

MERCER

Human Resource Consulting



March 30, 2007

PERS Financial Modeling Tier 1 Rate Guarantee Reserve

Bill Hallmark and Greg Smith



Contents

- Key Findings
- Statutory Structure of Rate Guarantee Reserve
- Baseline Results and Policy Objectives
- Development of Policy Alternatives
- Alternative Policy Results
- Limitations of Analysis
- Comments and Recommendations



Key Findings

- The Tier One Rate Guarantee Reserve is not “Fully Funded” as of 12/31/2006 under any of the policy alternatives considered
- Based on the reserve as of 12/31/2006, there is about a 22% chance of a negative reserve in 20 years if the Board only credits 8% earnings each year
- It is likely that the Tier One Rate Guarantee Reserve will be “Fully Funded” sometime in the future



Statutory Structure

Tier One Rate Guarantee Reserve

- **Interest credits to Tier 1 Member Accounts are limited to the actuarially assumed interest rate (currently 8%) until the Tier 1 Rate Guarantee Reserve has been “fully funded” for three consecutive years**
- Actual earnings in excess of amounts credited to Tier 1 Member Accounts are credited to the Tier 1 Rate Guarantee Reserve
- Any shortfall in actual earnings from the amounts credited to Tier 1 Member Accounts is transferred from the Tier 1 Rate Guarantee Reserve to Tier 1 Member Accounts
- **According to statute, the Tier 1 Rate Guarantee Reserve is “fully funded” when, after consulting with its actuary, the Board determines it has sufficient assets “to ensure a zero balance in the account” when all Tier 1 members have retired**
- The literal statutory requirement of ensuring a zero balance in the reserve is not viable or practical. In the end, there will likely be either a positive or negative reserve.



Baseline Results

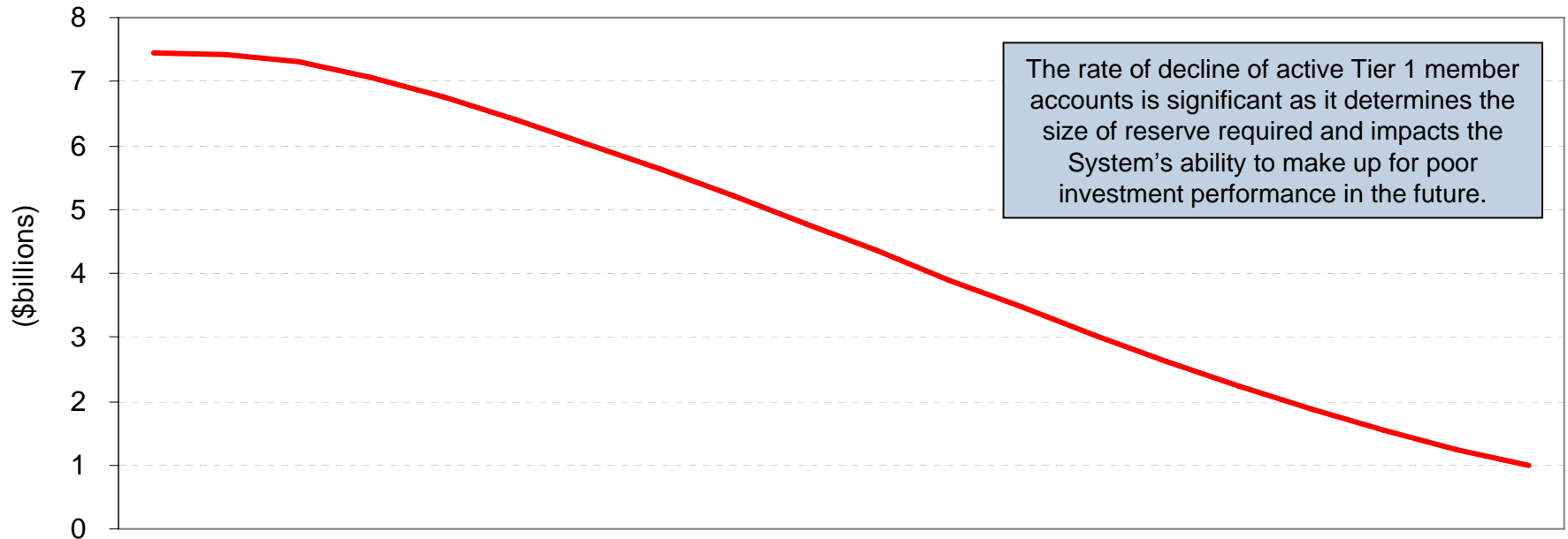
Always Credit Assumed Rate

- The baseline model is intended to show projections of the Tier 1 Rate Guarantee Reserve assuming the Board always credits the assumed rate of earnings
- The projections start with 2006 reflecting estimated values of the reserves as of 12/31/2006
- The projections extend 20 years. There are still projected to be active Tier 1 members at that point, but the aggregate value of member accounts is significantly smaller

Baseline Results

Value of Member Accounts

Tier 1 Member Accounts

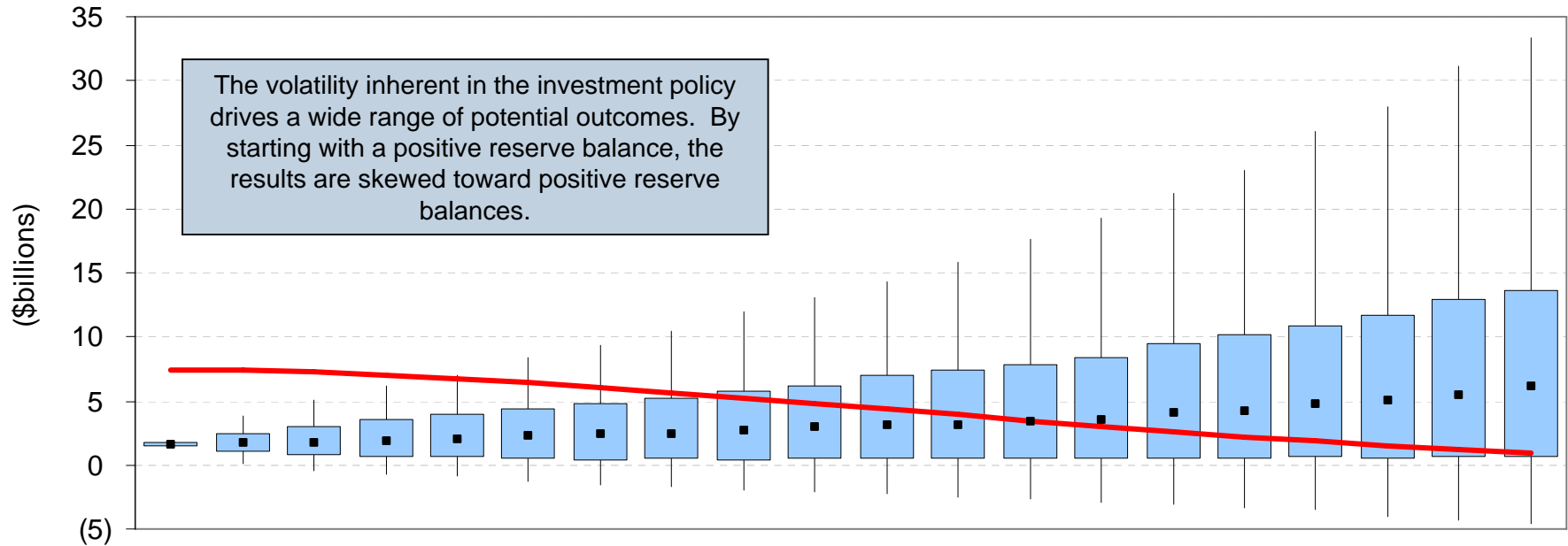
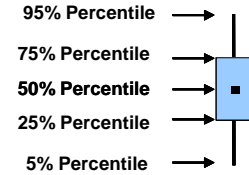


Valuation at 12/31:	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Baseline	7.4	7.4	7.3	7.1	6.8	6.4	6.0	5.6	5.2	4.8	4.4	3.9	3.5	3.0	2.6	2.2	1.9	1.5	1.3	1.0

Baseline Results

Value of Tier 1 Rate Guarantee Reserve

Rate Guarantee Reserve



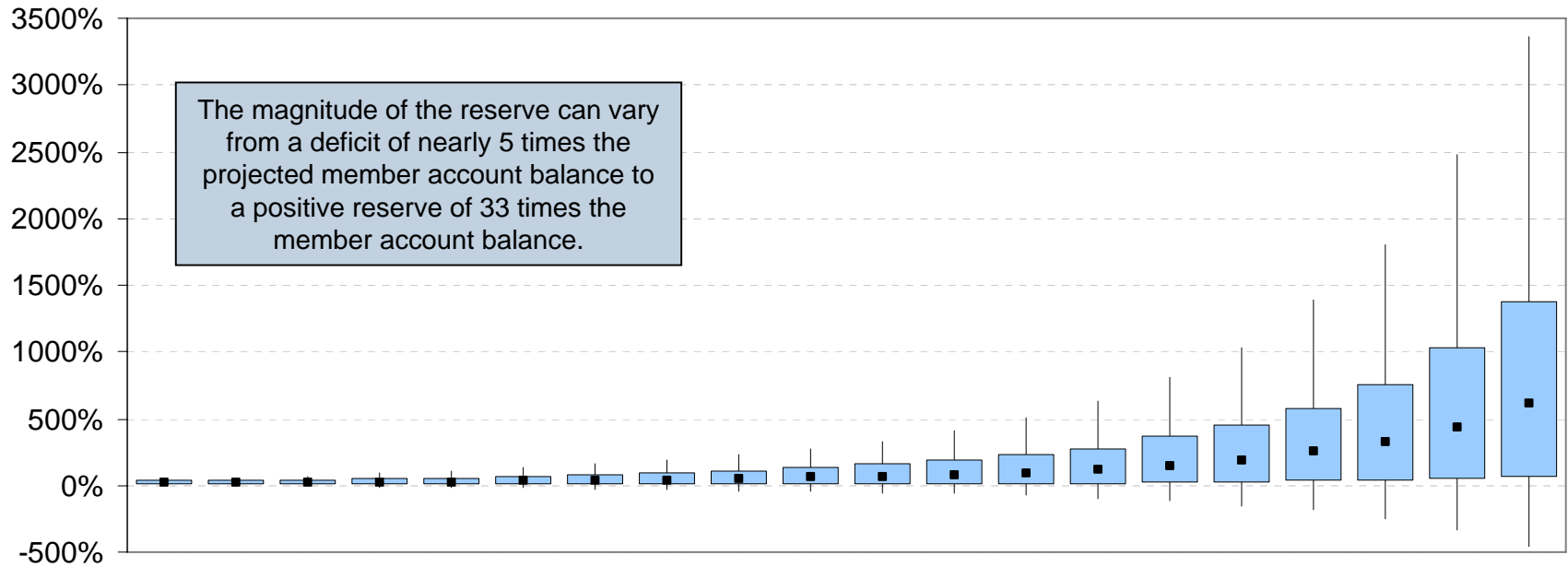
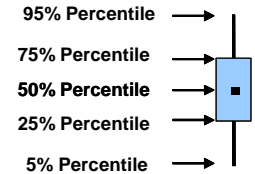
Valuation at 12/31:	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
95th V. Good	1.7	3.8	5.1	6.2	7.1	8.3	9.3	10.5	12.0	13.1	14.4	15.8	17.6	19.3	21.3	23.1	26.1	27.9	31.1	33.3
75th Good	1.7	2.4	3.0	3.6	3.9	4.3	4.9	5.2	5.8	6.2	7.0	7.4	7.9	8.4	9.6	10.1	10.9	11.6	12.9	13.6
50th Median	1.7	1.7	1.8	1.9	2.1	2.3	2.4	2.5	2.7	3.0	3.1	3.2	3.4	3.6	4.1	4.3	4.7	5.1	5.5	6.1
25th Bad	1.7	1.1	0.8	0.7	0.6	0.5	0.4	0.5	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.7	0.7
5th V. Bad	1.7	0.1	(0.4)	(0.8)	(0.9)	(1.2)	(1.6)	(1.7)	(2.0)	(2.1)	(2.3)	(2.5)	(2.6)	(2.9)	(3.1)	(3.3)	(3.5)	(4.0)	(4.3)	(4.6)
Member A/c	7.4	7.4	7.3	7.1	6.8	6.4	6.0	5.6	5.2	4.8	4.4	3.9	3.5	3.0	2.6	2.2	1.9	1.5	1.3	1.0



Baseline Results

Tier 1 Rate Guarantee Reserve as a Percentage of Member Accounts

Rate Guarantee Reserve as a % of Member Accounts



Valuation at 12/31:	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
95th V. Good	22%	51%	70%	87%	104%	130%	155%	186%	230%	273%	330%	405%	507%	636%	809%	1035%	1393%	1810%	2482%	3357%
75th Good	22%	33%	40%	51%	58%	68%	81%	93%	111%	129%	161%	191%	227%	278%	364%	454%	583%	753%	1026%	1371%
50th Median	22%	23%	25%	27%	31%	36%	40%	44%	51%	62%	72%	81%	97%	119%	155%	193%	253%	327%	442%	619%
25th Bad	22%	14%	12%	10%	9%	8%	7%	8%	9%	10%	11%	12%	14%	17%	19%	24%	33%	37%	53%	70%
5th V. Bad	22%	2%	-6%	-11%	-14%	-19%	-27%	-31%	-38%	-43%	-52%	-63%	-76%	-94%	-117%	-150%	-189%	-257%	-339%	-463%



Baseline Results Preliminary Observations

- The Tier 1 Rate Guarantee Reserve creates leverage on the earnings available for crediting to Tier 1 Member Accounts
 - A positive reserve balance means that less than 8% actual earnings is required in order to credit member accounts with 8% without using reserves
 - A negative reserve balance means that more than 8% actual earnings is required in order to credit member accounts with 8% without using reserves
- Because the initial reserve balance is positive, projected results are skewed toward positive outcomes

	Positive Reserve	Negative Reserve
Tier 1 Member Accounts	\$8.00	\$8.00
Rate Guarantee Reserve	\$2.00	(\$2.00)
Invested Assets	\$10.00	\$6.00
Earnings Needed (8% of Member Accounts)	\$0.64	\$0.64
Rate of Return Required	6.4%	10.7%

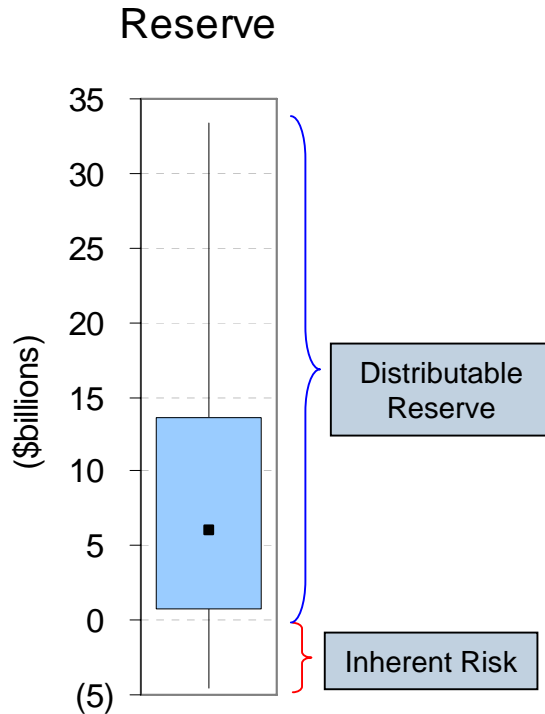
Please note that the illustration assumes a closed system for earnings related to Tier 1 Member Accounts and the Rate Guarantee Reserve



Baseline Results Preliminary Observations

- Initial investment returns have a dramatic impact on projected results.
 - It is difficult to make up for poor initial returns on the declining member account balances as members retire.
 - Good initial investment returns create a significant cushion against future poor investment experience for the declining member accounts

Policy Objectives



	2025
95% Percentile	33.31
75% Percentile	13.60
50% Percentile	6.14
25% Percentile	0.69
5% Percentile	(4.59)

- The objective of this study is to develop policy alternatives for the Board to consider that:
 - Reduce the potential distributable reserve at the end of the 20-year projection period
 - Do not increase the cost of potential negative outcomes
 - Comply with the existing statutory framework
- Current negative outcomes are considered an inherent risk because they exist even if the Board never distributes any amount in excess of the assumed earnings



Development of Policy Alternatives

- Consider three different definitions of a “fully funded” threshold for the Tier 1 Rate Guarantee Reserve
 - 90% probability of non-negative reserve at 12/31/2025 (*“90% Threshold”*)
 - 95% probability of non-negative reserve at 12/31/2025 (*“95% Threshold”*)
 - 99% probability of non-negative reserve at 12/31/2025 (*“99% Threshold”*)
- These probabilities are calculated assuming the Board always credits the assumed rate.
- Applying these thresholds will increase the probability of a negative reserve when compared to the baseline policy.
- The “fully funded” threshold is defined in terms of a percentage of total member accounts.

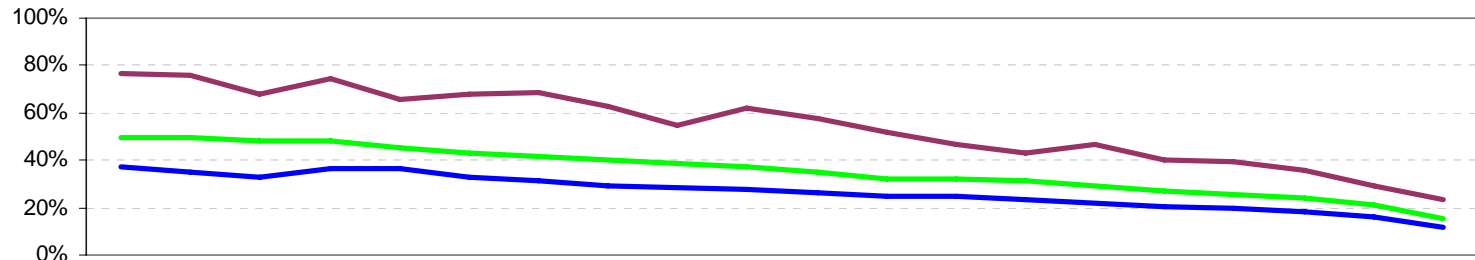


Development of Policy Alternatives

- These thresholds represent potential Board policies of varying degrees of conservatism.
- Once the threshold is defined, it is used to model outcomes under 1000 different trials of 20 years in length.
- In all projections, when the reserve has been “fully funded” for three consecutive years, amounts in the reserve are credited to the Tier 1 Member Accounts until the reserve equals the “fully funded” threshold. Please note that this policy is for the purposes of this model, and is not intended to imply that the Board would be required to credit this amount.
- The effectiveness and desirability of the threshold should be evaluated based on the outcomes from the model, not the probability used to define the threshold.

Development of Policy Alternatives “Fully Funded” Thresholds

Fully Funded Threshold - Reserve as a % of Member Accounts



Valuation at 12/31:	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
90% Threshold	37%	35%	33%	36%	36%	33%	31%	29%	28%	28%	26%	25%	25%	23%	22%	20%	20%	18%	16%	11%
95% Threshold	49%	50%	48%	48%	45%	43%	42%	40%	39%	37%	35%	32%	32%	32%	29%	27%	25%	24%	21%	16%
99% Threshold	77%	76%	68%	74%	66%	68%	69%	62%	55%	62%	58%	52%	47%	43%	47%	40%	39%	36%	30%	23%

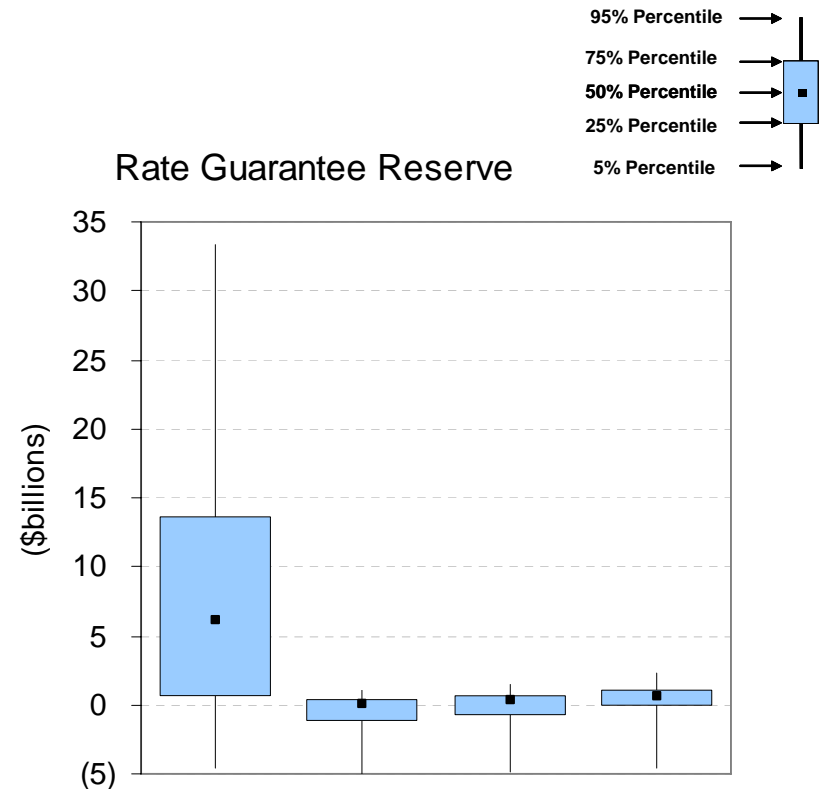
- Based on the Baseline Projection, the “fully funded” thresholds as a percentage of Tier 1 Member Accounts are shown above.
- “Fully Funded” thresholds decrease over time as there are fewer potential years of losses.
- The current reserve is approximately 22% of Tier 1 Member Accounts.
- The lack of smoothness in the calculated thresholds is due to the randomness of the trials and the measurements based on the tail of the distribution.

Alternative Policy Results

Distribution of Rate Guarantee Reserve at 12/31/2025



- The three policies (other than Baseline) clearly distribute a significant portion of the Rate Guarantee Reserve before 2025.
- However, this does lead to a small increase in the expected cost (negative reserve).
- As the threshold becomes more conservative (moving from 90% to 95% to 99%) we can see slightly more positive reserve remaining with less potential cost.
- Under all of the policy alternatives, most of the additional negative outcomes are small.



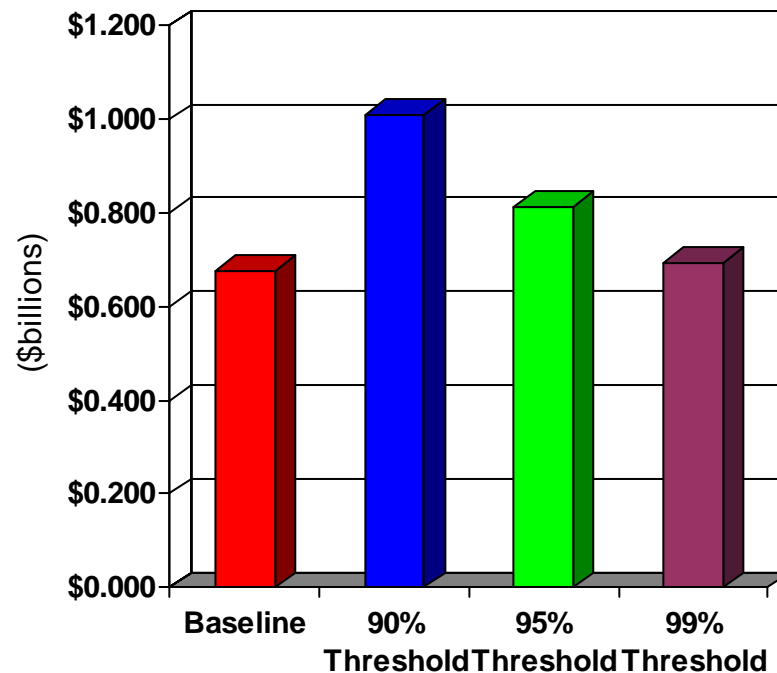
Valuation at 12/31:	2025	2025	2025	2025
Scenario:	Baseline	90%	95%	99%
Probability of < 0	22.2%	46.7%	36.3%	24.9%
95th V. Good	33.3	1.0	1.5	2.3
75th Good	13.6	0.4	0.6	1.1
50th Median	6.1	0.1	0.3	0.6
25th Bad	0.7	(1.2)	(0.7)	0.0
5th V. Bad	(4.6)	(5.3)	(4.9)	(4.6)

Alternative Policy Results

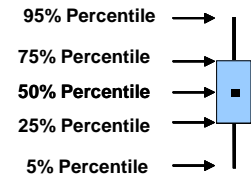
Cost of Negative Reserve

- The objective of the policies is to minimize any positive remaining reserve without increasing the cost of any negative reserve.
- The chart shows the average cost of each of the policy alternatives compared to the baseline.
- The average cost is calculated at the end of the projection period treating any positive reserve balance as \$0 and any negative reserve balance as a cost.

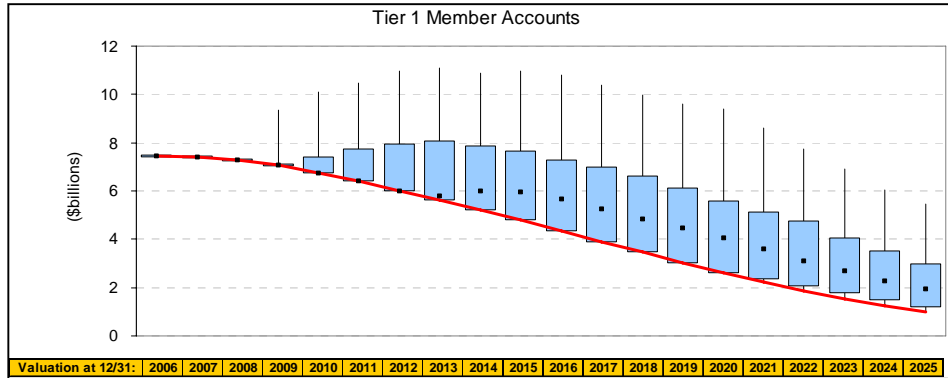
Average Cost for Negative Reserves



Alternative Policy Results Projection of Tier 1 Member Accounts (— represents Baseline)



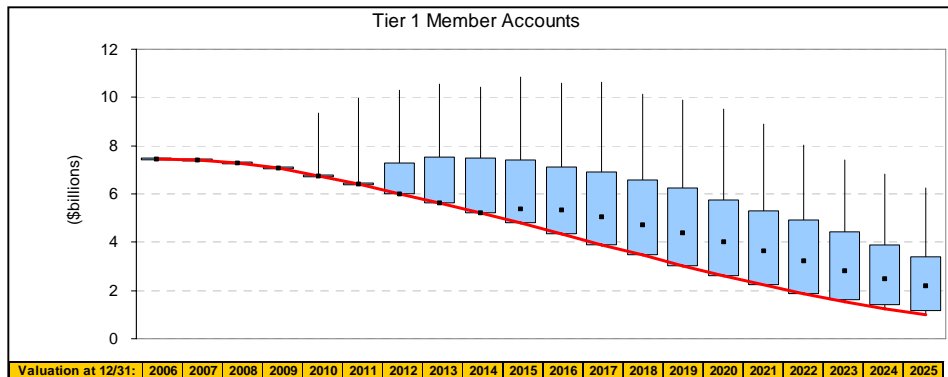
90% Threshold



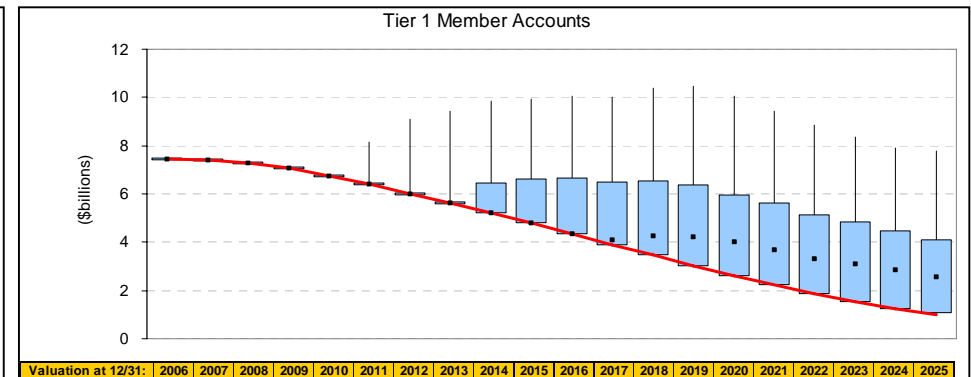
Any distribution policy will provide Member Accounts at least as large as the Baseline policy and potentially much larger.

The more conservative 99% threshold policy will pay out positive reserves more slowly, leading to larger Member Accounts at 2025 because members who have already retired by that point would have received less than under a less conservative policy.

95% Threshold



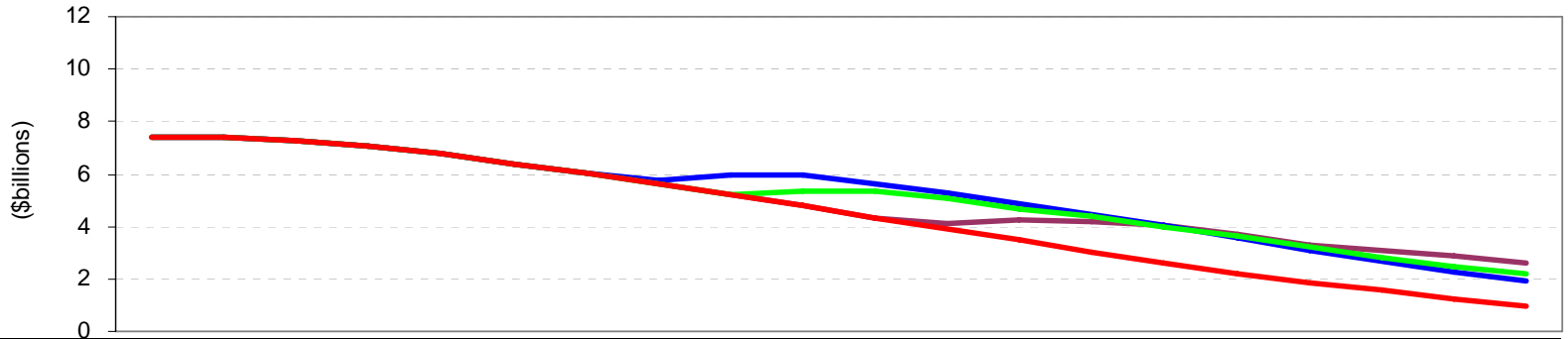
99% Threshold



Alternative Policy Results

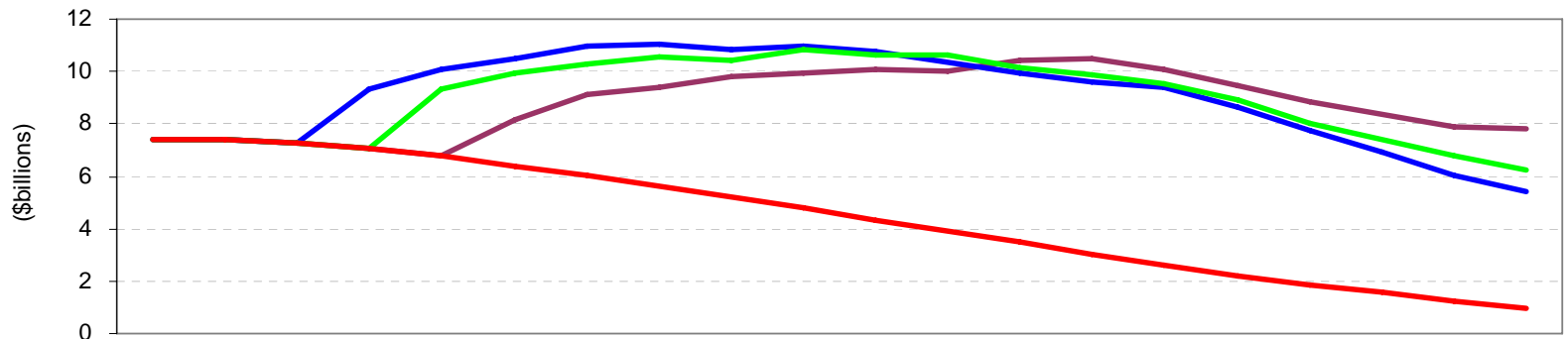
Projection of Tier 1 Member Accounts

Tier 1 Member Accounts - Median outcome



Valuation at 12/31:	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Baseline	7.4	7.4	7.3	7.1	6.8	6.4	6.0	5.6	5.2	4.8	4.4	3.9	3.5	3.0	2.6	2.2	1.9	1.5	1.3	1.0
90% Threshold	7.4	7.4	7.3	7.1	6.8	6.4	6.0	5.8	6.0	6.0	5.7	5.3	4.8	4.5	4.1	3.6	3.1	2.7	2.3	1.9
95% Threshold	7.4	7.4	7.3	7.1	6.8	6.4	6.0	5.6	5.2	5.4	5.4	5.0	4.7	4.4	4.0	3.6	3.2	2.8	2.5	2.2
99% Threshold	7.4	7.4	7.3	7.1	6.8	6.4	6.0	5.6	5.2	4.8	4.4	4.1	4.3	4.2	4.0	3.7	3.3	3.1	2.9	2.6

Tier 1 Member Accounts - 95th Percentile



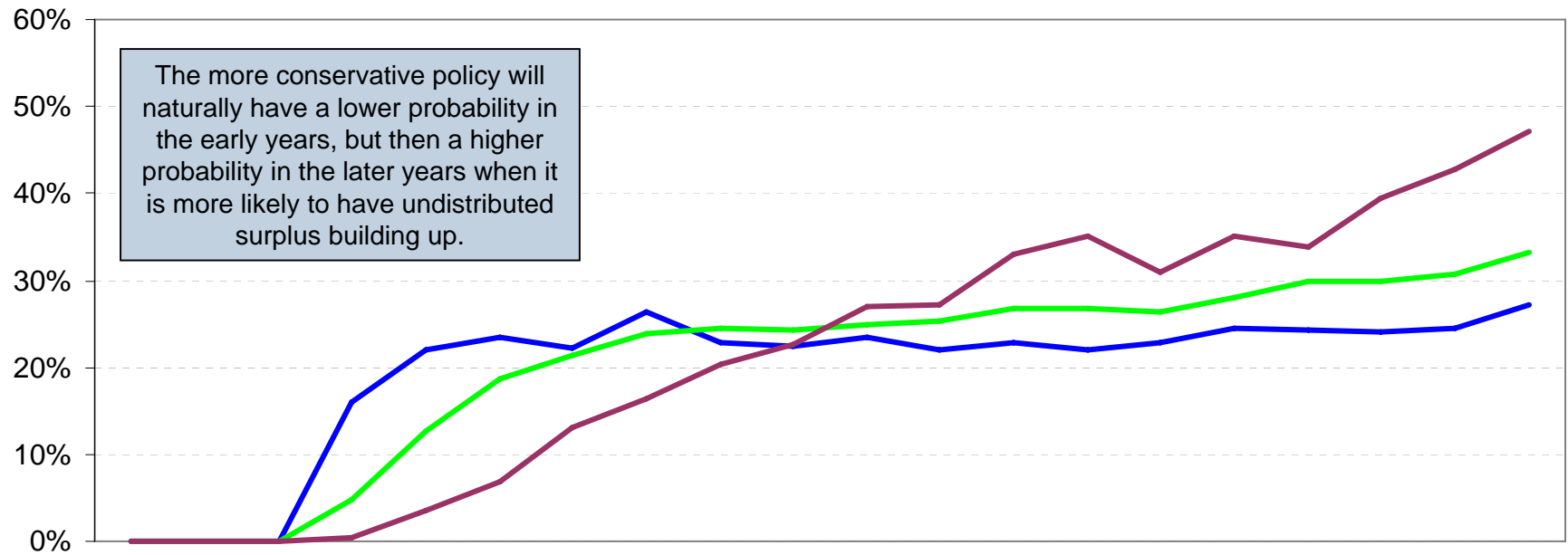
Valuation at 12/31:	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Baseline	7.4	7.4	7.3	7.1	6.8	6.4	6.0	5.6	5.2	4.8	4.4	3.9	3.5	3.0	2.6	2.2	1.9	1.5	1.3	1.0
90% Threshold	7.4	7.4	7.3	9.3	10.1	10.5	11.0	11.1	10.9	11.0	10.8	10.4	10.0	9.6	9.4	8.6	7.7	6.9	6.1	5.4
95% Threshold	7.4	7.4	7.3	7.1	9.3	10.0	10.3	10.6	10.4	10.8	10.6	10.6	10.2	9.9	9.5	8.9	8.0	7.4	6.8	6.2
99% Threshold	7.4	7.4	7.3	7.1	6.8	8.2	9.1	9.4	9.8	9.9	10.1	10.0	10.4	10.5	10.1	9.4	8.9	8.4	7.9	7.8

The variation between different approaches is widest for the best outcomes, because there are more excess earnings to distribute.

Alternative Policy Results

Probability of "Fully Funded" Reserve

Probability of "Fully Funded" Reserve for Three Consecutive Years



Valuation at 12/31:	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
90% Threshold (Blue line)	0%	0%	0%	16%	22%	23%	22%	26%	23%	22%	24%	22%	23%	22%	23%	24%	24%	24%	25%	27%
95% Threshold (Green line)	0%	0%	0%	5%	13%	19%	21%	24%	24%	24%	25%	25%	27%	27%	26%	28%	30%	30%	31%	33%
99% Threshold (Purple line)	0%	0%	0%	0%	4%	7%	13%	16%	20%	23%	27%	27%	33%	35%	31%	35%	34%	39%	43%	47%



Limitations of the Analysis

Sensitivity Issues

Retirement Rates

- The results of this analysis are dependent on the assumed pattern of retirement. Any event that accelerates or suppresses retirement rates will change the results of this analysis.

Investment Policy

- The amount required for the reserve to be “fully funded” depends on the volatility of expected investment returns. A more aggressive investment policy would require a larger reserve. A more conservative investment policy would allow PERS to hold a smaller reserve.

Timing of Investment Returns

- Because aggregate Tier 1 Member Accounts are expected to decline as Tier 1 members retire, investment returns in the next several years are very important in determining the likelihood of a negative reserve.



Limitations of the Analysis

Other Questions

Remaining Positive Reserve

- It is not clear what happens in the event there is a positive reserve when the last Tier 1 member retires. Depending on the potential uses of a remaining reserve, it may make sense for the Board to become less conservative with the reserve in later years.

Persistent Negative Reserve

- It is not clear when additional funds would be required due to a persistent negative reserve. In some of the worst outcomes a negative reserve persists for much of the projection period.



Comments and Recommendations

- The Tier 1 Rate Guarantee Reserve is not currently “Fully Funded” under any of the alternative policy thresholds. There is currently about a 22% chance of a negative reserve in 20 years.
- The first several years of investment returns will have a disproportionate impact on the projected reserve balance.
- When the reserve approaches the appropriate threshold, we recommend that this analysis be repeated before declaring the reserve to be “Fully Funded.”



Comments and Recommendations

- The Board may want to move from a more conservative policy to a less conservative policy as the dollars at risk due to the 8 percent guarantee decline.
- To better control outcomes, the Board may want to request that the OIC consider a different investment policy for the rate guarantee reserve.
- The Board may want to consider analysis and recommendation of structural changes to the long-term operation of the reserve.



Appendix

- Certification
- Methods and Assumptions
- Actual Investment Returns Produced by Model





Appendix Certification

The information in this report is based on the actuarial valuation report as of December 31, 2005. It reflects the member and financial data provided by Oregon PERS and the actuarial assumptions and methods described in the actuarial valuation report, except as noted in the appendix. Actual experience could differ from these assumptions and may produce results that differ materially and significantly from this report.

The liabilities, costs and other information included in this report were determined in accordance with generally accepted actuarial principles and procedures.

We are available to answer any questions on the material contained in the report, or to provide explanations or further details as may be appropriate.

	3/27/2007		3/27/2007
William R. Hallmark, ASA, MAAA Enrolled Actuary No. 05-5656	Date	David A. Kelly, FIA, FSA, MAAA, CFA Enrolled Actuary No. 05-6961	Date
Mercer Human Resource Consulting 111 SW Columbia Street, Suite 500 Portland, OR 97201-5839 503 273 5900			

Appendix Capital Market Assumptions

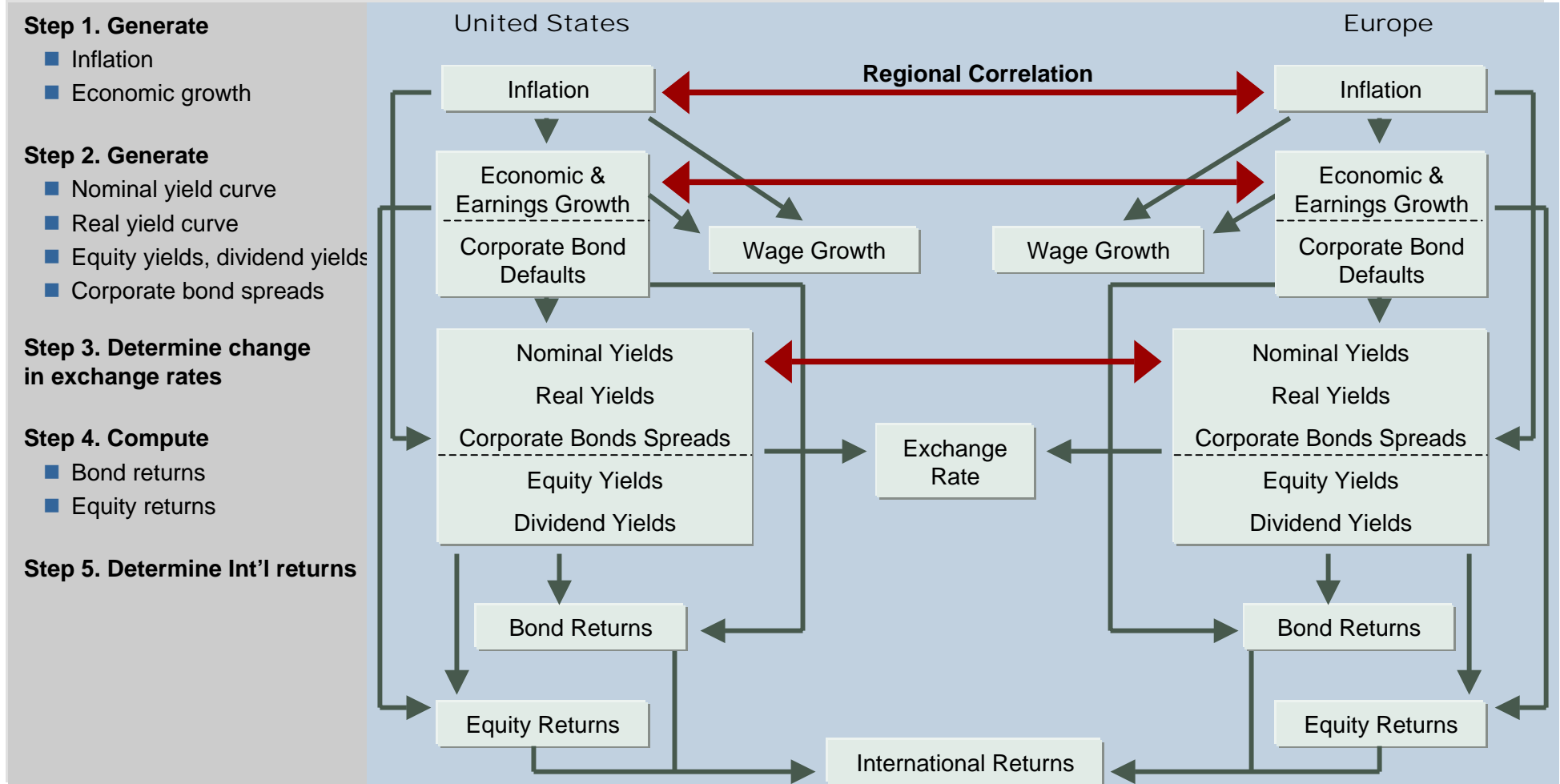
Our model of the capital markets is an economic model, not a pure mean/variance model. We first generate inflation and economic growth, and then generate several sets of yields: real, nominal, corporate default spreads, equity, and dividend yields. With the changes in yields, we can compute exact bond returns. Similarly, with equity we can use earnings growth, dividend yields, and changes in P/E levels to compute exact equity returns.

Thus, we will set the parameters of the model to reflect current conditions and the mean/variance characteristics.

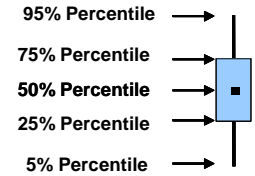
Asset Class	Expected Geometric Return	Standard Deviation
Domestic Equity	8.2%	18.6%
International Equity (ex-US)	8.4%	19.6%
Global Equity	8.4%	18.4%
Private Equity	9.4%	28.4%
Real Estate	7.1%	13.7%
Fixed Income (Lehmann Agg.)	5.1%	6.0%
Inflation	2.5%	1.8%

Correlations	DE	IE	GE	PE	RE	FI
Domestic Equity	1.00					
International Equity (ex-US)	0.65	1.00				
Global Equity	0.80	0.80	1.00			
Private Equity	0.70	0.30	0.65	1.00		
Real Estate	0.50	0.25	0.45	0.50	1.00	
Fixed Income (Lehmann Agg.)	0.30	0.15	0.25	0.20	0.25	1.00

Appendix Model to Simulate Investment Returns

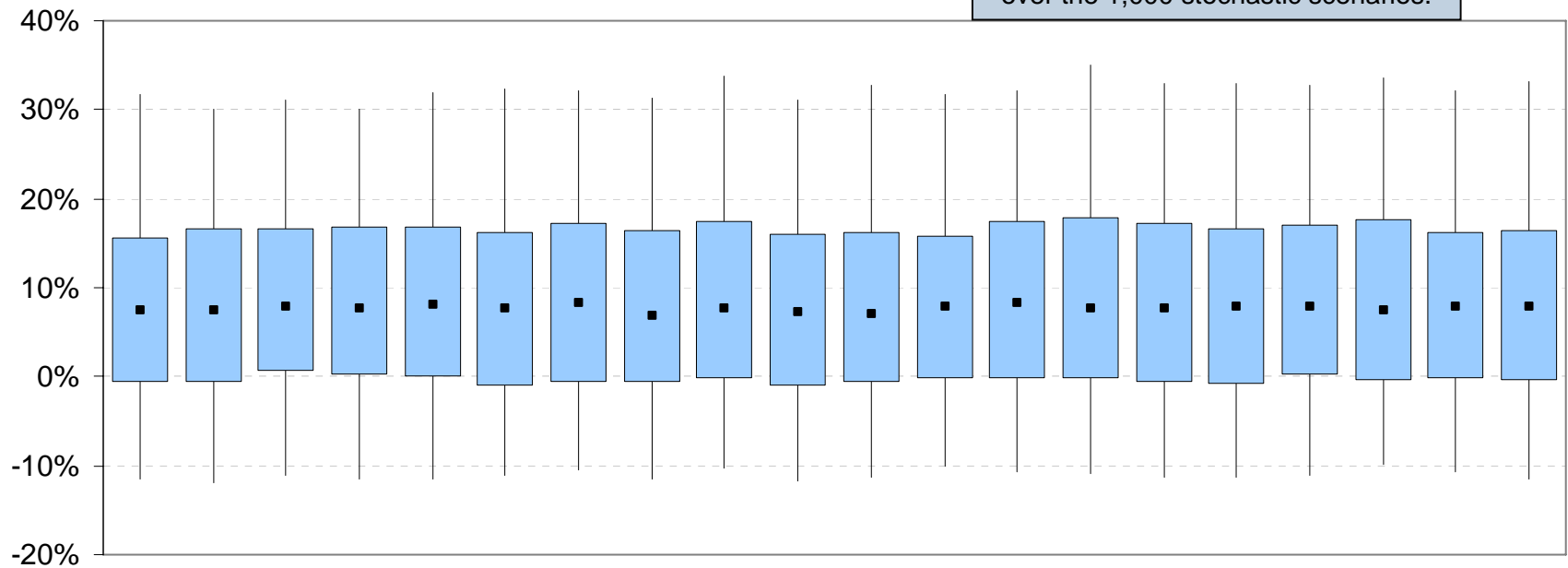


Appendix Simulated Investment Returns from the Model in Each Future Year*



Investment Returns

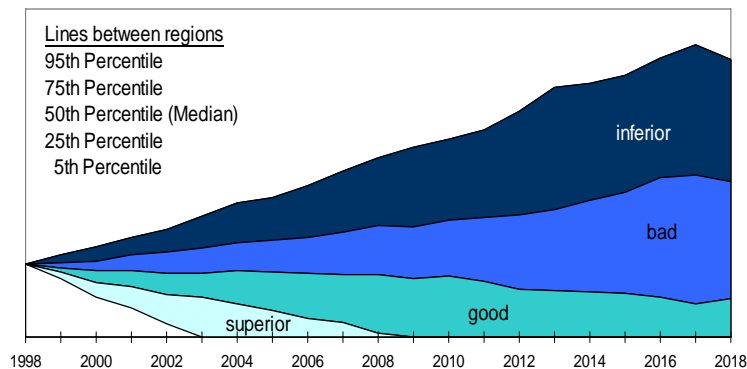
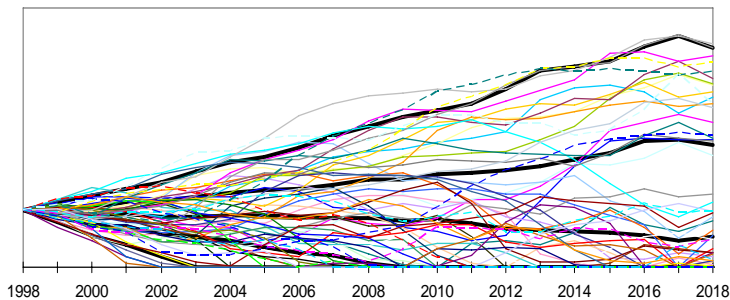
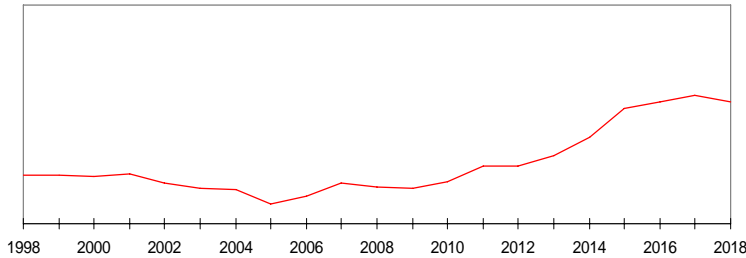
The geometric average return is 8% over the 1,000 stochastic scenarios.



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
95th V. Good	32%	30%	31%	30%	32%	32%	32%	31%	34%	31%	33%	32%	32%	35%	33%	33%	33%	34%	32%	33%
75th Good	16%	17%	17%	17%	17%	16%	17%	16%	17%	16%	16%	16%	17%	18%	17%	17%	17%	18%	16%	16%
50th Median	7%	8%	8%	8%	8%	8%	8%	7%	8%	7%	7%	8%	8%	8%	8%	8%	8%	8%	8%	8%
25th Bad	-1%	-1%	1%	0%	0%	-1%	0%	-1%	0%	-1%	-1%	0%	0%	0%	-1%	-1%	0%	0%	0%	0%
5th V. Bad	-11%	-12%	-11%	-11%	-11%	-11%	-10%	-11%	-10%	-12%	-11%	-10%	-11%	-11%	-11%	-11%	-11%	-10%	-11%	-12%

This does not imply that there is a 5% probability of assets earning more than 30% annually for twenty years, rather it implies that in any given year there is a 5% probability of asset returns exceeding 30%.

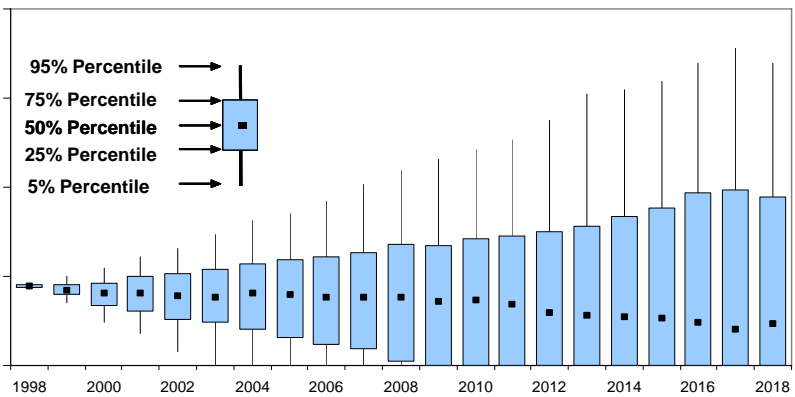
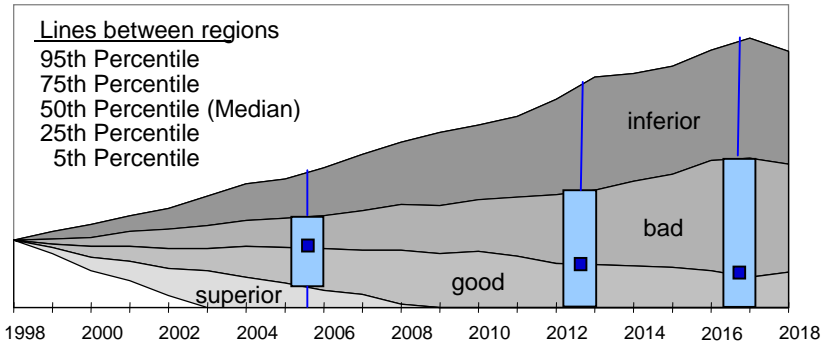
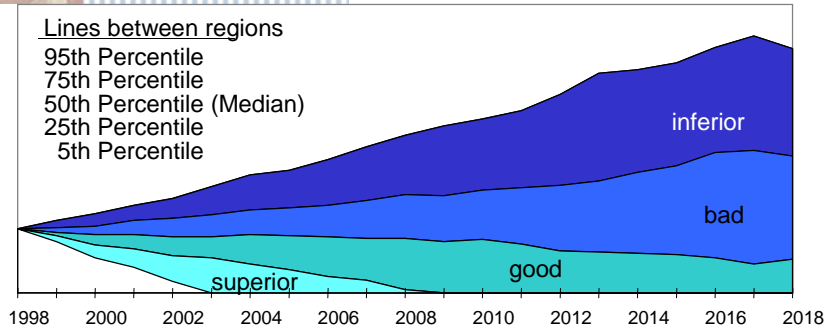
Appendix Simulation Framework



- Results are calculated for one path of the stochastic model
- This is repeated 1000 times
- Each year is percentiled
- The percentiles group each years' results into regions
- The good and bad regions represent 25% variance from median results, or together what would be expected half of the time
- The superior and inferior regions add another 20% of upside and downside variance
- All the regions combined show 90% of simulated results

Appendix

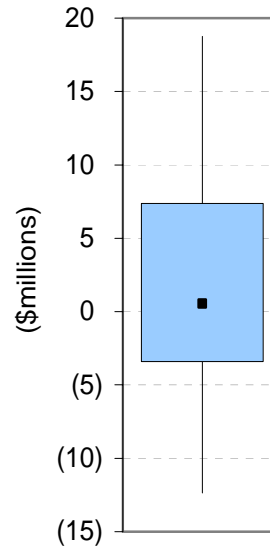
Presenting Stochastic Percentiles



- The line chart is potentially misleading because it might appear that the 75th percentile (say) is generated by the same simulated path over time.
- In fact, any given simulated path could vary between regions over time
- In any year, we can represent the key percentile values with “candlesticks”, which remove the implied connection between percentiles over time.

Appendix Explanation of Simulation Graphs

Each forecast comprises 1,000 independent economic scenarios. The box represents the more likely scenarios which are between the 25th and 75th percentile. The top and bottom “antenna” reflects the next 20% of the results. The dot represents the median result.

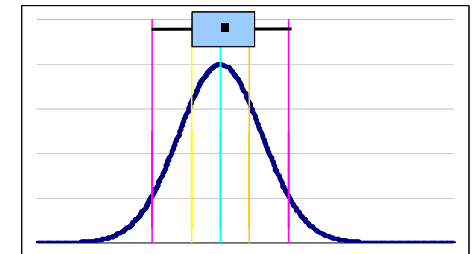


5% Percentile →
25% Percentile →
50% Percentile →
75% Percentile →
95% Percentile →

The “candlestick” represents a distribution of outcomes through selected percentile points.

The 5th Percentile represents the worst case (very bad results), while the 95th Percentile represents the best case (very good results).

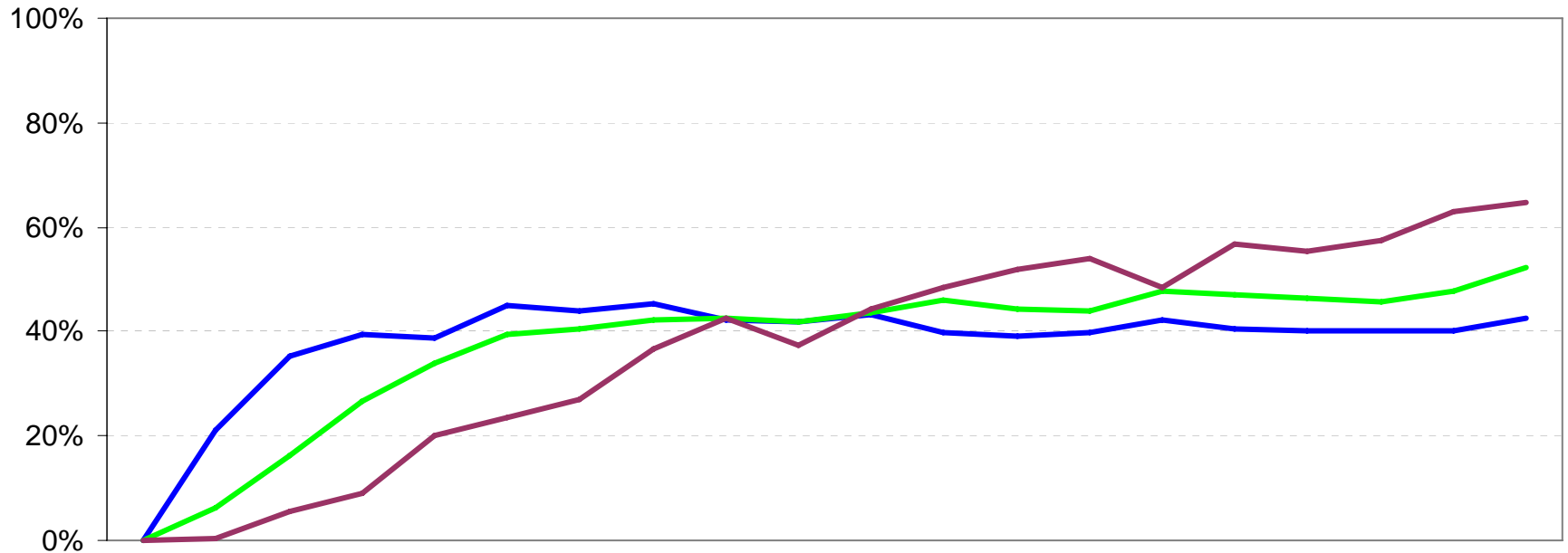
	2010
5th V. Bad	18.8
25th Bad	7.4
50th Median	0.5
75th Good	(3.4)
95th V. Good	(12.4)



Appendix

Probability of "Fully Funded" Reserve

Probability of "Fully Funded" Reserve In Each Year



Valuation at 12/31:	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
90% Threshold —	0%	21%	35%	39%	39%	45%	44%	45%	42%	42%	43%	40%	39%	40%	42%	41%	40%	40%	40%	42%
95% Threshold —	0%	6%	16%	27%	34%	39%	40%	42%	43%	42%	44%	46%	44%	44%	48%	47%	46%	46%	48%	52%
99% Threshold —	0%	0%	5%	9%	20%	24%	27%	37%	43%	37%	44%	48%	52%	54%	49%	57%	55%	58%	63%	65%

In compliance with the Americans with Disabilities Act, PERS will provide this document in an alternate format upon request. To request this, contact PERS at 888-320-7377 or TTY 503-603-7766.