

# **Economic Capital Related to Pension Closeout and Payout Annuity Liabilities, Before and After Longevity Hedging – A Case Study**

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## WILL COVER:

- US Statutory Reserve and Capital Methodology
- Economic Reserve and Capital
- Comparing Statutory Capital to Economic Capital
- Range of Economic Liabilities and Capital – current and over time
- Managing Economic Capital

## Case Study – a block of Single Premium Immediate Annuities (SPIA)

Age	Annual Benefit	Lives
65	50,000	7,000
70	43,600	6,000
75	38,800	5,000
80	34,200	4,000
85	27,700	3,000

\* All lives are males

# Statutory Reserves

## ■ Statutory Reserve for Immediate Annuities

- Defined deterministic formula using prescribed mortality table with prescribed discount rate
  - Annuity 2000 mortality table
    - Contains 10% reduction to mortality rates
    - Does NOT reflect mortality improvement
  - Statutory Discount Rate
    - Current discount rate is 5.50%
- Principles Based Reserving – the future
  - Still far off as they have not yet focused on Payout Annuities

# Statutory Capital

- **NAIC Risk Based Capital (RBC)**
  - Factor driven formula
    - C1 – Asset Default Risk
    - C2 – Insurance Mispricing Risk
    - C3 – Interest Rate Mismatch Risk
    - C4 – General Other Risks
    - Formula to reflect correlation adjustments
  - Companies usually hold multiples of Company Action Level RBC
    - Level depends on desired rating
    - Usually 250% to 450%

## RBC for SPIA block

- **C1 and C3 are non-zero**
- **C2 and C4 are zero**
  - There is no RBC charge for longevity risk
  - Given recent levels of mortality improvement, this is probably an oversight

## Economic Reserves and Capital

- **Principles Based Approach**
  - No set definition, although building consensus
- **Economic Reserve calculated as best estimate valuation**
  - With or without margins
- **Economic Capital defined as additional capital that satisfies a defined risk measure**
  - For example, CTE90 or 99.5<sup>th</sup> Percentile

# Economic Calculation Methodology

- **Stochastic Process**

- Provides useful information (e.g., confidence intervals, standard deviations)
- CTE90 or 99.5<sup>th</sup> percentile economic liability values could be an amount that represents economic capital

- **Need to recognize dynamic assumption set**

- Assuming a static assumption set will not provide useful information relating to confidence intervals



# Volatility in Underlying Assumptions

## ▪ Mortality

- Underlying baseline mortality table
  - Is the base table appropriate for population being valued?
- Future Trends in Mortality Improvement
  - General trends based on historical levels of volatility
  - Extreme longevity events not reflected in historical levels of volatility (e.g., medical breakthrough that significantly reduces cancer related deaths)
- Catastrophic mortality events (e.g., pandemic, terrorist attack)

## Economic Capital

- **Assuming best estimate investment return, Economic Capital is a measure of longevity risk (for SPIAs)**
  - A representative value for C2
- **Need to also reflect asset related risk**
  - The discount rate is a sensitive issue in Principles Based Reserve discussions
  - Could discount at treasuries to eliminate default and spread risk
  - Could discount at expected earned rate assumption less a charge for a total return swap

## Statutory Reserves and Capital (\$ in billions)

Age	Benefit	Lives	NSP	Stat Rsv @ 5.5%
65	50,000	7,000	12.09	4.23
70	43,600	6,000	10.68	2.79
75	38,800	5,000	9.21	1.79
80	34,200	4,000	7.74	1.06
85	27,700	3,000	6.37	<u>0.53</u>
Total Stat Reserve				\$10.40
CAL RBC C-1 Risk - Asset Default				0.11
CAL RBC C-2 Risk - Insurance Risk				0.00
CAL RBC C-3 Risk - Interest Rate Mismatch				0.05
Total CAL RBC				<u>0.16</u>
400% CAL RBC				\$0.64
Total Asset Requirement				\$11.04

## Static Economic Assumptions

- **Annuity 2000 Basic Table**
  - Same as statutory mortality table without 10% loading for conservatism
- **Mortality Improvement starting in 2000**
  - Based on historical improvement in general population mortality rates
- **Assumed Earned Rate is 5.50%**
  - same as Statutory Discount Rate
  - But pay 75 bps for a total return swap (reflects hedge for credit losses and interest rate mismatch)
  - That guarantees 4.75% return
- **Thus, use 4.75% discount rate for discounting economic cash flows**

## Dynamic Mortality Assumptions

- **Volatile Baseline Mortality Table**
  - Normal Distribution with 5% standard deviation
- **Volatile Mortality Improvement Assumption**
  - Based on historical levels of volatility in mortality improvement by age and gender
  - Reflects correlations across age groups and time intervals
- **Reflects the probability of extreme mortality improvement outside historical trends**
  - Medical breakthroughs
- **Reflects the probability of a catastrophic mortality event (e.g., pandemic)**
  - Not relevant for determining economic capital in a SPIA block but would be relevant in determining economic capital in a block of close out annuities that pay death benefits before retirement

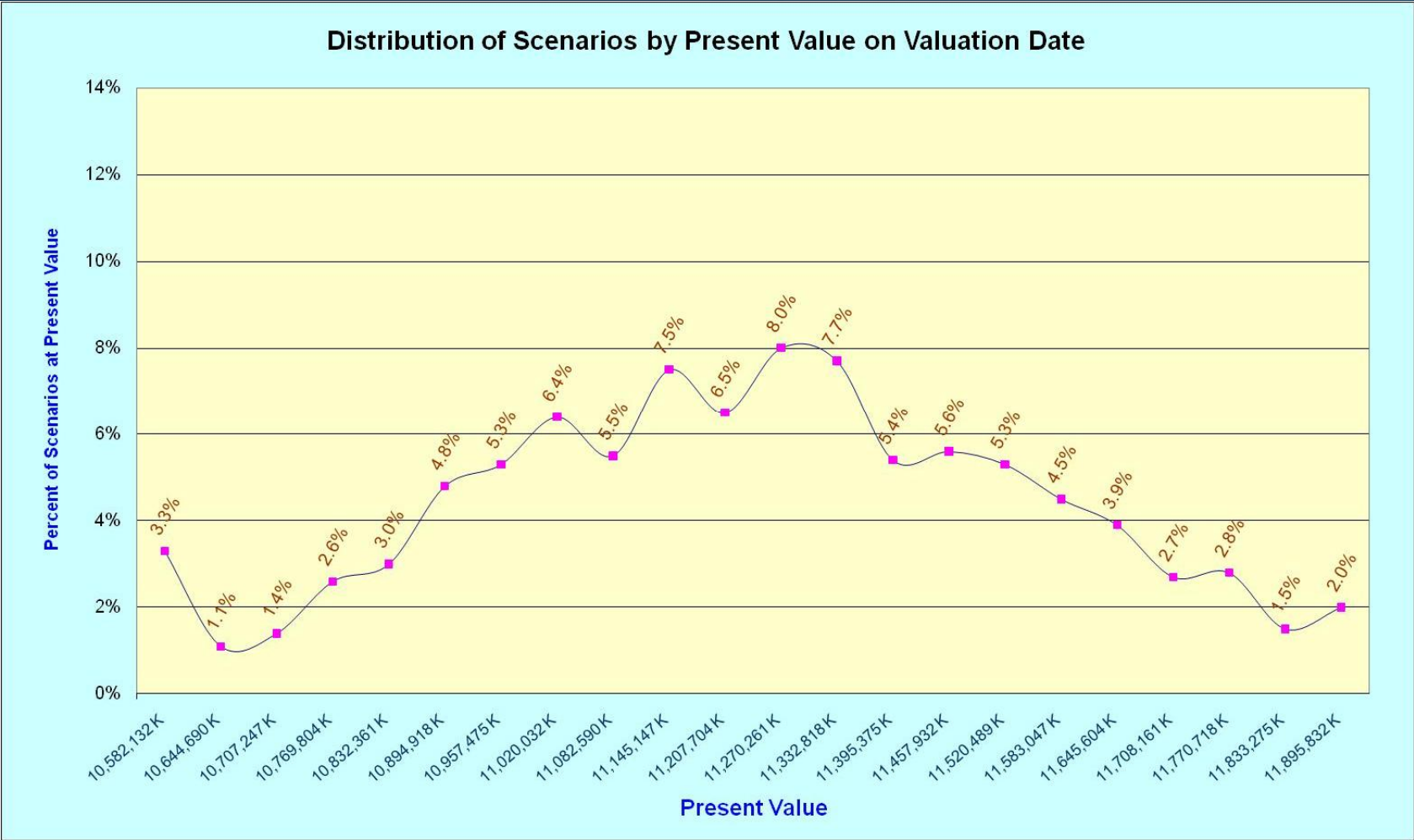
## Economic Reserve and Capital (\$ in billions)

(1) Average Economic Liability Value discounted at 5.50% ("Economic Reserve")	\$10.61	
	<u>99.5th Percentile</u>	<u>90CTE</u>
(2) Economic Liability Value discounted at 5.50%	\$11.44	\$11.17
(3) Economic Liability Value discounted at 4.75%	\$12.18	\$11.87
Capital for Longevity Risk (2) - (1)	\$0.83	\$0.55
Capital for Asset Risk (3) - (2)	\$0.74	\$0.70
Total Economic Capital: (3) - (1)	\$1.57	\$1.26

## Comparison of Statutory to Economic (\$ in billions)

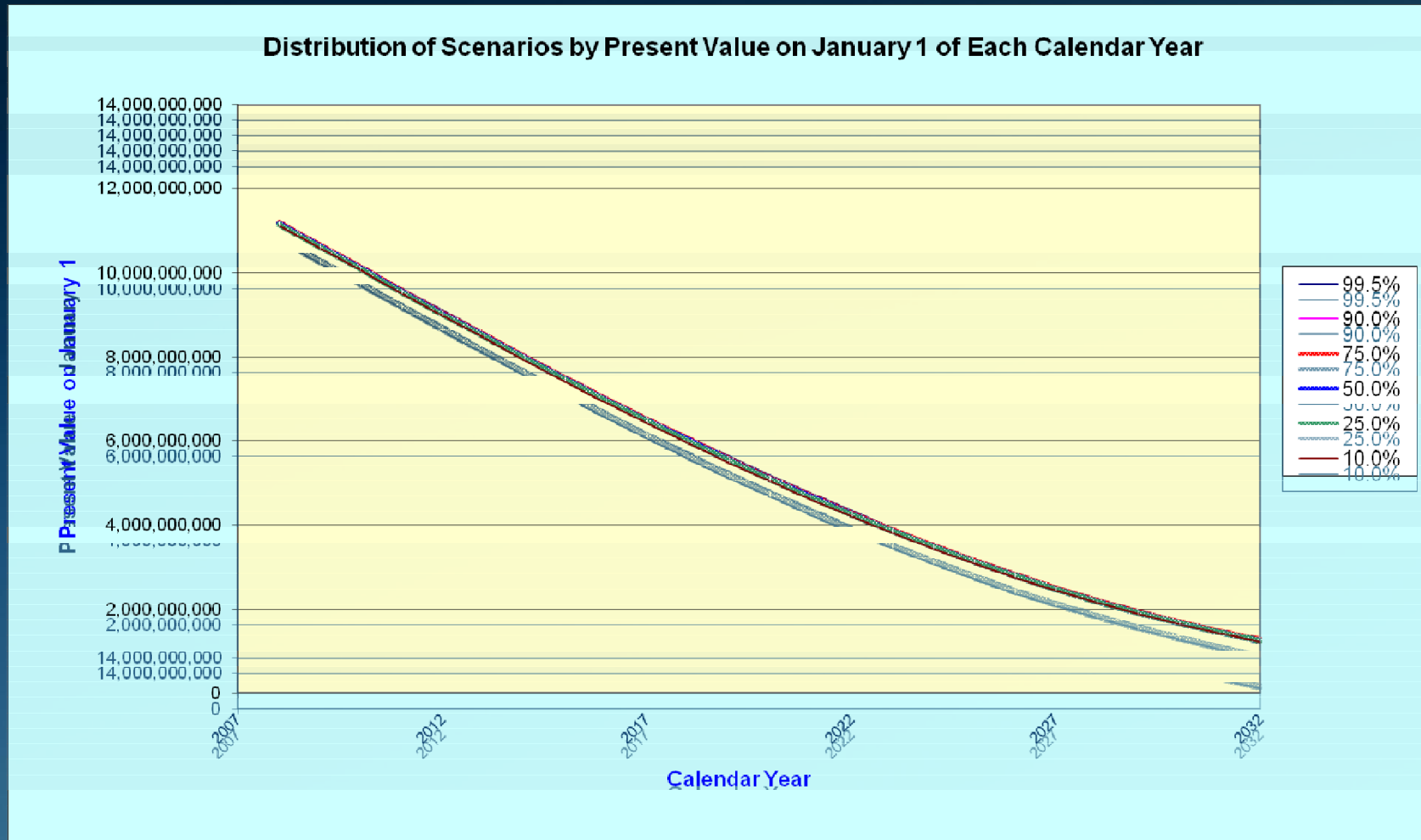
	(1) Statutory	(2) Economic 99.5th Percentile	(3) (1) / (2)	(4) Economic 90 CTE	(5) (1) / (4)
Reserve	\$10.40	\$10.61	98%	\$10.61	98%
Capital for Asset Risk	\$0.64	\$0.74	86%	\$0.70	90%
Capital for Longevity Risk	\$0.00	\$0.83	0%	\$0.55	0%
Total Capital	\$0.64	\$1.57	40%	\$1.26	51%
Asset (Reserve + Capital)	\$11.04	\$12.18	91%	\$11.87	93%

# Distribution of Current Economic Liability – discounted at 4.75%

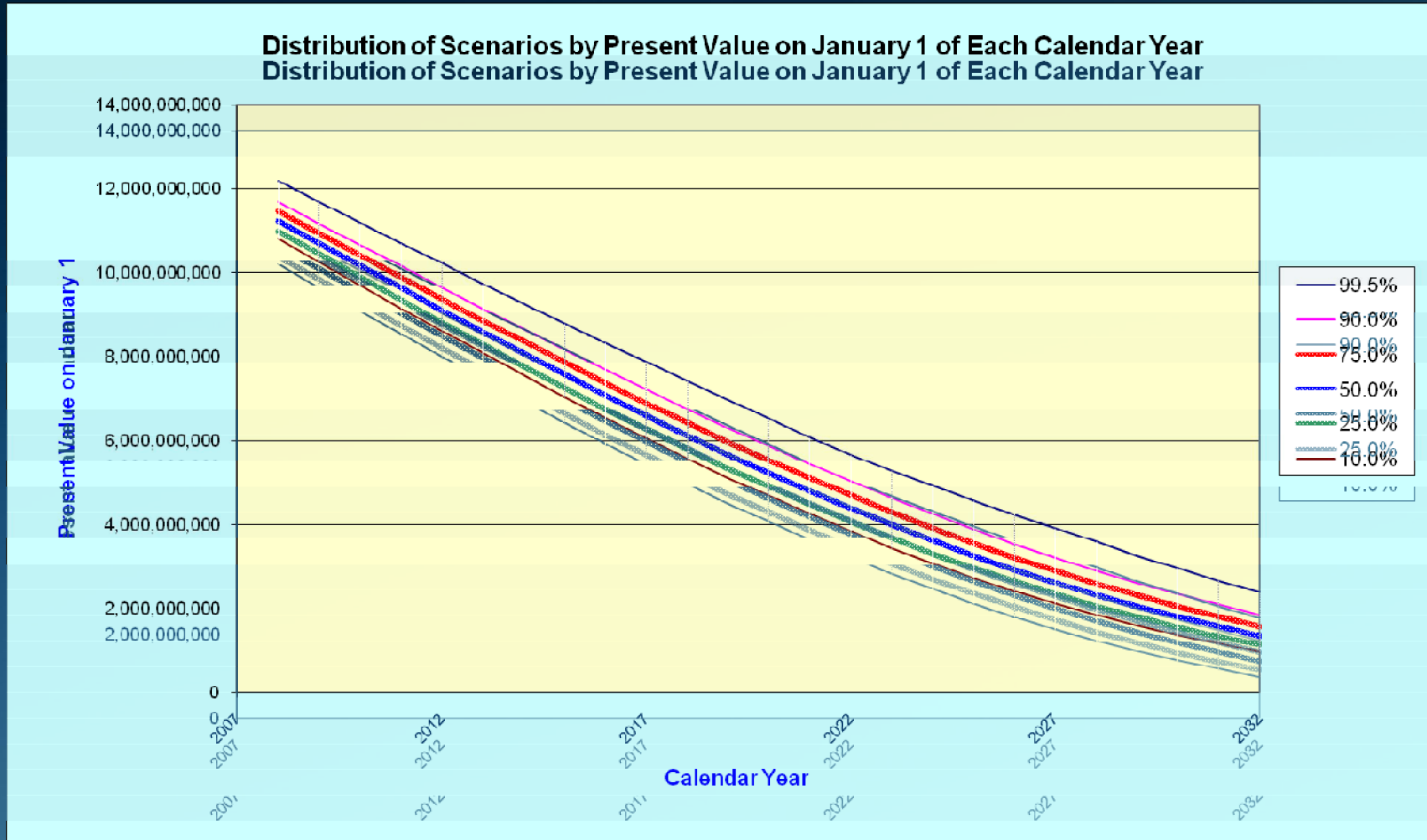




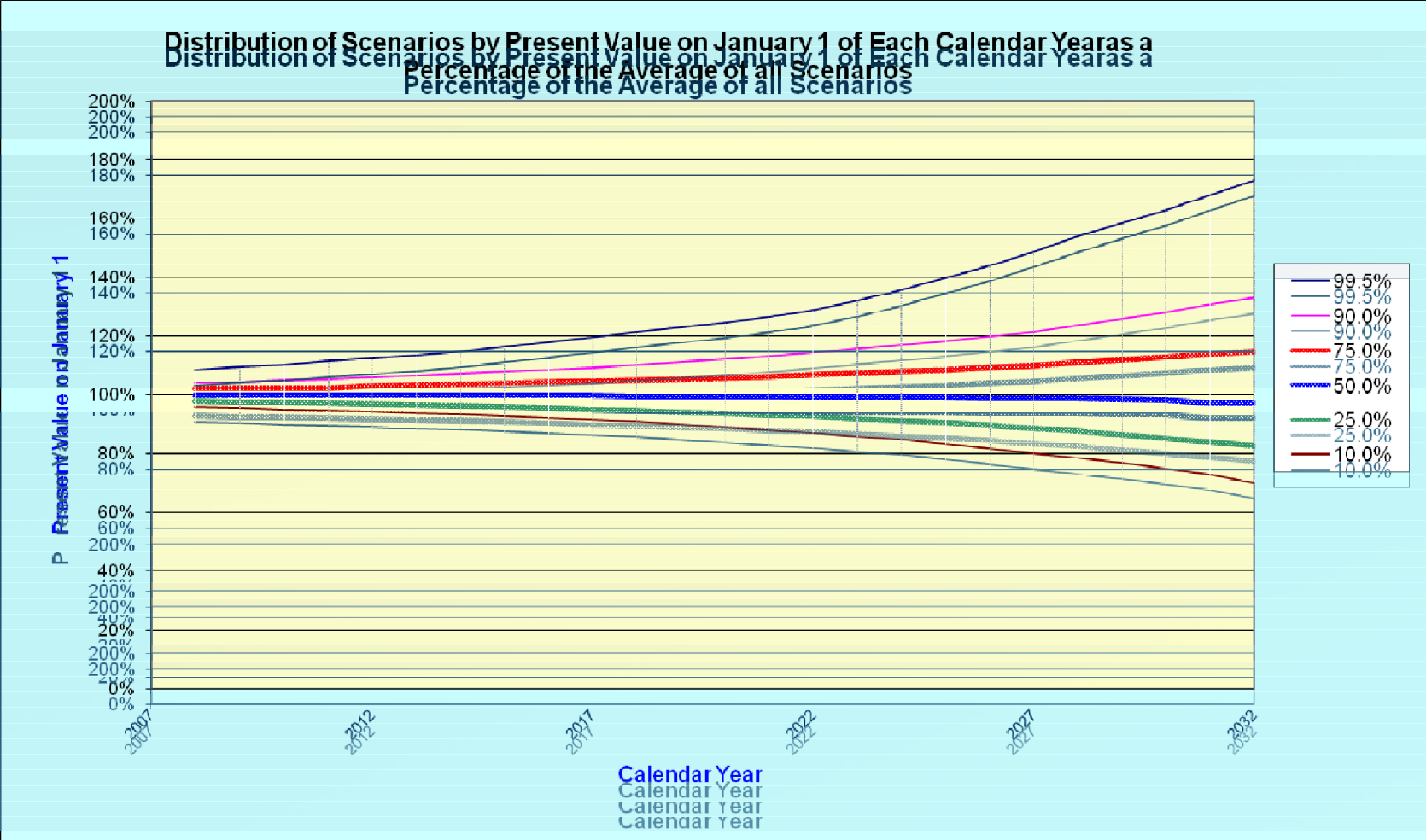
# Economic Liability Value Over Time (with static assumptions) - discounted at 4.75%



# Economic Liability Value Over Time (with volatile assumptions) - discounted at 4.75%



# Economic Liability Value as a Percentage of the Average Value

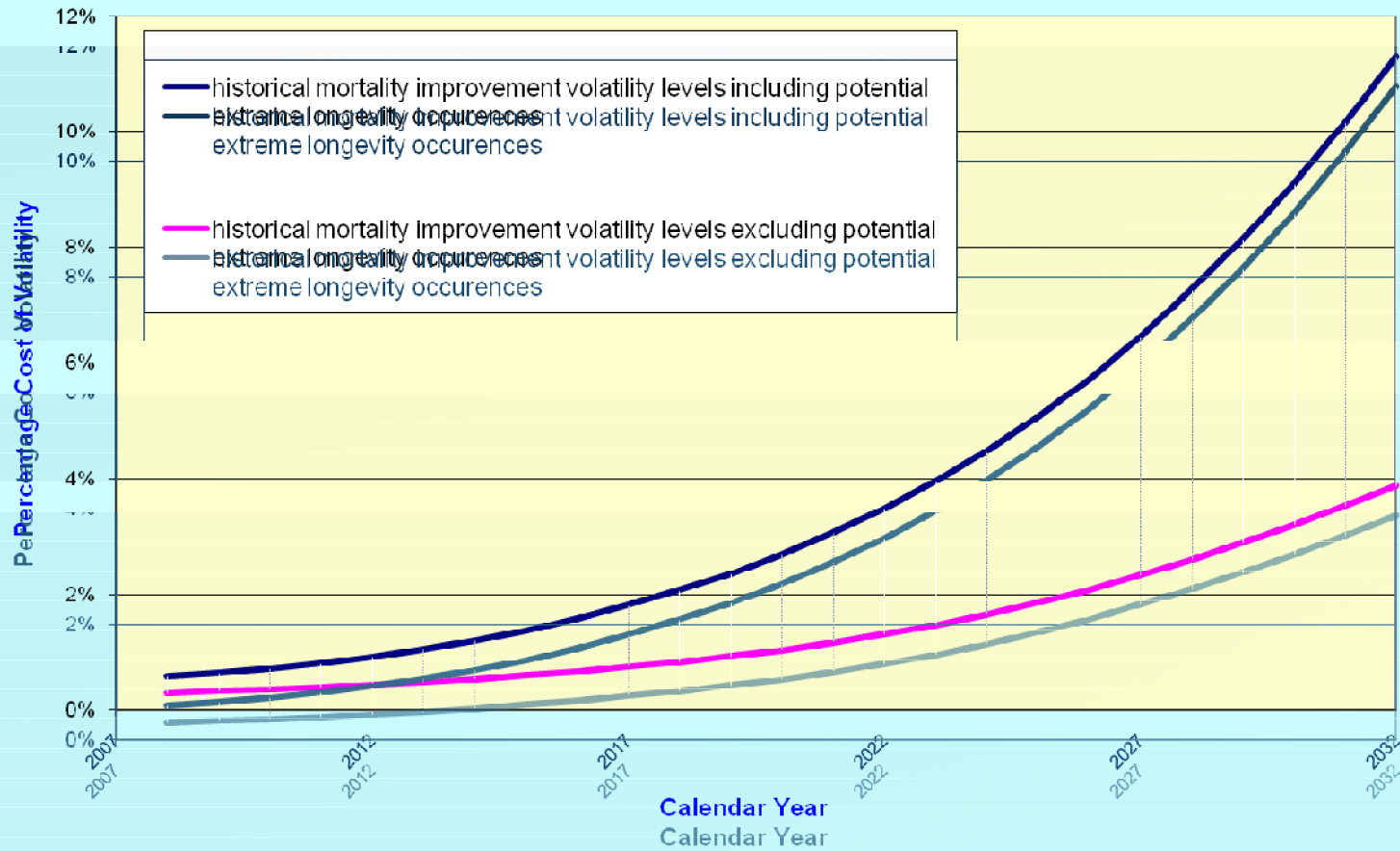


## Cost of Volatility

- **Average Economic Liability @4.75% Assuming Static Mortality Assumption**
  - \$ 11.169 Billion
- **Average Economic Liability @4.75% Assuming Dynamic Mortality Assumption**
  - \$11.235 Billion
- **\$ 66 Million Cost of Volatility**
  - For which investors should be compensated
- **Dependent on Volatility Assumptions**
- **More room for individuals to live longer than to die earlier creating an asymmetric cash flow pattern in the face of volatility**
- **Cost of Volatility grows over time**

# Cost of Volatility

**Average Economic Liability with Volatile Assumptions  
/ Average Economic Liability with Static Assumptions - 1**



# How to Reduce Economic Capital

- **Not an easy task**
- **First step - Analysis**
  - Recognize volatility in underlying assumptions
  - Analyze annuity liabilities in conjunction with life insurance liabilities
    - Negatively correlated, but not perfectly
- **Next Step – Action**
  - Longevity Derivatives
    - Longevity Bonds and Longevity Swaps
  - Target new business to complement existing risks
- **Work with Rating Agencies**
  - ERM programs may result in improved ratings
  - May give credit and lower required capital based on initial analysis

## Economic Capital with Longevity Bond

- 10 Year Longevity Bond
- \$1 Billion Principal
- Investment Assumption is 4.75%
- Pay 5.50% Coupons
- After 10 years, repay principal assuming Economic Liability is below Attachment Point
- Keep proportional principal above Attachment Point until Exhaustion
- Attachment Point = 115%
- Exhaustion Point = 125%

## Characteristics of Hypothetical Longevity Bond

- **Probability of Attachment – 4.0% (i.e., 40 scenarios out of 1,000)**
- **Expected Loss – 1.2% of Principal at the end of 10 years**
- **Average Loss of 40 Attachment scenarios - \$308 million**
- **Probability of Exhaustion – 0.2% (i.e., 2 scenarios out of 1,000)**



## Initial Economic Liability Before and After Liability Hedge - discounted at 4.75% (\$ in billions)

	Before Hedge	After Hedge	Difference
Average	\$11.20	\$11.26	\$0.06
75th Percentile	\$11.44	\$11.51	\$0.07
90th Percentile	\$11.68	\$11.74	\$0.06
99th Percentile	\$12.04	\$11.94	(\$0.10)
99.5th Percentile	\$12.18	\$11.95	(\$0.22)

## Beginning of Tenth Duration Economic Liability Before and After Liability Hedge - discounted at 4.75% (\$ in billions)

	Before Hedge	After Hedge	Difference
Average	\$6.08	\$6.07	\$0.00
75th Percentile	\$6.41	\$6.42	\$0.01
90th Percentile	\$6.72	\$6.71	(\$0.01)
99th Percentile	\$7.22	\$6.97	(\$0.25)
99.5th Percentile	\$7.35	\$6.98	(\$0.37)

## Contact Information

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