1.0%	-1.0%	-0.9%	-0.9%	-0.9%	-0.9%	-0.8%
Median	0.3%	-2.0%	1.3%	0.1%	-0.6%	-0.6%	-0.6%	-0.6%	-0.6%	-0.6%	-0.6%
75th Percentile	0.6%	-1.6%	1.6%	0.6%	-0.1%	-0.2%	-0.3%	-0.4%	-0.4%	-0.4%	-0.4%
95th Percentile	1.0%	-1.1%	2.2%	1.2%	0.5%	0.3%	0.1%	0.1%	-0.1%	-0.1%	-0.1%

Dividend Rates
Scenario 3 – 5.5% Return, 6.2% Volatility



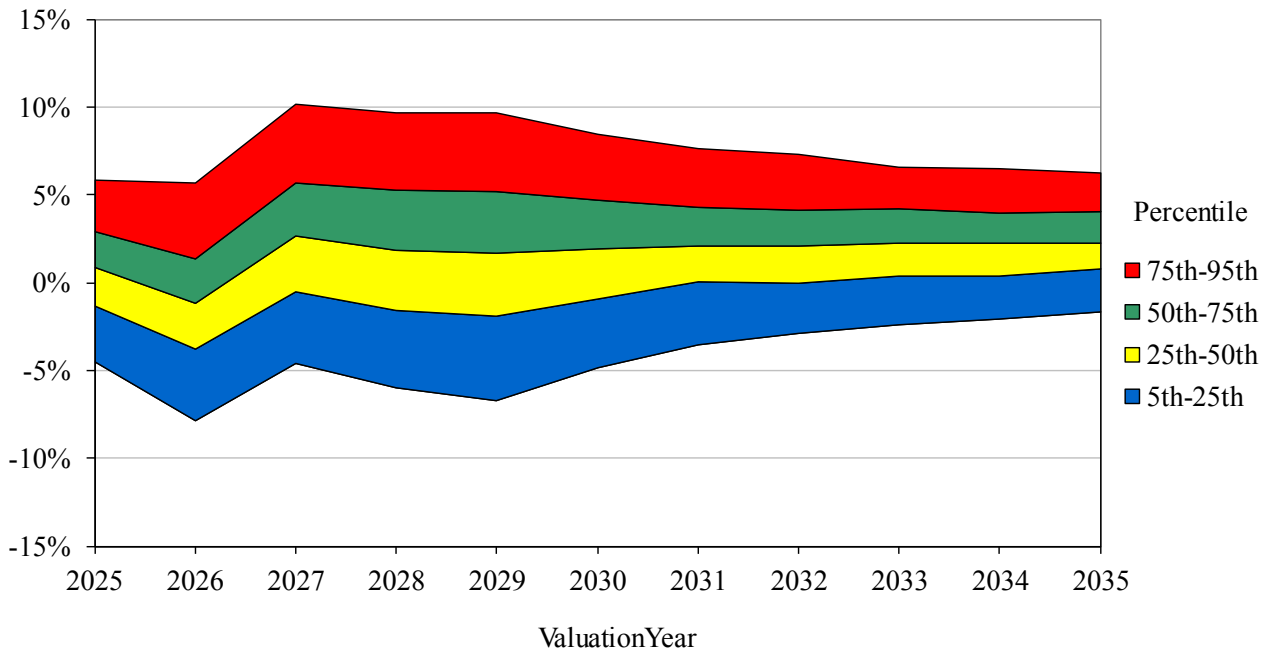
5th Percentile	-1.5%	-4.1%	-0.9%	-2.0%	-2.7%	-2.1%	-1.7%	-1.5%	-1.3%	-1.2%	-1.1%
25th Percentile	-0.3%	-2.6%	0.6%	-0.5%	-1.0%	-0.7%	-0.4%	-0.4%	-0.3%	-0.3%	-0.2%
Median	0.5%	-1.7%	1.8%	0.8%	0.3%	0.3%	0.4%	0.3%	0.4%	0.4%	0.4%
75th Percentile	1.3%	-0.7%	2.9%	2.0%	1.6%	1.3%	1.2%	1.1%	1.1%	1.0%	1.0%
95th Percentile	2.3%	0.8%	4.5%	3.7%	3.3%	2.7%	2.4%	2.3%	2.0%	1.9%	1.8%

Dividend Rates
Scenario 5 – 6.5% Return, 10.7% Volatility



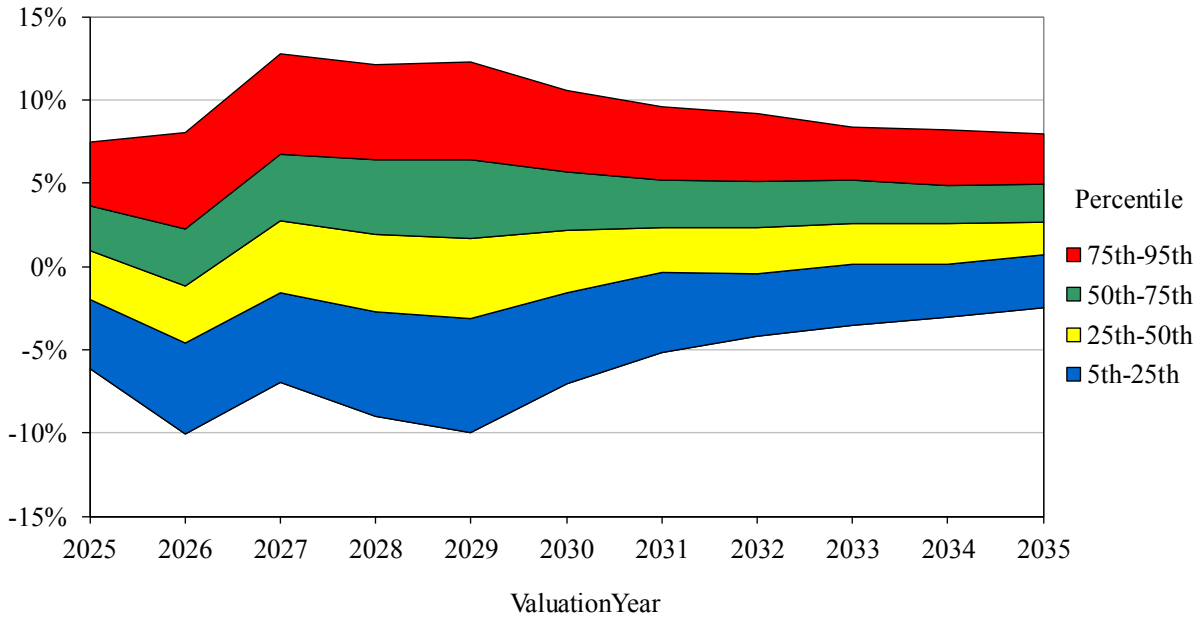
5th Percentile	-2.7%	-5.6%	-2.3%	-3.5%	-4.2%	-3.0%	-2.3%	-1.9%	-1.5%	-1.4%	-1.1%
25th Percentile	-0.7%	-3.0%	0.3%	-0.8%	-1.2%	-0.6%	0.0%	-0.1%	0.2%	0.2%	0.4%
Median	0.7%	-1.4%	2.3%	1.4%	1.0%	1.2%	1.3%	1.2%	1.3%	1.3%	1.3%
75th Percentile	2.0%	0.3%	4.1%	3.6%	3.3%	3.0%	2.7%	2.6%	2.6%	2.4%	2.5%
95th Percentile	3.8%	2.9%	7.0%	6.4%	6.1%	5.4%	4.7%	4.6%	4.1%	4.0%	3.9%

Dividend Rates
Scenario 7 – 7.5% Return, 16.9% Volatility



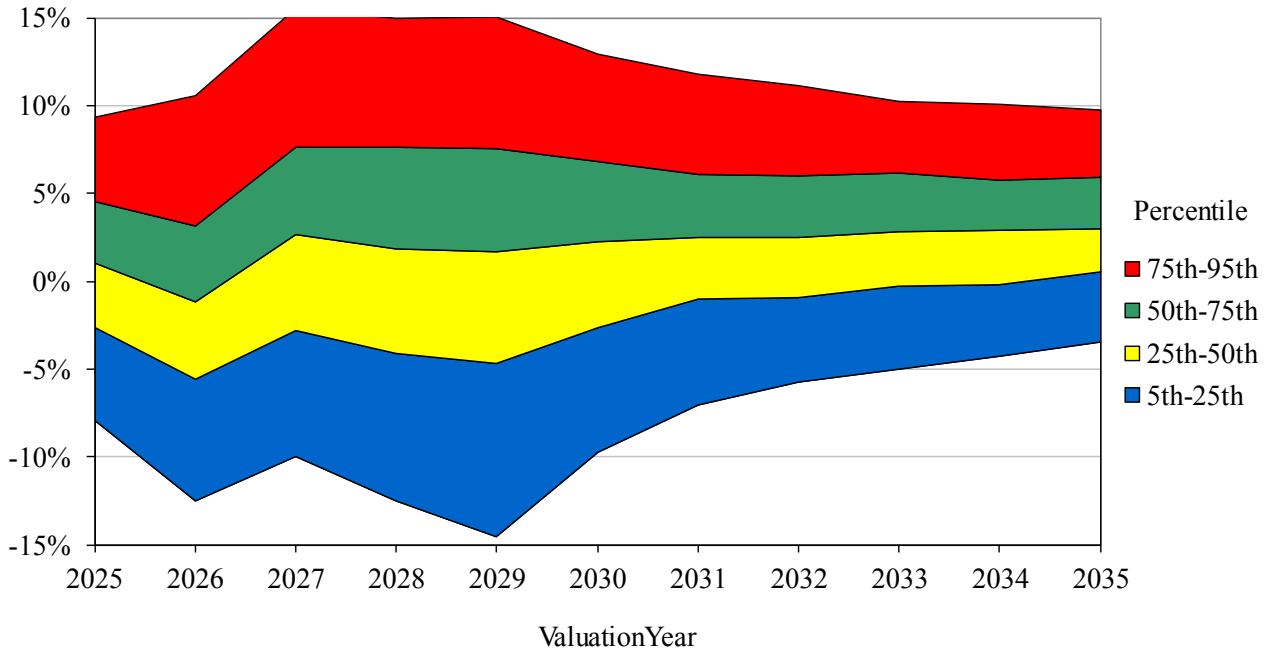
5th Percentile	-4.5%	-7.9%	-4.6%	-5.9%	-6.7%	-4.8%	-3.5%	-2.9%	-2.4%	-2.1%	-1.6%
25th Percentile	-1.3%	-3.7%	-0.6%	-1.6%	-1.9%	-0.9%	0.1%	0.0%	0.4%	0.4%	0.8%
Median	0.9%	-1.2%	2.7%	1.9%	1.7%	2.0%	2.1%	2.1%	2.2%	2.2%	2.3%
75th Percentile	2.9%	1.4%	5.7%	5.3%	5.2%	4.7%	4.3%	4.1%	4.2%	3.9%	4.0%
95th Percentile	5.8%	5.7%	10.2%	9.7%	9.7%	8.5%	7.6%	7.3%	6.6%	6.5%	6.3%

Dividend Rates
Scenario 8 – 8.0% Return, 22.3% Volatility



5th Percentile	-6.1%	-10.1%	-6.9%	-9.0%	-10.0%	-7.0%	-5.2%	-4.2%	-3.6%	-3.1%	-2.5%
25th Percentile	-2.0%	-4.6%	-1.5%	-2.7%	-3.1%	-1.5%	-0.4%	-0.4%	0.1%	0.1%	0.7%
Median	1.0%	-1.2%	2.8%	1.9%	1.7%	2.2%	2.3%	2.3%	2.6%	2.6%	2.7%
75th Percentile	3.7%	2.2%	6.7%	6.4%	6.4%	5.7%	5.2%	5.1%	5.2%	4.9%	5.0%
95th Percentile	7.5%	8.1%	12.8%	12.2%	12.3%	10.5%	9.6%	9.2%	8.4%	8.2%	8.0%

Dividend Rates
Scenario 9 – 8.5% Return, 28.3% Volatility



5th Percentile	-7.9%	-12.5%	-10.0%	-12.5%	-14.6%	-9.8%	-7.1%	-5.7%	-5.0%	-4.3%	-3.5%
25th Percentile	-2.7%	-5.5%	-2.8%	-4.1%	-4.7%	-2.6%	-1.0%	-1.0%	-0.3%	-0.2%	0.5%
Median	1.1%	-1.2%	2.7%	1.8%	1.7%	2.3%	2.5%	2.5%	2.9%	2.9%	3.0%
75th Percentile	4.5%	3.1%	7.7%	7.7%	7.5%	6.8%	6.1%	6.0%	6.2%	5.8%	5.9%
95th Percentile	9.3%	10.6%	15.6%	15.0%	15.0%	12.9%	11.8%	11.1%	10.3%	10.1%	9.8%

WRS Stress Testing (Limitations and Simplifications)

- Goal is to understand the potential effect of various levels of stress on the System (not calculate exact predictions)
- Simplifying assumptions
  - Retiree funded status allowed to become negative and recover over time
  - Typical dividend adjustments (mortality improvements, carryover, timing, etc.) assumed to average to zero
  - Iterative impact between Money Purchase Minimum and contribution rates assumed to average to zero
  - Modified Normal Distribution in future years (standard deviation gradually declines in future years)

Combination of All Scenarios

2045 Results by Percentile of Investment Return Outcomes										
			Contribution Rates			Dividend Rates			Highest	Worst Retiree
Scenario	Expected RoR	Standard Deviation	95th	50th	5th	95th	50th	5th	Div. Dep. PRB	Funded %
1	4.5%	2.2%	18.5%	18.9%	19.4%	0.0%	-0.5%	-1.1%	100%/Year50	72%/Year50
2	5.0%	4.1%	17.2%	18.2%	19.1%	0.9%	0.0%	-1.0%	50%/Year50	86%/Year50
3	5.5%	6.2%	15.8%	17.5%	18.8%	1.9%	0.5%	-1.0%	10%/Year50	98%/Year50
4	6.0%	8.2%	14.3%	16.6%	18.5%	2.9%	1.0%	-1.0%	5%/Year50	106%/Year10
5	6.5%	10.7%	12.3%	15.8%	18.3%	4.0%	1.5%	-1.0%	6%/Year50	103%/Year10
6	7.0%	14.0%	9.8%	14.9%	18.3%	5.3%	2.0%	-1.3%	11%/Year50	96%/Year10
7	7.5%	16.9%	7.2%	14.0%	18.3%	6.5%	2.6%	-1.5%	15%/Year50	91%/Year10
8	8.0%	22.3%	2.7%	13.1%	18.8%	8.3%	3.1%	-2.3%	24%/Year50	79%/Year10
9	8.5%	28.3%	0.0%	12.2%	19.4%	10.3%	3.5%	-3.4%	30%/Year50	66%/Year10

Actuarial Rate 6.8% →

- Portfolios with lower expected return result in higher expected contributions and lower expected dividends
- Higher assumed rates of return are associated with higher standard deviation (i.e., risk) and 5th percentile scenario for retiree dividend pool falling below 75% (Worst Retiree Funded %)
- Scenarios 4 through 7 represent potential 'Goldilocks Zone'

Disclaimers

- This presentation shall not be construed to provide tax advice, legal advice or investment advice.
- Mark Buis, James Anderson and Rich Koch are Members of the American Academy of Actuaries and meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions contained herein.
- This is one of multiple documents comprising the actuarial report. Additional information regarding actuarial assumptions and methods, and important additional disclosures are provided in the full report entitled "Forty-Fourth Annual Actuarial Valuation and Gain Loss Analysis."
- If you need additional information to make an informed decision about the contents of this presentation or the contents of the full report, or if anything appears to be missing or incomplete, please contact us before making use of the information.