

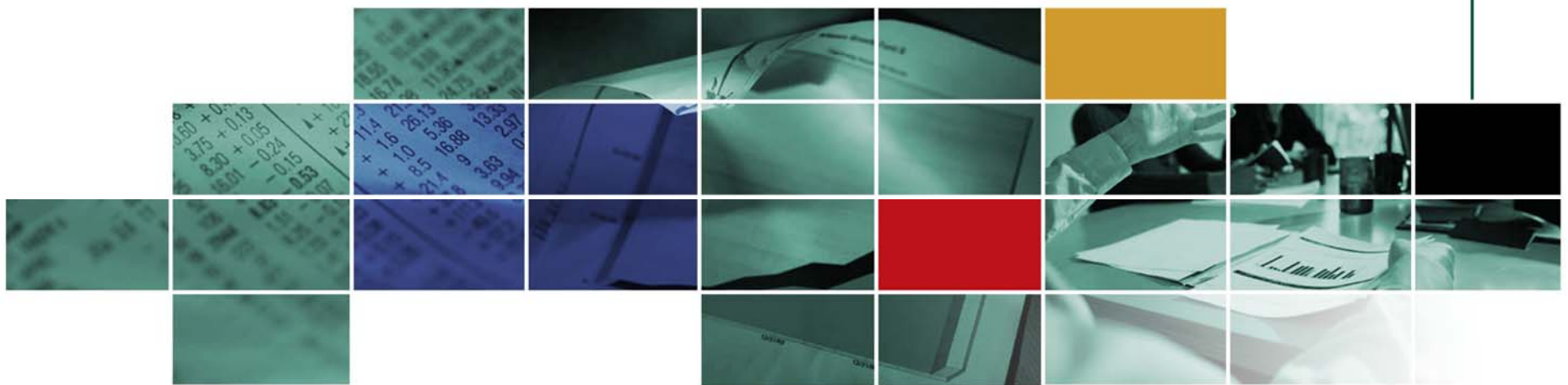
RVKuhns

▶▶▶ & ASSOCIATES, INC.

Michigan State Employees Retirement System

Asset Liability Study

November 2009



Executive Summary

Asset Liability Study of the Michigan State Employees Retirement System

November 30, 2009

Overview:

The Bureau of Investments for the State of Michigan tasked R.V. Kuhns & Associates (RVK) with conducting Asset Liability Studies of the four largest retirement plans whose assets the Bureau is charged with investing. This report covering the Michigan State Employees Retirement System (MSERS) is the third in that series. As the study notes, this work was greatly aided by cooperation from MSERS actuary (Gabriel Roeder Smith & Company) as well as RVK's consulting actuaries (Standard Retirement Services).

Purpose:

The central purpose of an A/L study is to examine the likely future consequences of applying a series of different investment strategies to the assets invested to meet the liabilities created by the benefit provisions in the MSERS plan. In this study, we examined a series of related questions associated with this central purpose, projecting future outcomes both on a deterministic (assumed drivers such as investment return adhere precisely without any variance to forecast each and every year) and stochastic (outcomes vary each year according to estimated volatility for these parameters) basis.

Key Findings—Status and Deterministic:

In this section of the executive summary, we will address the general findings of the study. In the section that immediately follows, we will address some issues specific to MSERS as a closed DB plan and implications for future investment strategies used to fund its liabilities.

Among our key findings from this study related to plan status and the outlook on a determinist basis are:

- The MSERS plan MVA (Market Value of Assets) based funding ratio has deteriorated sharply. The precise estimation of the plan's funding status is the purview of the system's actuary and is determined through a comprehensive valuation taking into account factors beyond the value of assets alone. However, the decline in asset values across the capital markets over the past year has suggested its funding ratio fell to approximately 63% as of 9/30/2009 versus 72% on the same basis one year earlier.
- The MSERS plan is a closed plan whose active members are exceeded by retired members and the ratio of active members to retired members will continue to fall

for the life of the plan. This is an important factor when considering the findings on plan risk/return options and the projected status of plan liquidity below. (page 8)

- *It is not too early* to recognize that given the actuary's current demographic and benefit projections, a higher state of plan "maturity" lies ahead post 2020, with higher levels of annual benefit obligations and a shrinking ratio of active to retired participants. (page 10) This steady and inevitable move toward increasing plan maturity will have a material effect on the investment strategies most appropriate over this period.
- Using deterministic methods, contributions rates are forecasted to rise notably from now to 2020 and stay at that elevated level through 2028. Precise actuarially required rates are the purview of the plan's actuary and are affected by factors beyond just investment returns and resulting asset values for the fund. However, again it seems likely that given the declines in the capital markets, this projection of contribution rate increases may be conservative. An illustration of why we believe that is a likely outcome is that using the deterministic assumptions and the 9/30/2009 asset values for the fund, the MVA of MSERS closes the gap with the actuary's estimate of the System's liabilities through 2028, but the plan is still projected to remain less than 80% funded by 2028. (pages 11 and 15)
- Again, using the deterministic approach, the MSERS MVA-AAL deficit in absolute terms will likely remain at high levels (approximately \$2 to \$4 billion) through 2028 absent changes in contributions or returns above the deterministically forecast 8% annual gain. However, this outcome should not be interpreted as a complete stagnation of progress in the system's ability to meet benefits since, while this projection shows the absolute level of the deficit remaining high, the deficit *as a percentage of plan liabilities* declines notably over this period leading to some improvement in the system's MVA funding ratio over that period. (pages 13 and 14)

Key Findings—Stochastic Approach and Strategic Options:

The deterministic approach is useful for gauging general direction of change and associated consequences, but adding the element of uncertainty—more specifically year to year variability in the performance of the capital markets and the value of the funds assets over time is far more realistic and can offer greater insights.

At the heart of the MSERS situation is a simple question that is difficult to answer: whether the plan, currently well below full funding levels on an MVA basis, is better off following a strategy that:

- (A) falls in the general category of higher prospective return with greater risk (i.e. potential for more widely varying outcomes), or

- (B) falls in the general category of lower prospective return with concomitantly lower risk (i.e. a tighter band of likely outcomes).

Part of this question is precisely how the Bureau of Investments and the plan's broader constituencies define what "better off" means.

In this analysis, we have created five different investment approaches (page 21) and stochastically projected their expected performance—both the most likely (median) outcome as well as the worst and best expected cases (the "tails" or extremes that might occur). These are the "strategies" we are testing against the MSERS liabilities. The metrics we use for each to determine whether the plan is "better off" under one approach versus another are twofold:

- (1) The effect on funding ratio (and thus on contribution rates which decline with higher funding ratios and vice versa).
- (2) The effect on plan liquidity (i.e. the fund's ability to pay annual benefits without major disruption of its strategic asset allocation—its investment strategy).

The results of this analysis are displayed on pages 22 through 31 of this report. But for purposes of this summary, the consequences of choosing A versus B as described above are summarized most clearly on page 32 where the current target allocation is compared to four other portfolios.

The base results using our standard assumptions are then "stress tested" using two alternative sets of assumptions. The purpose of this additional analysis is to test how the outcomes discussed above might change if the investment markets are subjected to extreme stress, beyond most historical norms. The first assumes standard deviations double from the original assumptions, exploring the potential effect of a riskier, far more volatile capital market environment. The second assumes correlations among each asset class are equal to 1, highlighting the potential effect of converging capital market correlations—i.e., where all investments behave in lockstep, particularly in decline.

The results of these sensitivity analyses can be seen in Appendix 1 (pages 34 through 45) and Appendix 2 (pages 46 through 57) of this report. While the range of potential results differs (widens) under these alternative assumption scenarios, the conclusions are consistent with the results of the base analysis.

Conclusions:

The table on page 32 leads us to the following conclusions stated in question and answer format.

What are the consequences of adopting a significantly more conservative investment approach that combines lower expected returns with reduced risk?

The deeply conservative approach (titled Portfolio 2) yields an exceedingly small expected improvement in the MSERS MVA funding level from its current level, with the ratio rising to only 75% by year 2028. This is a highly discouraging result if the goal is to reach or come reasonably close to full funding over a period of time this long. Discouraging not so much in the sense that if these expectations become reality the funding level will actually be this low in 2028, rather, the practical outcome would be that the funding level would be driven higher than this, *but only because actuarial valuations conducted throughout this period would likely call for higher contribution rates to amortize away the deficit – a deficit that persists because the deeply conservative approach is expected to produce returns too low to materially close the gap.* Hence the need for additional increases in contribution rates as a result. We suggest that this is a material difference and one that indicates this approach is significantly less desirable presuming that MSERS does not want to materially shift the burden of financing the plan from investment returns toward contributions.

The comments above address the “better off” metric of the funding ratio. What about metric number two, fund liquidity? Here the deeply conservative approach is less attractive than either the current asset allocation strategy or the highly diversified, higher return approach. As the table on page 32 shows, the median payout ratio (what percentage of the fund must be used each year to pay that year’s benefits) is higher for the deeply conservative approach. We would suggest, though, that these differences are notable, but not so large that when considered alone it would render the highly conservative approach undesirable, merely less desirable.

What are the consequences of adopting a highly diversified approach with higher expected returns and an associated increase in risk after mitigation via diversification?

The diversified, higher return approach (titled Portfolio 9) offers the best chance of creating investment returns through 2028 that are far less likely to require additional increases in contribution rates. As noted in the table on page 32, the expected MVA funding ratio in 2028 is 89%, similar but slightly higher than the level expected from the current asset allocation strategy which itself is a partially diversified variant. Both, however, are meaningfully different than the deeply conservative approach; see page 21 for a table showing the different asset class allocations involved. We suggest this is a material difference in favor of the diversified, higher return approach and argues for a sustained effort over the next several years to incrementally complete the diversification that is already significantly embedded in the current asset allocation in the fund.

Looking at fund liquidity, the diversified, higher return approach has slightly better projected outcomes with peak payout ratios moderately lower than for the deeply conservative approach.

Are there any other reasons why the BOI might give serious consideration to the deeply conservative approach?

None that we find compelling. However, we would point out that the deeply conservative approach is expected to produce a more stable contribution level. This can be inferred from the table on page 32 which shows that the difference between the highest expected funding ratio versus the worst case ratio (95th percentile versus 5th percentile respectively) is much narrower for the conservative approach. This is inherently logical as the reduced expected volatility of that approach should lead to a narrower band of probable outcomes.

But what benefit this would be is questionable. The worst case funding ratio in 2028 for the deeply conservative approach hardly differs from that of the current approach or a more highly diversified, higher return approach. This means that the stability that might be gained is essentially greater stability in contribution rates that are likely to be much higher than current ones. The price that is paid to achieve such a modest benefit is a significant reduction in the potential for better funding ratio outcomes. This can be seen in the table on page 32 by noting the reduction of best case funding outcomes from extraordinarily high over-funded status in 2028 (translation—declining contribution rates over that period) to a best case outcome that exceeds full funding by a much more modest amount (see 95th percentile column on page 32).

Are there circumstances that would change the direction and overall magnitude of these conclusions?

Yes. None of the three circumstances mentioned below currently exist, yet a brief discussion of each, we believe, may be instructive.

First, the status of the plan and the expected outcomes under various scenarios would become worse should the liability stream increase—for example, via any change in plan structure that would raise benefits. The degree to which plan status and outlook would deteriorate is directly proportional to the increase in liabilities due to such benefit changes. We would characterize this as a change in magnitude.

Second, should the asset base of the MSERS fund be increased dramatically—for example, through the addition of funds raised via a pension obligation bond—to an extent that full or overfunded status was achieved on an MVA basis, we would reconsider the merits inherent in an approach similar to the deeply conservative, lower risk scenario presented in this study.

Third, our recommendations might change should, for any reason, contributions be reduced or held well below actuarially appropriate levels, meaning at levels insufficient to cover normal costs (the liabilities created by ongoing service of active employees) plus pay down (amortize) the current unfunded liability in a reasonable period of time (reasonable is open to debate but typically 20 to 30 years). In these circumstances, a sufficiently large and persistent gap between actuarially appropriate and actual contributions would make funding levels, but more critically plan liquidity as measured by payout levels, highly vulnerable to declines in plan assets due to capital market volatility. In such a situation, we might recommend the adoption of a far more

conservative investment strategy in order to preserve the solvency of the plan for as long a period as possible, allowing action to redress the contribution gap.

The Dynamics of a Closed DB Plan and the Increasing Financial Maturity of the MSERS Plan:

As a closed DB plan, MSERS will gradually over a period of years become increasingly mature. We say gradually, but in this context gradually means more rapidly than other chronologically old DB plans and dramatically so in its final 25 to 35 years of life—a period that might commence anywhere from 12 to 20 years from now depending on investment returns, any changes in the benefit structure and contribution levels. Analysis of the demographic foundation for this maturation is the purview of the MSERS actuary.

What does “maturity” mean for a DB and what are the implications for investment strategy? The foundation of plan maturation is, as noted above, the underlying demographics. As noted in the figure on page 8, the ratio of actives to retirees falls steadily and by the end of the forecast period in 2028, retirees outnumber actives 28 to 1. Obviously, retirees pull cash from the plan’s assets while active members provide cash (or at least the employer does) via contributions to cover their accruing pension benefits. Setting aside the contributed amounts needed to pay off the MSERS unfunded liability, this means a continuously widening gap between cash outflows versus inflows from these two sources. While plan assets are sizable, investment returns will help fill that gap, but gradually the negative cash flow will grow too large and return-producing assets will begin to shrink. Payout ratios will rise and continue to do so as the MSERS plan winds down.

The implication for investment policy and strategy is straightforward. As the plan matures and these financial changes proceed, an investment strategy characterized by the pursuit of high returns with associated high volatility will pose ever greater liquidity risks for the MSERS plan. A sharp decline in plan assets due to market declines late in the maturation cycle will leave little time for any increase in contributions to accumulate sufficient capital to restore investable assets to an actuarially appropriate level. This means under sufficiently unfavorable market conditions, the contribution increases, expressed as a rate of payroll for the continually shrinking active participant base, could conceivably be large. In short, as payout ratios rise, the plan’s investment strategy will likely need to pursue a progressively more conservative allocation that limits expected volatility.

Best practice for a plan like MSERS, we believe, would involve periodic assessment by the plan’s actuary of the rate of plan maturation and periodic A/L studies based on their findings. The objective would be to begin incrementally adjusting investment strategy to avoid the potential problems that asset volatility would pose and instead achieve a “soft landing” from a financial point of view. As we noted at the outset of the executive summary, it is still fairly early in the MSERS maturation cycle, but not too early to begin a discussion, with the objective of planning the necessary steps to achieve that soft landing.

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Introduction

R.V. Kuhns & Associates, Inc. has prepared this report for the Michigan State Employees Retirement System to:

- Present projected valuation results of the Retirement Plan with respect to the funded status of the Plan.
- Present projected benefit payments of the Plan.
- Investigate asset mixes to determine those which best serve to protect and increase funding levels, while providing adequate liquidity for benefit payments.

The valuation projections are shown using both a deterministic and stochastic process.

The deterministic process provides a closed group analysis of projected valuation results based on a fixed set of future assumptions (see summary in the Assumptions and Methods section of this report).

The stochastic process provides a closed group analysis of projected valuation results under many capital market environments based on expected asset returns and inflation, and their expected volatility. Using a Monte Carlo simulation technique, both assets and liabilities are assumed to vary stochastically, linked together by changes in inflation. Expected values, variances of the returns and inflation, and correlations are used to generate 2000 trials to produce a distribution of potential outcomes. A stochastic analysis can answer questions about the best/worst case outcomes along with the probability of such outcomes.

Introduction (continued)

What is an Asset/Liability Study?

- Investment programs do not exist in a vacuum. They seek to satisfy one or more investment objectives.
- The purpose of an Asset/Liability Study is to examine how well alternative investment strategies (i.e., differing asset allocations) address the objectives served by the fund – the fund “liabilities”.
- In doing so, it creates an important “guidepost” for the actual asset allocation for the fund; the asset allocation chosen by the fund’s fiduciaries will likely reflect the nature of the liabilities but also numerous other factors including risk preferences, liquidity, implementation constraints, etc.
- For the Michigan State Employees Retirement System Asset/Liability Study, we assume the objectives are:
 - Fund all participants’ benefits over time.
 - Assure sufficient liquidity to pay benefits at all times.
 - Foster a stable contribution stream consistent with objectives 1 and 2.
 - Achieve adequate returns without accepting unnecessary or imprudent levels of risk.

An Asset/Liability Study is NOT . . .

- An actuarial study of the Michigan State Employees Retirement System pension liabilities—that is the purview of the Fund’s actuary.
- A prescription for plan benefits—that is the purview of the legislature.
- An assessment of the affordability of contribution levels—that is the purview of the elected officials and their constituents.
- The sole determinant of the final asset allocation adopted for the fund—there are a number of factors, including insights from an Asset/Liability Study, which will bear on the optimal asset allocation.

Introduction (continued)

Asset/Liability Study in Practice . . .

- Begin with a forecast of the financial liabilities (i.e., benefit obligations).
- Include a baseline estimation of the financial contributions to the Fund over time.
- Compare alternative investment strategies (i.e., total fund asset allocations to the Fund's financial needs).
- Draw conclusions regarding how well various investment strategies satisfy the Fund's financial needs.

This Asset/Liability Study . . .

- Uses data from the most recent (September 30, 2008) Michigan State Employees Retirement System Actuarial Valuation to project pension liabilities.
- Accounts for Year 1 (October 1st, 2008 through September 30th, 2009) known Plan return, and known inflation during the same time period.
- Uses the Actuarial Cost Method and recommended contribution policy described in the September 30, 2008 Actuarial Valuation.
- Uses current employer and employee contribution rates described in the September 30, 2008 Actuarial Valuation.
- Compares these specific investment strategies—(A) Current Target Allocation, (B) Potential Policy Target with increased absolute return and real return exposure, (C) Illustrative Portfolio with increased fixed income exposure, (D) diversified lower risk (Portfolio 2), and (E) diversified higher risk (Portfolio 9)—expressed as total fund asset allocations to the projection of Fund liabilities.
- Note: Does not assume any actuarial adjustments that may take place in future years.

Current Status

A summary of the Plan follows:

Valuation Date September 30, 2008

Market Value of Assets (MVA) as of:
 9/30/2008 \$9,781,238,658
 9/30/2009 Estimate **\$8,680,991,423**

Actuarial Value of Assets (AVA) as of:
 9/30/2008 \$11,402,861,292
 9/30/2009 Estimate **\$10,417,189,708**

Actuarial Accrued Liability (AAL) as of:
 9/30/2008 \$13,662,532,396
 9/30/2009 Estimate **\$13,827,067,668**

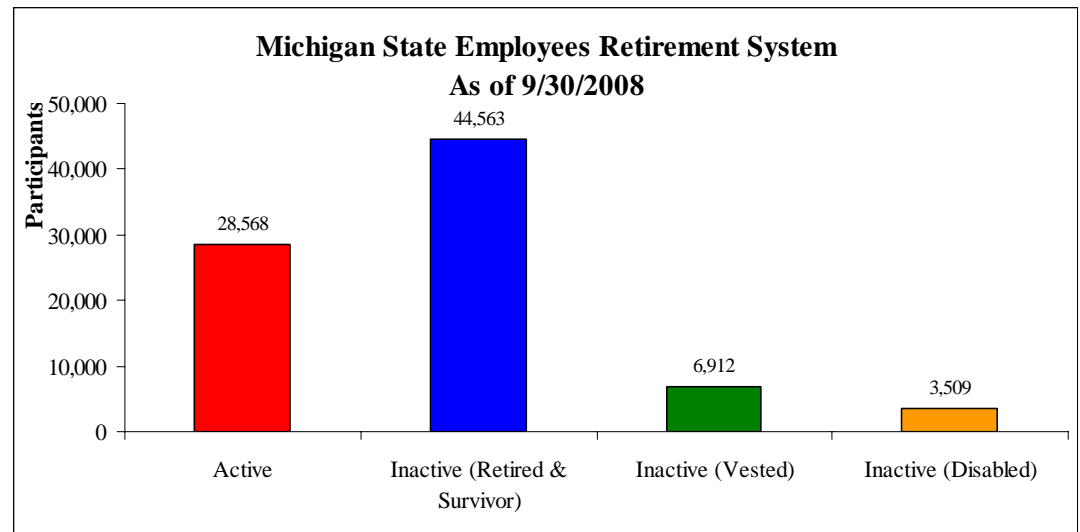
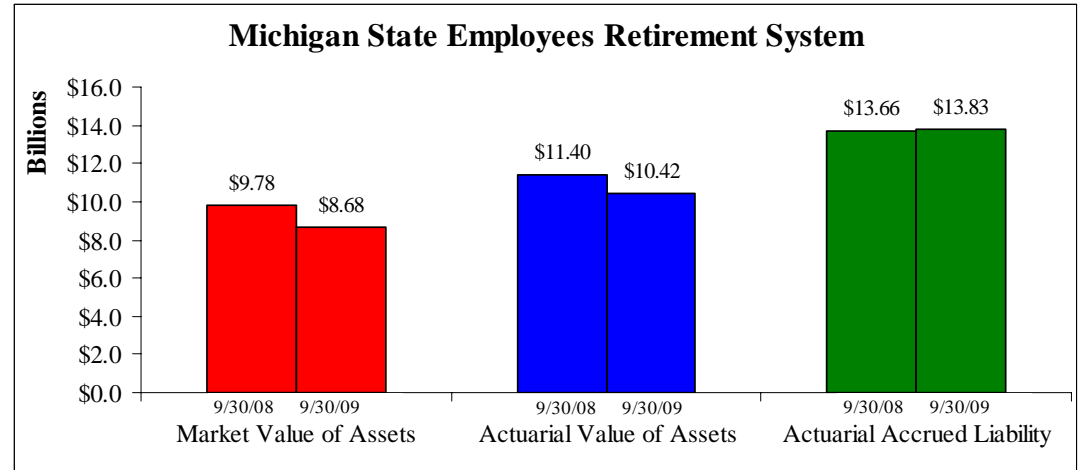
Actuarial Funded Ratio (AVA/AAL) as of:
 9/30/2008 83%
 9/30/2009 Estimate **75%**

Market Value Funded Ratio (MVA/AAL) as of:
 9/30/2008 72%
 9/30/2009 Estimate **63%**

Active Participants 28,568

Inactive (Retired & Survivor) Participants
 Retirees and Beneficiaries 44,563

Inactive (Other) Participants
 Vested 6,912
 Disabled 3,509



Deterministic Analysis

This section provides an analysis of the Plan's assets, liabilities, funded status, and benefit payments based on a fixed set of future assumptions.

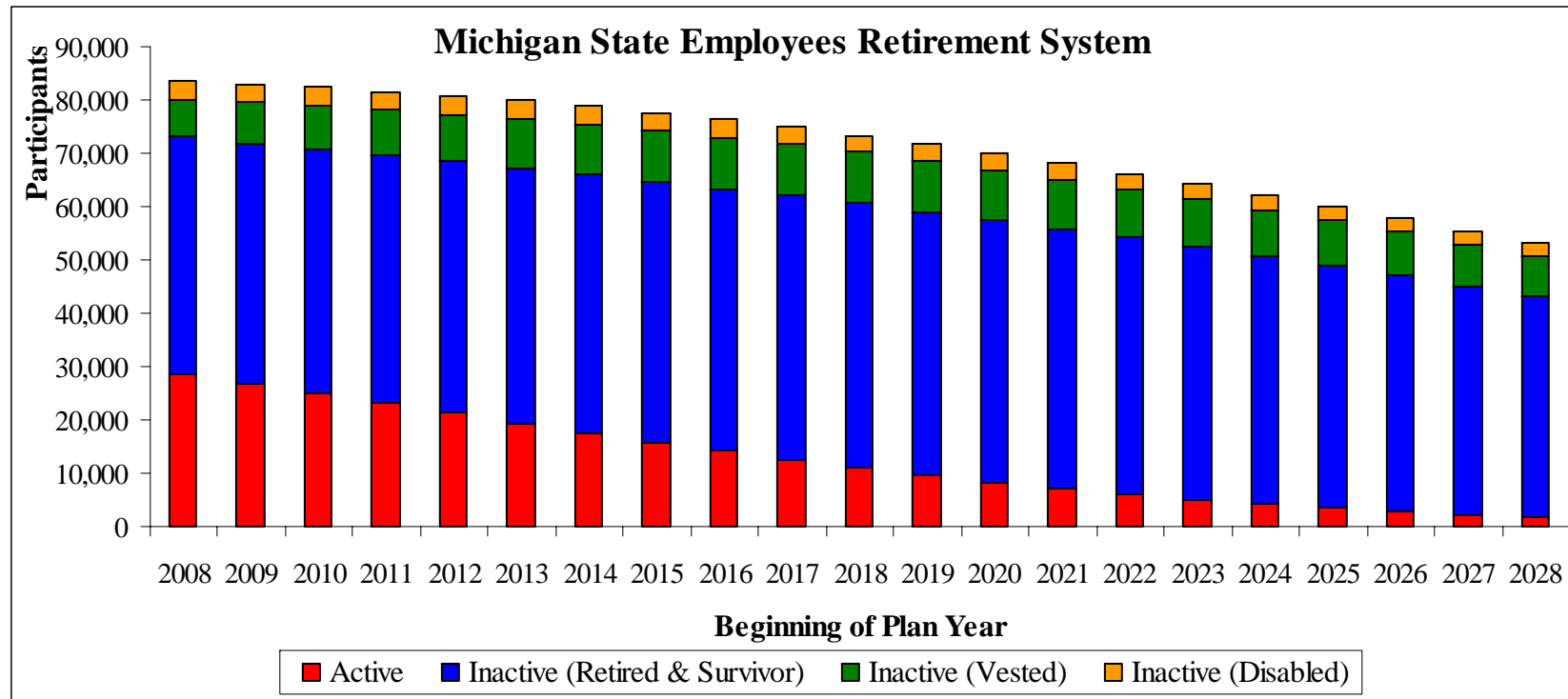
The deterministic assumptions are as follows:

- Current Plan provisions (see summary of Benefit Provisions in the Assumptions and Methods section of this report)
- The actuarial data used by Gabriel Roeder Smith & Company (see summary in the Assumptions and Methods section of this report)
- Assumed rate of return on Plan assets for years 2 through 20: 8.00%
- Replaces the actuarially assumed investment return of 8.00% with the Plan's actual rate of return of -6.27% for Year 1
- Replaces the actuarially assumed inflation rate of 3.50% with the actual rate of inflation of -1.29% for Year 1
- Current employer contribution rate, as a weighted average % of salary (members no longer contribute to this plan)
- Closed group analysis: No new participants enter the plan

Deterministic Analysis (continued)

Demographics

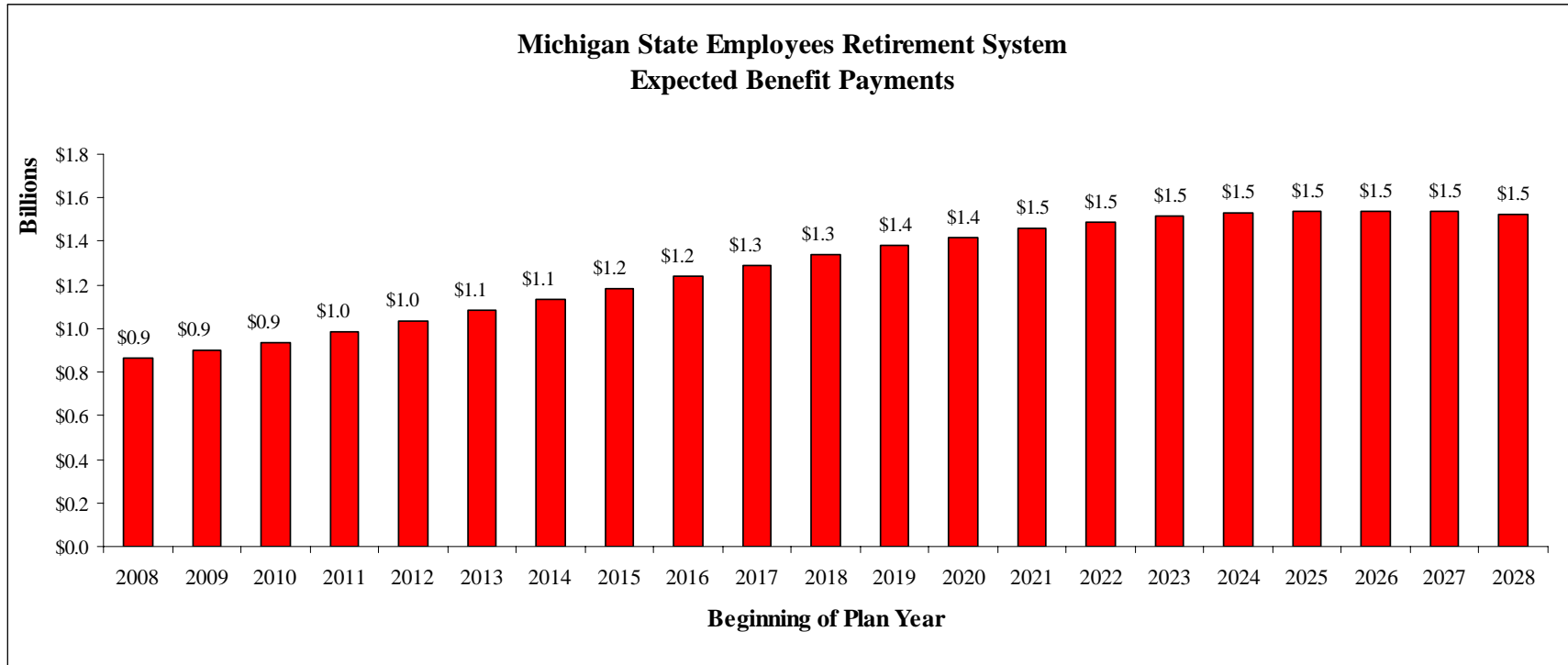
Following are the projected number of active and inactive participants at the beginning of each plan year from 2008 through 2028 (2008 is actual). These projections are based on a closed group analysis. Using the actuary’s assumptions for death, termination, retirement, and disability, current participants are assumed to leave the Plan in the future. The number of inactive participants remains roughly constant over the 20-year projection period shown.



Deterministic Analysis (continued)

Benefit Payments

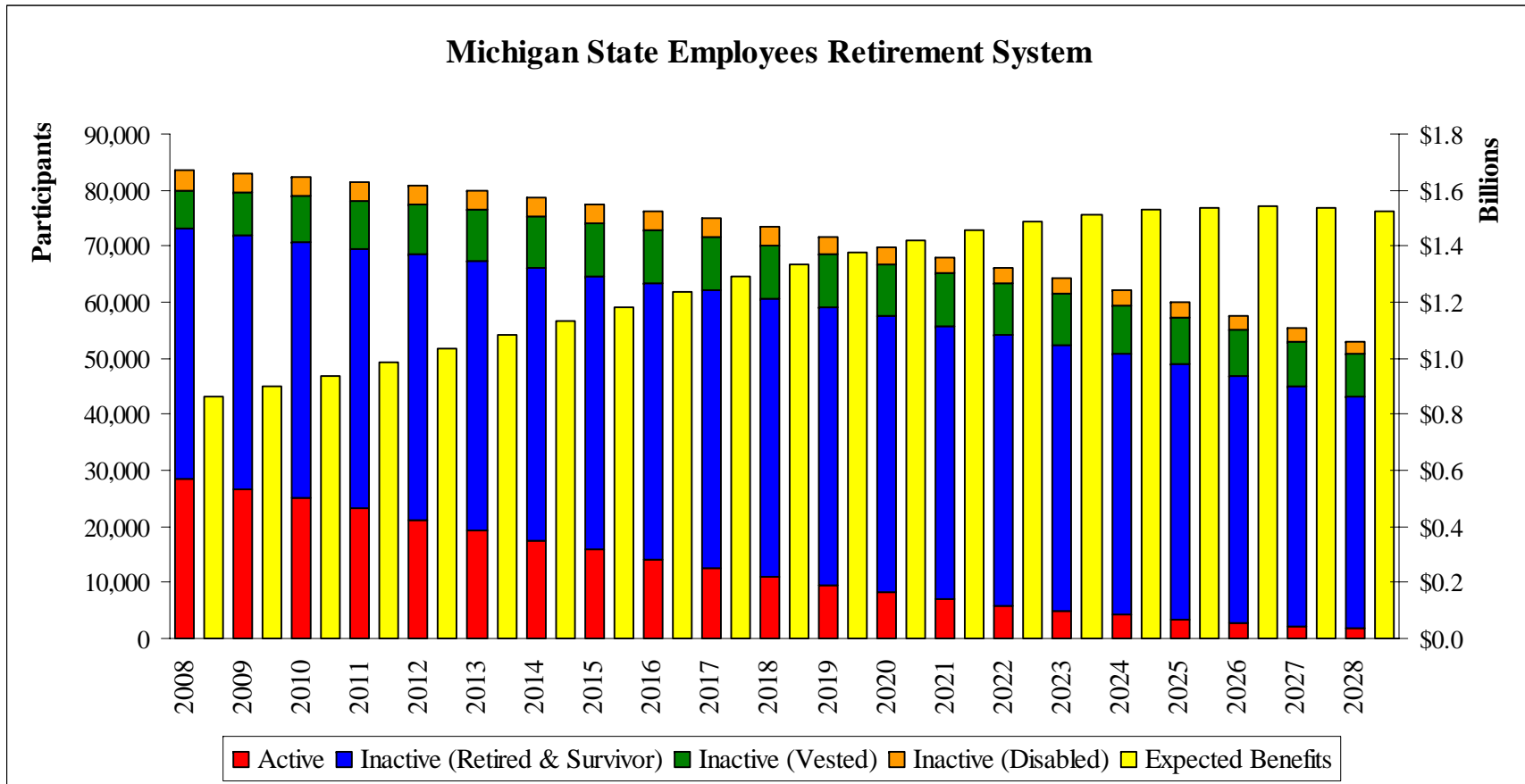
The Plan’s projected benefit payments for plan years beginning in 2008 through 2028 are shown below. The expected benefit payments are expected to increase by almost 75% over the next 20 years. As a percentage of the market value of Plan assets, benefit payments are expected to increase by less than 7% over the same 20 year time period.



Deterministic Analysis (continued)

Demographics and Benefit Payments

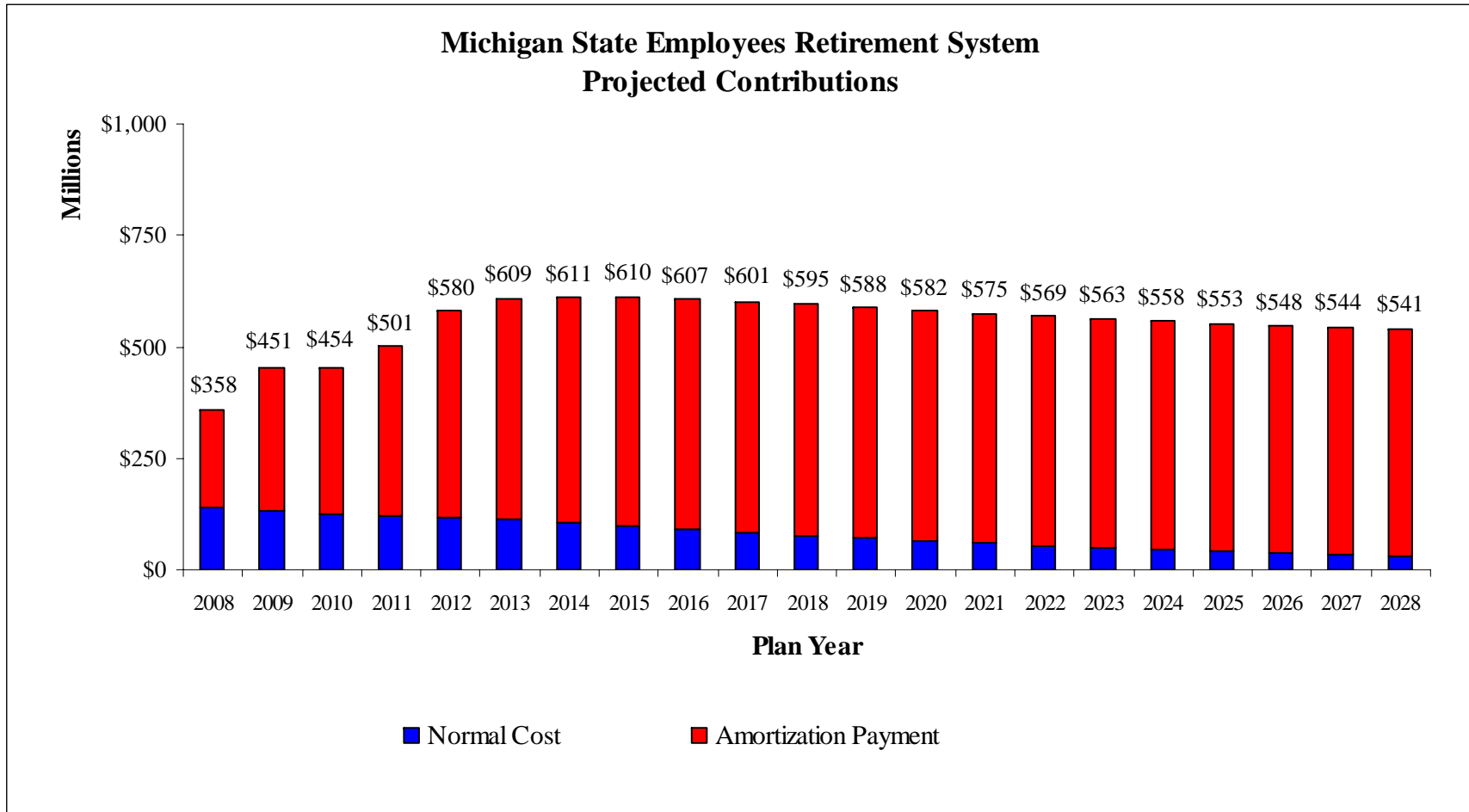
The chart below highlights the demographic and benefit payment projections shown on the prior two pages, illustrating the comparison between the projected number of active and inactive participants and the projected benefit payments for plan years beginning in 2008 through 2028.



Deterministic Analysis (continued)

Projected Contributions

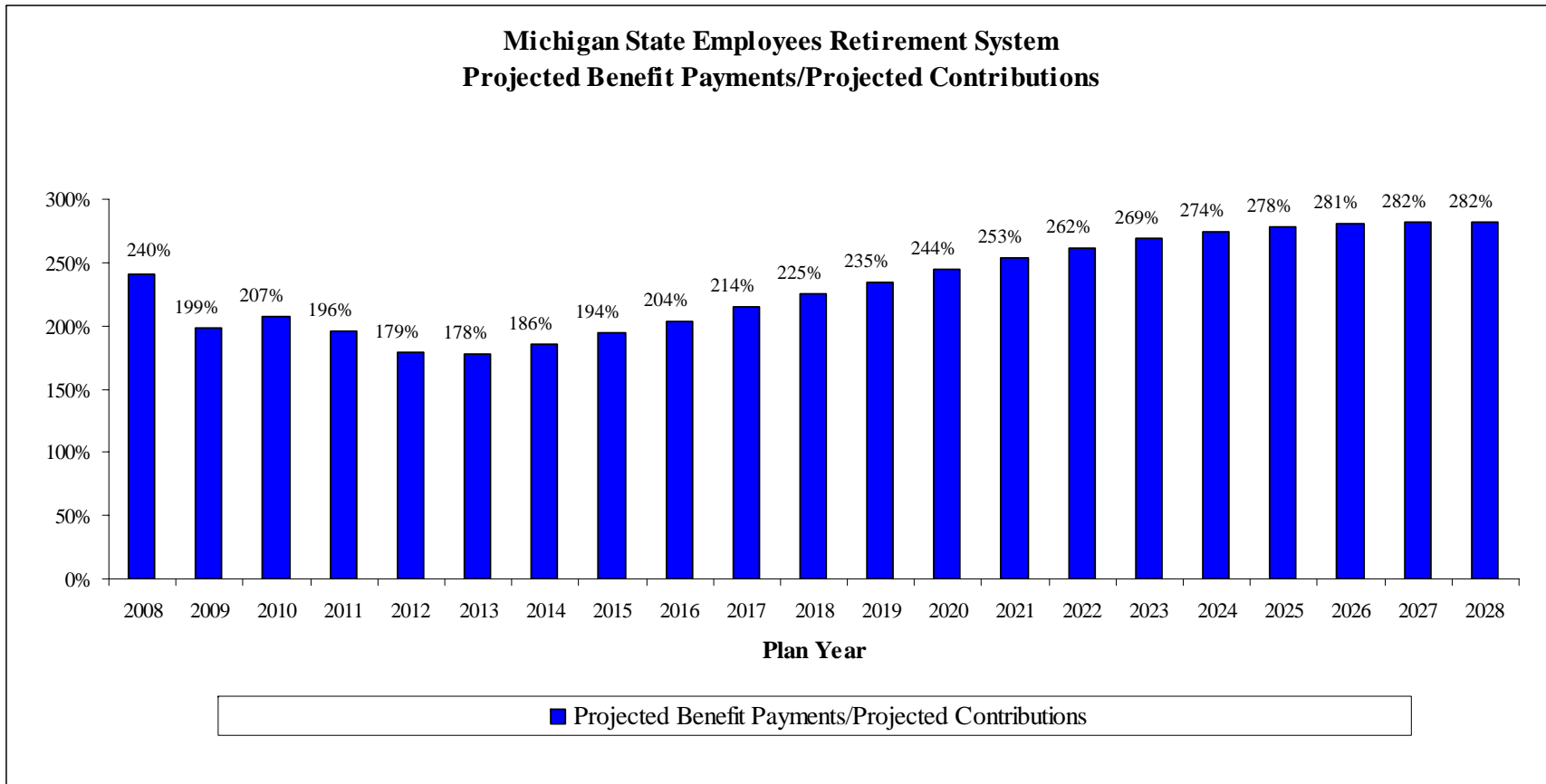
The Plan’s assumed projected contributions, expressed as total dollar contributions by the plan, are shown in the chart below. Members no longer contribute to the plan. Note, contributions expressed as a percentage of member salary is not a useful measure for a closed plan.



Deterministic Analysis (continued)

Projected Benefit Payments/Projected Contributions

The Plan's assumed projected benefit payments divided by projected contributions are shown in the chart below.

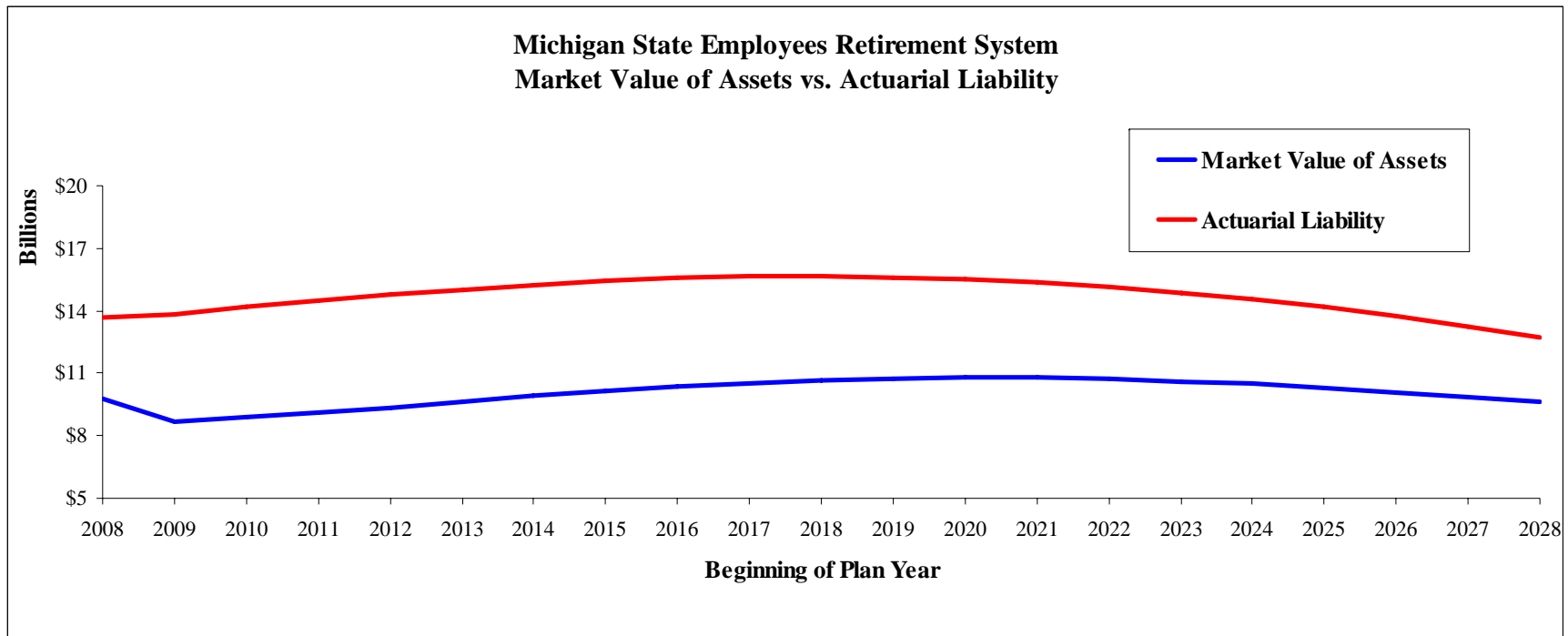


Deterministic Analysis (continued)

Actuarial Accrued Liabilities and Market Value of Assets

The Plan’s projected actuarial accrued liabilities and market value of assets are shown below. The results assume the current contribution policy remains unchanged for all projection years.

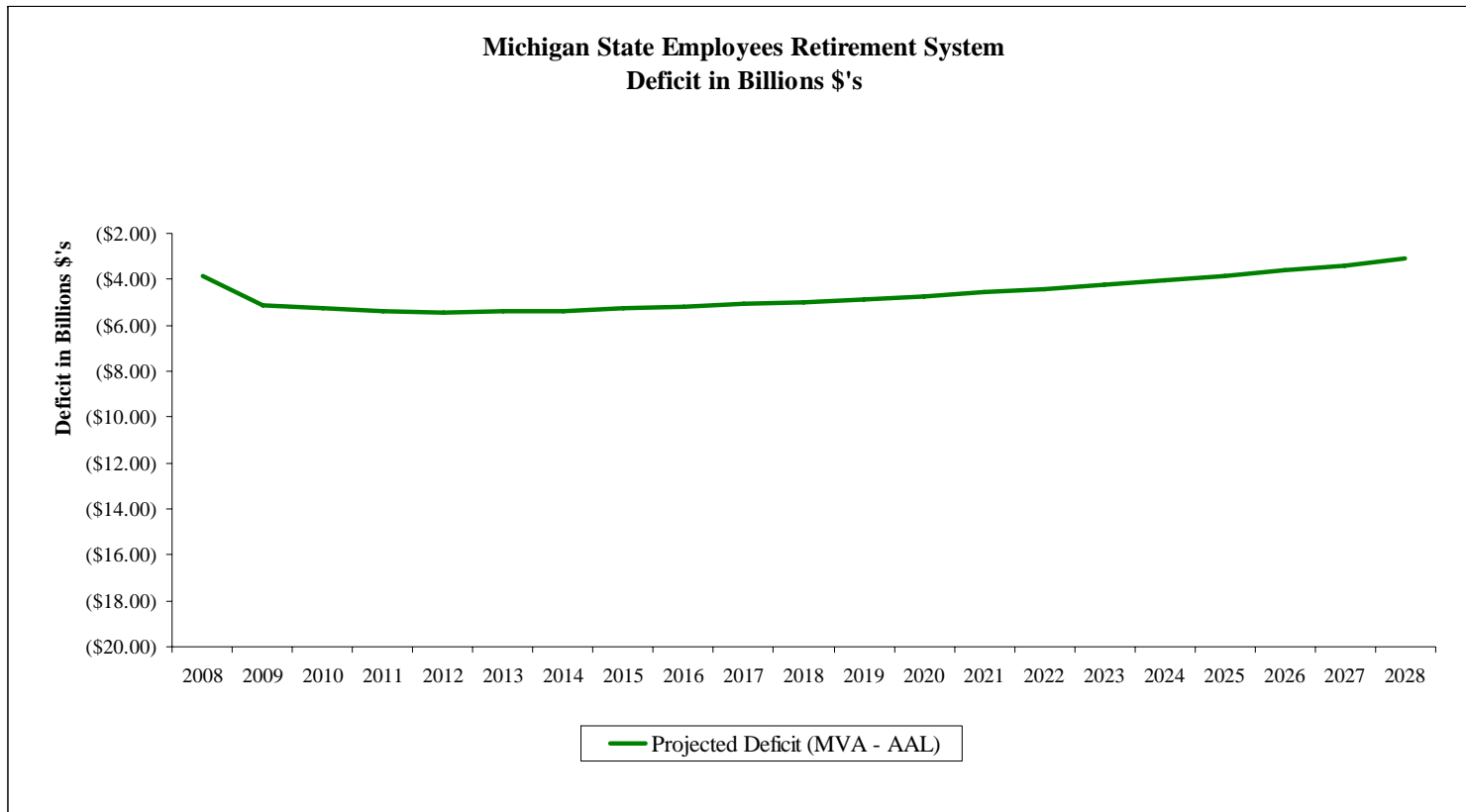
The relative disparity between the market value of assets and Plan liabilities is expected to decrease over time, bringing the Plan to approximately 76% funded over the next 20 years. This is shown more clearly on the following pages, where the funded ratio (based on actuarial value of assets) is projected to range from a low of 65% in 2013 to 76% in 2028.



Deterministic Analysis (continued)

Projected Deficit (market value of assets – actuarial accrued liabilities)

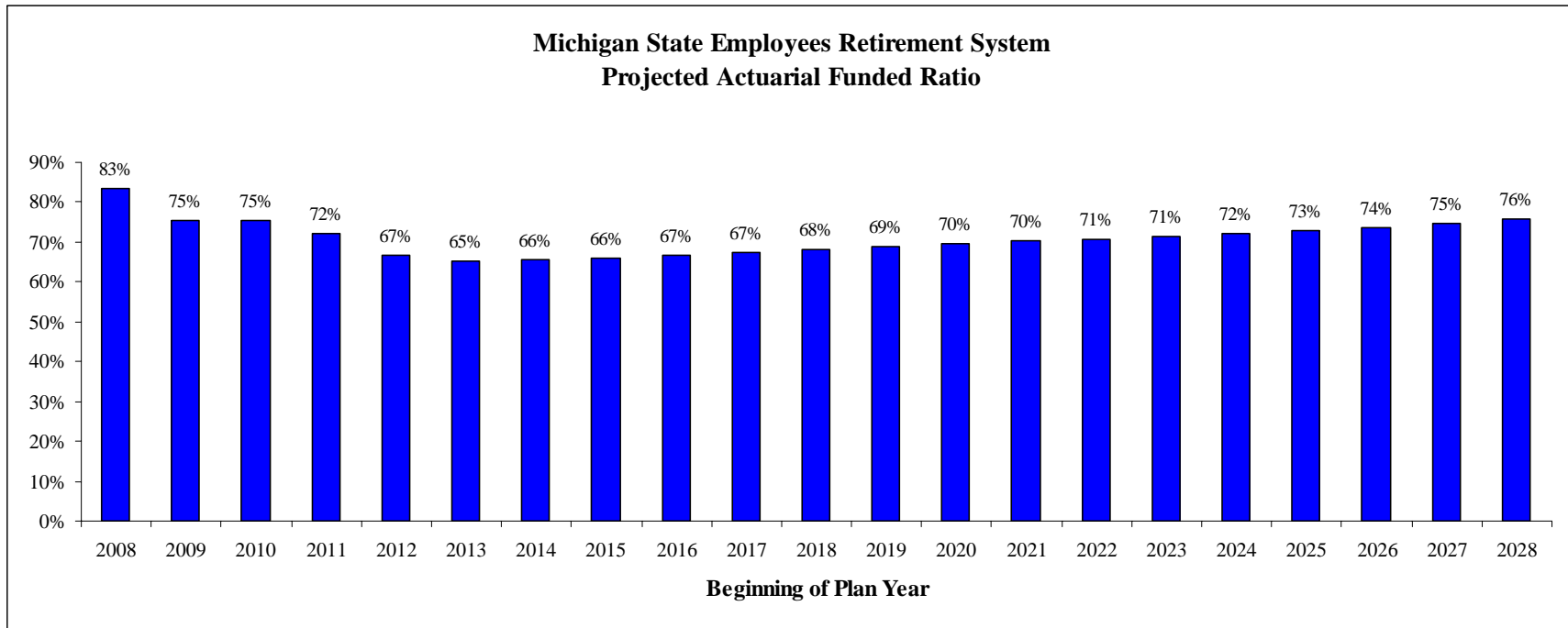
The Plan’s projected deficit of assets is shown below. The results assume the current contribution policy remains unchanged for all projection years. With the exception of 2009, the disparity between the market value of assets and Plan liabilities is expected to decrease, improving the funding status of the Plan. This can be seen in the table below indicating slight reductions in the MSERS deficit over time. This can also be seen on the following page, where the funded ratio (based on actuarial value of assets) is projected to increase from a low of 65% in 2013 to 76% by 2028.



Deterministic Analysis (continued)

Actuarial Funded Ratio (actuarial assets/actuarial accrued liability)

The Plan’s projected actuarial funded ratio is shown below. The chart shows the actual funded ratio for 2008, the estimated funded ratio for 2009, and then outlines the projected funded ratio for years 2010 through 2028 assuming the current contribution policy remains unchanged. The Plan is expected to approach 76% funding over the next 20 years. Of course, this assumes that all actuarial and return assumptions are met over that time period.



Stochastic Analysis

This section analyzes Plan assets and liabilities under many capital market environments based on expected asset returns and inflation, and their expected volatility. Using a Monte Carlo simulation technique, both assets and liabilities are assumed to vary stochastically, linked together by changes in inflation.

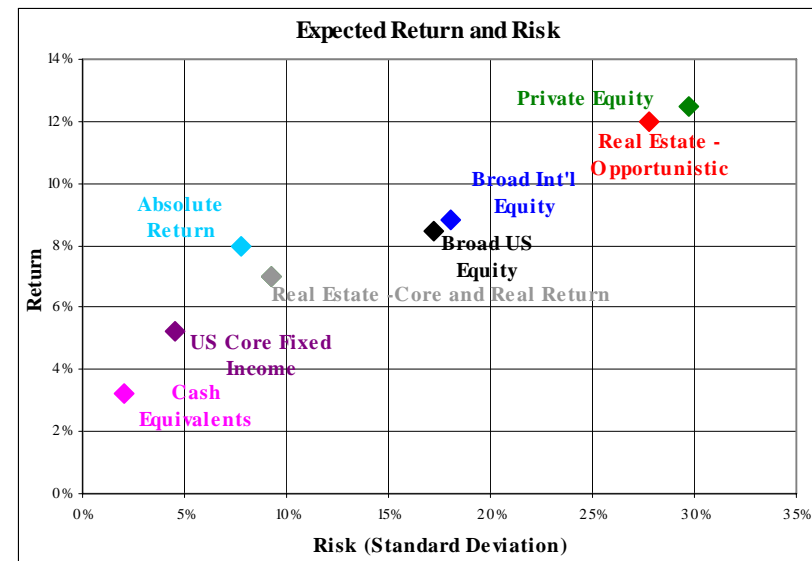
Using the expected values and variances of the returns and inflation, along with their correlations, 2000 trials are generated to produce a distribution of results. A stochastic analysis can answer questions about the best/worst case outcomes along with the probability of such outcomes. This is contrasted with the deterministic analysis that provides an expected value if all assumptions are exactly met.

Stochastic Analysis (continued)

Long-Term Return and Risk Assumptions

In order to perform a stochastic analysis and create asset allocation alternatives, it is necessary to estimate, for each asset class, its probable return and risk. The expected returns are our best estimates of the average annual percentage increases in values of each asset class over a prospective long period of time, and assumed to be normally distributed. The risk of an asset class is measured by its standard deviation, or volatility. If asset returns are normally distributed, as they historically have been, two-thirds (67%) of all returns are expected to lie within one standard deviation on either side of the mean. For example, we expect Broad US Equity to return, annually on average, 8.45% with a standard deviation of 17.25%, meaning that two-thirds of the time we expect its return to lie between -8.80% (= 8.45 - 17.25) and 25.70% (= 8.45 + 17.25). Moreover, we expect 95% of all return outcomes to lie within two standard deviations of the mean return, implying only a one-in-twenty chance that the return on Broad US Equity will either fall below -26.05% or rise above 42.95%. The risk and return assumptions used in this study are outlined in the charts below:

Asset Class	Return Assumption (Annualized)	Risk Assumption (Standard Deviation)
Broad US Equity	8.45%	17.25%
Broad Int'l Equity	8.85%	18.10%
US Core Fixed Income	5.25%	4.50%
Real Estate - Core	7.00%	9.25%
Real Estate - Opportunistic	12.00%	27.75%
Absolute Return	8.00%	7.75%
Private Equity	12.50%	29.75%
Real Return	7.00%	9.25%
Cash Equivalents	3.25%	2.00%



The actual Year 1 portfolio return was -6.27%, and the observed inflation rate for this same period was -1.29%. This data was incorporated into the stochastic model. As a result, the stochastic variation of plan outcomes based on the capital market assumptions does not effectively begin until Year 2 (2010) of the simulation. Implications of this assumption are discussed in the conclusion section of this report.

Stochastic Analysis (continued)

Correlation Between Asset Classes

Creating a diversified portfolio of asset classes enables the investor to achieve a high rate of return while minimizing volatility of the portfolio. As defined on the previous page, volatility is “risk” or standard deviation. By minimizing the volatility of a portfolio, we produce asset returns that vary less from year to year. Diversification exists because the returns of different asset classes do not always move in the same direction, at the same time, or with the same magnitude. Correlation values are between 1.00 and -1.00. If returns of two asset classes rise or fall at the same time and in the same magnitude, they have a correlation value of 1.00. Conversely, two asset classes that simultaneously move in opposite directions, and in the same magnitude, have a correlation value of -1.00. A correlation of zero indicates no relationship between returns. The assumed correlations are largely based on historical index data, with some qualitative analysis applied. For instance, where appropriate, we have weighted current history more heavily. The correlation matrix used in this study is shown below:

	Broad US Equity	Broad Int'l Equity	US Core Fixed Income	Real Estate - Core	Real Estate - Opp	Absolute Return	Private Equity	Real Return	Cash Equivalents
Broad US Equity	1.00								
Broad Int'l Equity	0.69	1.00							
US Core Fixed Income	0.20	0.06	1.00						
Real Estate - Core	0.07	0.18	-0.16	1.00					
Real Estate - Opp	0.60	0.53	-0.27	0.39	1.00				
Absolute Return	0.46	0.43	0.13	0.02	0.39	1.00			
Private Equity	0.64	0.55	-0.10	0.19	0.66	0.64	1.00		
Real Return	0.32	0.49	0.20	0.12	-0.01	0.50	0.11	1.00	
Cash Equivalents	0.02	-0.02	0.15	0.33	-0.03	0.24	0.02	-0.09	1.00

The fact that the correlations shown in the table are nearly all positive does not imply that these asset classes do not diversify one another. Their correlations are significantly less than 1.00, meaning we expect a measurable number of instances when the underperformance of one or more of the asset classes will be offset by the outperformance of others. This point is demonstrated on the following pages, which illustrate that diversification into less correlated asset classes can decrease the expected overall volatility of a portfolio.

Stochastic Analysis (continued)

Efficient Portfolios

Each frontier portfolio (optimal allocation) is created using target rates of return both above and below the projected rate of return for the current allocation. This range illustrates the trade-off between return and risk; additional return can only be achieved by undertaking additional risk. The table below shows the possible optimal allocations given the selected asset classes and their constraints listed under “Min” and “Max.” In addition to the 10 efficient portfolios, the table shows the current allocation for the Michigan State Employees Retirement System, as well as a Potential Policy Target for consideration throughout this study and an Illustrative Portfolio for demonstrative purposes throughout this study. Portfolios 2 and 9 are also highlighted for examination.

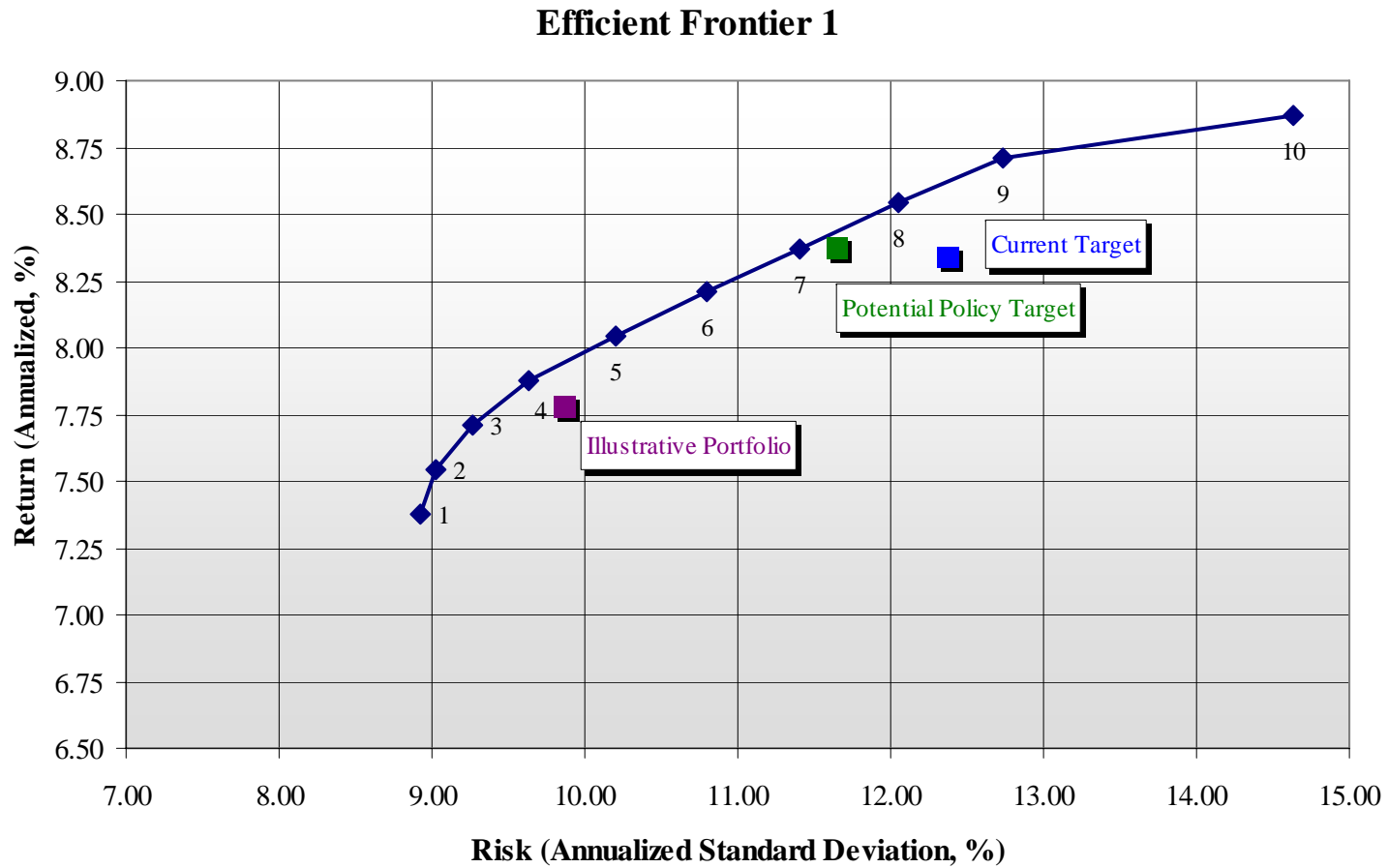
Asset Classes	Min	Max	Current Target	Potential Policy Target	Illustrative Portfolio	1	2	3	4	5	6	7	8	9	10
Broad US Equity	20	70	34	25	20	20	20	20	20	20	20	20	20	21	38
Broad International Equity	10	20	17	16	14	10	10	10	10	10	10	12	17	20	20
US Core Fixed Income	10	50	17	16	34	42	39	32	28	27	24	21	16	12	10
Real Estate - Core	8	12	11	8	11	8	12	12	9	8	8	8	8	8	8
Real Estate - Opportunistic	0	2	0	2	0	0	0	0	1	2	2	2	2	2	2
Absolute Return	0	10	2	10	2	0	0	4	10	10	10	10	10	10	0
Private Equity	15	20	16	16	16	15	15	15	15	16	19	20	20	20	20
Real Return	0	5	1	5	1	0	2	5	5	5	5	5	5	5	0
Cash Equivalents	2	5	2	2	2	5	2	2	2	2	2	2	2	2	2
Total			100	100	100	100	100	100	100	100	100	100	100	100	100
Total Public Equity	30	65	51	41	34	30	30	30	30	30	30	32	37	41	58
Return			8.34	8.38	7.78	7.38	7.54	7.71	7.88	8.04	8.21	8.37	8.54	8.71	8.87
Risk (1 Year Holding Period)			12.37	11.65	9.86	8.92	9.03	9.27	9.63	10.20	10.80	11.41	12.05	12.74	14.63
Risk (3 Year Holding Period)			7.14	6.73	5.69	5.15	5.21	5.35	5.56	5.89	6.24	6.59	6.96	7.36	8.45
Risk (5 Year Holding Period)			5.53	5.21	4.41	3.99	4.04	4.15	4.31	4.56	4.83	5.10	5.39	5.70	6.54
Risk (7 Year Holding Period)			4.68	4.40	3.73	3.37	3.41	3.50	3.64	3.86	4.08	4.31	4.55	4.82	5.53
Risk (10 Year Holding Period)			3.91	3.68	3.12	2.82	2.86	2.93	3.05	3.23	3.42	3.61	3.81	4.03	4.63

A group constraint restricts combined Real Estate plus Absolute Return to less than 20% of the total portfolio.

Stochastic Analysis (continued)

Efficient Frontier

The risk of each alternative allocation is plotted against the horizontal axis, while the return is measured on the vertical axis. The line connecting the points represents all the optimal portfolios subject to the given constraints and is known as the “efficient frontier.” The upward slope of the efficient frontier indicates the direct relationship between return and risk.



Stochastic Analysis (continued)

Asset Mixes

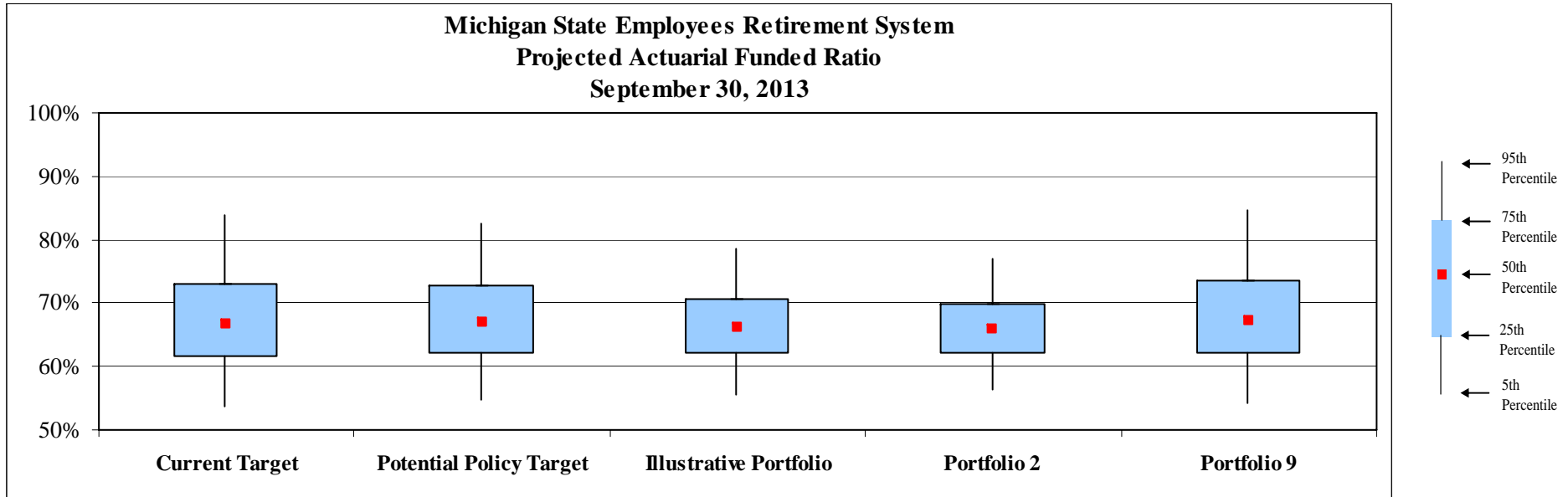
Outlined below is the current target allocation for the Michigan State Employees Retirement System, as well as four other mixes to be examined in this study. The expected return and expected risk, as measured by standard deviation, for each are also shown.

Asset Class	Current Target	Potential Policy Target	Illustrative Portfolio	Portfolio 2	Portfolio 9
Broad US Equity	34.0%	25.0%	20.0%	20.0%	21.5%
Broad Int'l Equity	17.0%	16.0%	14.0%	10.0%	20.0%
US Core Fixed Income	17.0%	16.0%	34.0%	39.0%	11.5%
Real Estate - Core	11.0%	8.0%	11.0%	12.0%	8.0%
Real Estate - Opportunistic	0.0%	2.0%	0.0%	0.0%	2.0%
Absolute Return	2.0%	10.0%	2.0%	0.0%	10.0%
Private Equity	16.0%	16.0%	16.0%	15.0%	20.0%
Real Return	1.0%	5.0%	1.0%	2.0%	5.0%
Cash	2.0%	2.0%	2.0%	2.0%	2.0%
Expected Return	8.34%	8.38%	7.78%	7.54%	8.71%
Expected Risk	12.37%	11.65%	9.86%	9.03%	12.74%

Stochastic Analysis (continued)

Projected Actuarial Funded Ratio (actuarial assets/actuarial accrued liability); 5 Years

The graph below shows the distribution of possible actuarial funded ratios five years from now, assuming the five different asset mixes highlighted on the prior pages. The results below assume the current contribution policy remains unchanged for all projection years.



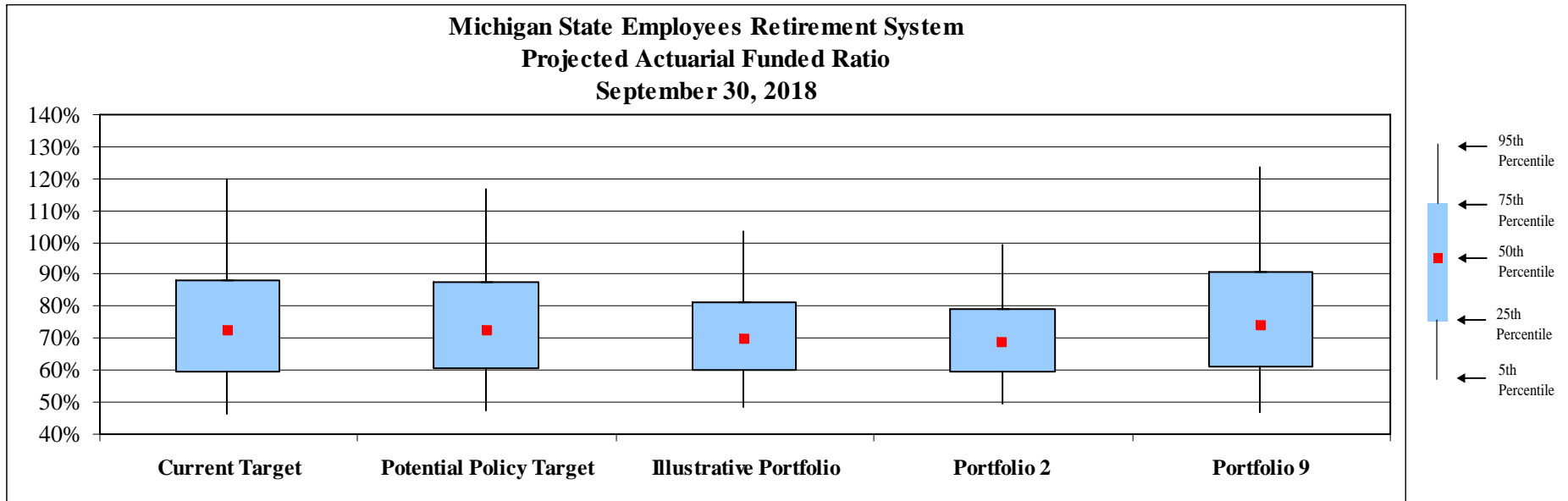
	Current Target		Potential Policy Target		Illustrative Portfolio		Portfolio 2		Portfolio 9	
	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio
5th Percentile	\$6,480,416,766	53.7%	\$6,315,637,440	54.7%	\$6,145,919,600	55.7%	\$6,048,751,467	56.3%	\$6,389,731,567	54.2%
25th Percentile	\$5,539,917,486	61.7%	\$5,479,041,286	62.1%	\$5,461,610,911	62.2%	\$5,459,084,260	62.2%	\$5,473,476,552	62.1%
50th Percentile	\$4,949,052,171	66.7%	\$4,931,297,640	66.8%	\$5,050,109,075	66.0%	\$5,085,440,363	65.8%	\$4,864,619,650	67.3%
75th Percentile	\$4,206,186,438	73.1%	\$4,271,502,475	72.8%	\$4,536,143,096	70.6%	\$4,645,450,205	70.0%	\$4,111,923,377	73.6%
95th Percentile	\$2,942,598,811	83.8%	\$3,123,346,987	82.5%	\$3,712,016,293	78.6%	\$3,893,789,827	77.1%	\$2,756,538,579	84.7%

Percentiles indicate the probability of achieving a Funded Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile indicates that 50% of the time the Plan can expect a Funded Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected. For further example, the 25th percentile indicates that 25% of the time the Plan can expect a Funded Ratio lower than the ratio shown, and 75% of the time a higher ratio is expected.

Stochastic Analysis (continued)

Projected Actuarial Funded Ratio (actuarial assets/actuarial accrued liability); 10 Years

The graph below shows the distribution of possible actuarial funded ratios ten years from now, assuming the five different asset mixes highlighted on the prior pages. The results below assume the current contribution policy remains unchanged for all projection years.



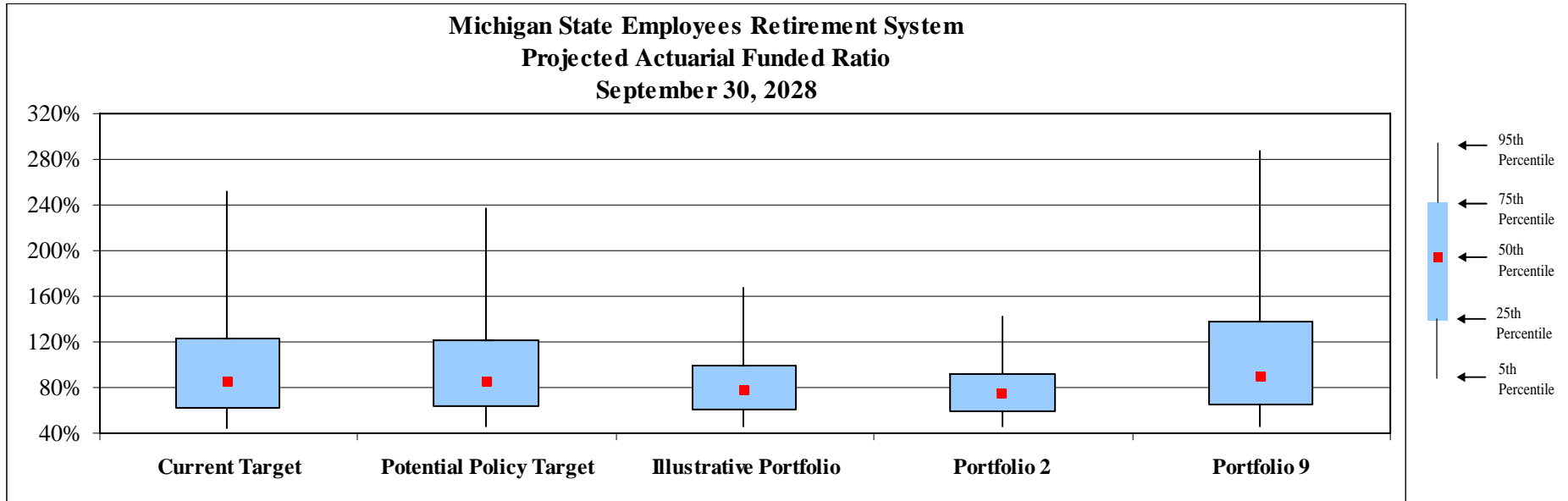
	Current Target		Potential Policy Target		Illustrative Portfolio		Portfolio 2		Portfolio 9	
	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio
5th Percentile	\$7,427,776,873	46.1%	\$7,228,271,406	47.5%	\$7,050,554,762	48.6%	\$7,012,654,275	49.3%	\$7,306,196,189	46.9%
25th Percentile	\$5,806,993,190	59.7%	\$5,700,066,485	60.7%	\$5,847,766,027	60.0%	\$5,865,145,127	59.8%	\$5,643,973,708	61.3%
50th Percentile	\$4,185,970,470	72.1%	\$4,174,271,184	72.5%	\$4,600,451,002	69.7%	\$4,791,897,569	68.6%	\$3,930,003,730	73.8%
75th Percentile	\$2,043,143,339	88.2%	\$2,190,902,882	87.6%	\$3,079,818,924	81.1%	\$3,401,662,095	79.2%	\$1,745,483,452	90.9%
95th Percentile	(\$2,570,869,928)	119.8%	(\$1,935,074,086)	116.5%	\$184,952,397	103.5%	\$838,075,849	99.1%	(\$3,103,593,797)	123.7%

Percentiles indicate the probability of achieving a Funded Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile indicates that 50% of the time the Plan can expect a Funded Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected. For further example, the 25th percentile indicates that 25% of the time the Plan can expect a Funded Ratio lower than the ratio shown, and 75% of the time a higher ratio is expected.

Stochastic Analysis (continued)

Projected Actuarial Funded Ratio (actuarial assets/actuarial accrued liability); 20 Years

The graph below shows the distribution of possible actuarial funded ratios twenty years from now, assuming the five different asset mixes highlighted on the prior pages. The results below assume the current contribution policy remains unchanged for all projection years.



	Current Target		Potential Policy Target		Illustrative Portfolio		Portfolio 2		Portfolio 9	
	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio
5th Percentile	\$5,831,129,634	44.4%	\$5,693,516,583	45.8%	\$5,727,210,582	45.9%	\$5,727,614,533	46.0%	\$5,689,557,950	45.6%
25th Percentile	\$4,166,638,639	62.5%	\$4,013,063,833	64.0%	\$4,362,235,974	60.9%	\$4,494,815,796	59.7%	\$3,796,016,648	65.7%
50th Percentile	\$1,812,159,517	84.4%	\$1,797,231,447	84.6%	\$2,739,476,098	77.3%	\$3,057,368,644	74.5%	\$1,311,808,564	88.8%
75th Percentile	(\$2,576,931,226)	123.7%	(\$2,333,032,213)	121.5%	\$345,663,545	98.7%	\$1,115,608,028	92.4%	(\$4,279,854,315)	137.7%
95th Percentile	(\$17,395,559,468)	252.4%	(\$15,521,393,684)	237.2%	(\$7,328,893,882)	166.9%	(\$4,547,541,743)	142.7%	(\$21,666,177,101)	287.0%

Percentiles indicate the probability of achieving a Funded Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile indicates that 50% of the time the Plan can expect a Funded Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected. For further example, the 25th percentile indicates that 25% of the time the Plan can expect a Funded Ratio lower than the ratio shown, and 75% of the time a higher ratio is expected.

Stochastic Analysis (continued)

Projected Actuarial Funded Ratio (actuarial assets/actuarial accrued liability); 20 Years

The table below displays the projected actuarial funded ratio 20 years from now, under a worst-case scenario (5th percentile), assuming the Plan’s assets are allocated at target, as well as the four additional mixes (highlighted on the prior pages).

These figures are displayed graphically on the prior page, but are summarized below to highlight the potential effects that the expected volatility of each mix can have on the Plan’s actuarial funded ratio. Note, however, if the capital market returns produce worst-case results, the contribution level would have to increase, or benefits decrease, to keep the Plan viable. Therefore, the funded ratios shown below are highly unlikely, if not impossible from a practical standpoint. They are shown for illustrative purposes.

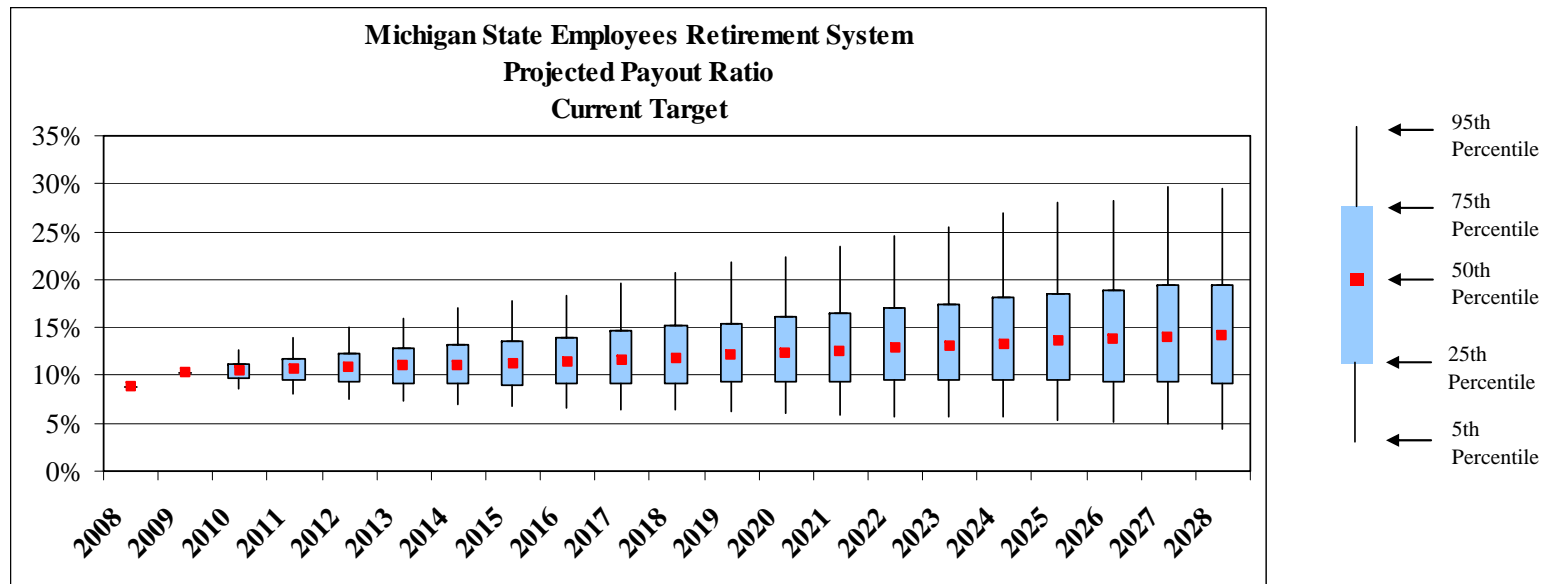
Michigan State Employees Retirement System Worst Case Actuarial Funded Ratio Comparison Septmeber 30, 2028	
Current Target	44%
Potential Policy Target	46%
Illustrative Portfolio	46%
Portfolio 2	46%
Portfolio 9	46%

Stochastic Analysis (continued)

Projected Payout Ratio (expected benefit payments/market value of assets); Current Target

The graph below displays the range of possible payout ratios over the next twenty years, assuming the Plan’s assets are allocated according to the Current Target. The results below assume the current contribution policy remains unchanged for all projection years.

The annual median benefit payment is expected to be approximately 9 to 14 percent of the market value of assets in any given year. The worst-case scenario could reach 30% or higher. However, if the capital market returns produce worst-case results, the contribution level would have to increase, or benefits decrease, to keep the Plan viable. Therefore, a payout ratio of 30% is unlikely over much of the forecast period. However, in the later years of the forecast period (circa 2021 to 2028) and beyond, the accelerating financial maturity of the closed MSERS Plan will make the payout ratio highly sensitive to the volatility of the Plan’s assets. This has significant implications for the Plan’s asset allocation and is discussed in more detail in the findings section of this report.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Median	8.8%	10.3%	10.4%	10.6%	10.8%	10.9%	11.0%	11.2%	11.3%	11.6%	11.8%	12.1%	12.3%	12.5%	12.9%	13.0%	13.2%	13.5%	13.7%	13.8%	14.1%

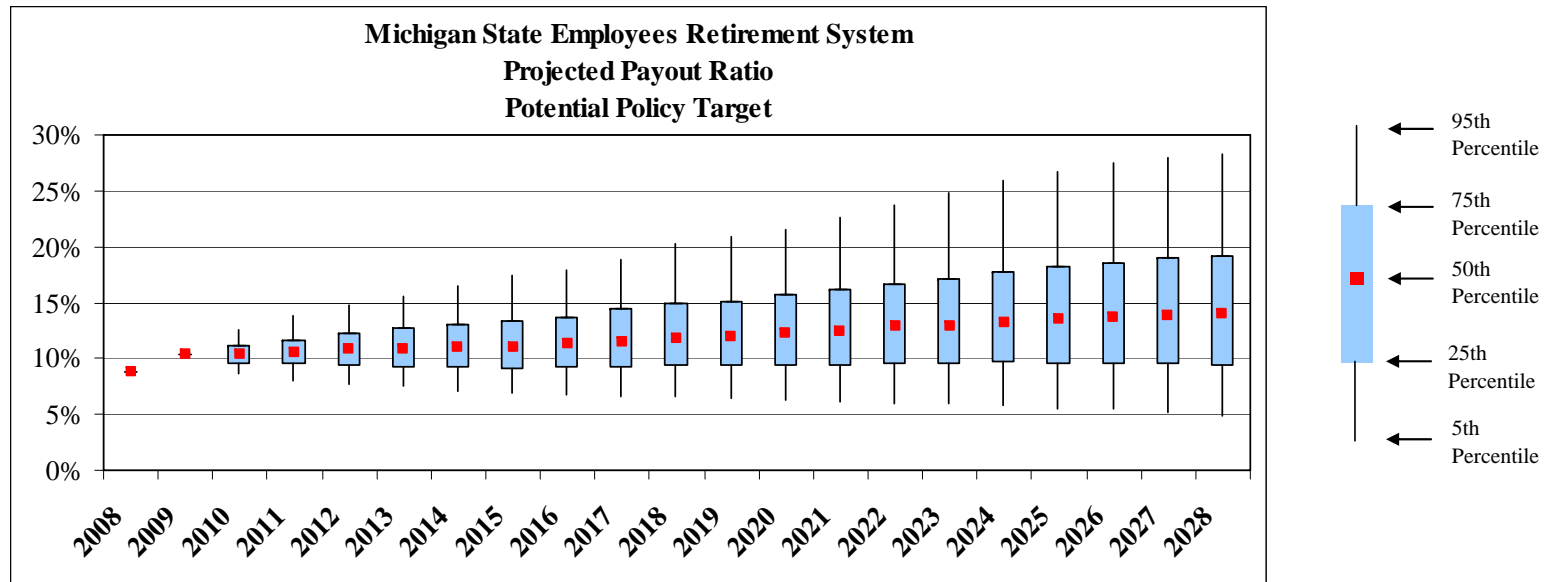
Percentiles indicate the probability of achieving a Payout Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile (median) indicates that 50% of the time the Plan can expect a Payout Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected.

Stochastic Analysis (continued)

Projected Payout Ratio (expected benefit payments/market value of assets); Potential Policy Target

The graph below displays the range of possible payout ratios over the next twenty years, assuming the Plan’s assets are allocated according to the Potential Policy Target (highlighted on the prior pages). The results below assume the current contribution policy remains unchanged for all projection years.

The annual median benefit payment is expected to be approximately 9 to 14 percent of the market value of assets in any given year. The worst-case scenario could reach 28% or higher. However, if the capital market returns produce worst-case results, the contribution level would have to increase, or benefits decrease, to keep the Plan viable. Therefore, a payout ratio of 28% is unlikely over much of the forecast period. However, in the later years of the forecast period (circa 2021 to 2028) and beyond, the accelerating financial maturity of the closed MSERS Plan will make the payout ratio highly sensitive to the volatility of the Plan’s assets. This has significant implications for the Plan’s asset allocation and is discussed in more detail in the findings section of this report.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Median	8.8%	10.3%	10.4%	10.5%	10.8%	10.9%	11.0%	11.1%	11.3%	11.5%	11.8%	12.0%	12.2%	12.5%	12.8%	12.8%	13.1%	13.4%	13.6%	13.8%	14.0%

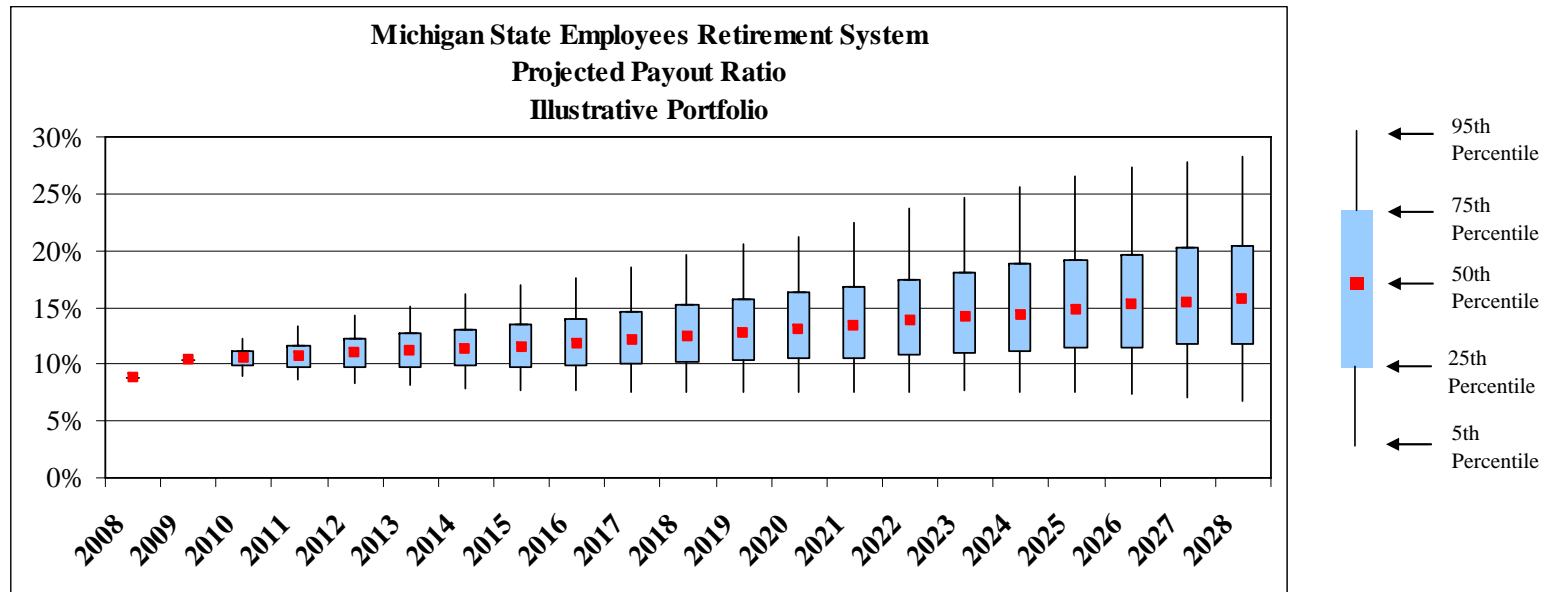
Percentiles indicate the probability of achieving a Payout Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile (median) indicates that 50% of the time the Plan can expect a Payout Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected.

Stochastic Analysis (continued)

Projected Payout Ratio (expected benefit payments/market value of assets); Illustrative Portfolio

The graph below displays the range of possible payout ratios over the next twenty years, assuming the Plan’s assets are allocated according to the Illustrative Portfolio (highlighted on the prior pages). The results below assume the current contribution policy remains unchanged for all projection years.

The annual median benefit payment is expected to be approximately 9 to 16 percent of the market value of assets in any given year. The worst-case scenario could reach 28% or higher. However, if the capital market returns produce worst-case results, the contribution level would have to increase, or benefits decrease, to keep the Plan viable. Therefore, a payout ratio of 28% is unlikely over much of the forecast period. However, in the later years of the forecast period (circa 2021 to 2028) and beyond, the accelerating financial maturity of the closed MSERS Plan will make the payout ratio highly sensitive to the volatility of the Plan’s assets. This has significant implications for the Plan’s asset allocation and is discussed in more detail in the findings section of this report.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Median	8.8%	10.3%	10.5%	10.7%	10.9%	11.1%	11.3%	11.5%	11.8%	12.1%	12.4%	12.7%	13.1%	13.3%	13.8%	14.1%	14.4%	14.7%	15.2%	15.4%	15.7%

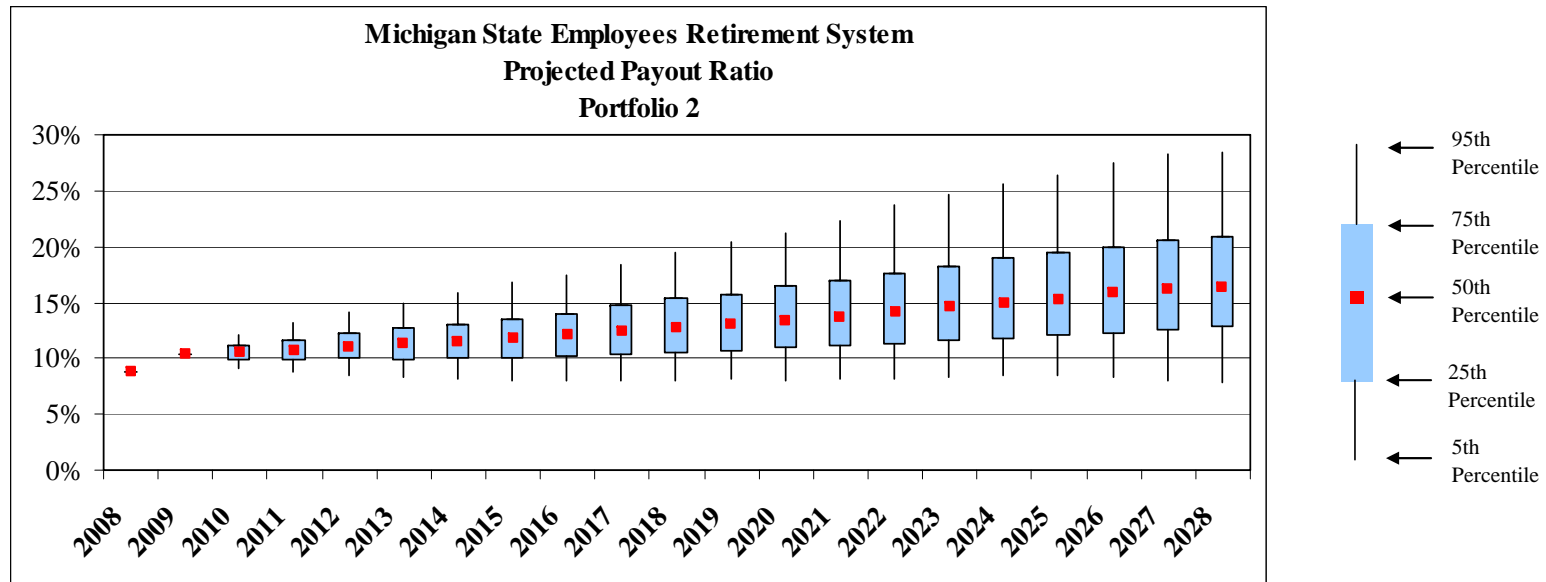
Percentiles indicate the probability of achieving a Payout Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile (median) indicates that 50% of the time the Plan can expect a Payout Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected.

Stochastic Analysis (continued)

Projected Payout Ratio (expected benefit payments/market value of assets); Portfolio 2

The graph below displays the range of possible payout ratios over the next twenty years, assuming the Plan’s assets are allocated according to Portfolio 2 (highlighted on the prior pages). The results below assume the current contribution policy remains unchanged for all projection years.

The annual median benefit payment is expected to be approximately 9 to 16 percent of the market value of assets in any given year. The worst-case scenario could reach 28% or higher. However, if the capital market returns produce worst-case results, the contribution level would have to increase, or benefits decrease, to keep the Plan viable. Therefore, a payout ratio of 28% is unlikely over much of the forecast period. However, in the later years of the forecast period (circa 2021 to 2028) and beyond, the accelerating financial maturity of the closed MSERS Plan will make the payout ratio highly sensitive to the volatility of the Plan’s assets. This has significant implications for the Plan’s asset allocation and is discussed in more detail in the findings section of this report.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Median	8.8%	10.3%	10.5%	10.7%	11.0%	11.3%	11.5%	11.7%	12.0%	12.4%	12.7%	13.0%	13.4%	13.7%	14.2%	14.6%	14.9%	15.3%	15.8%	16.1%	16.3%

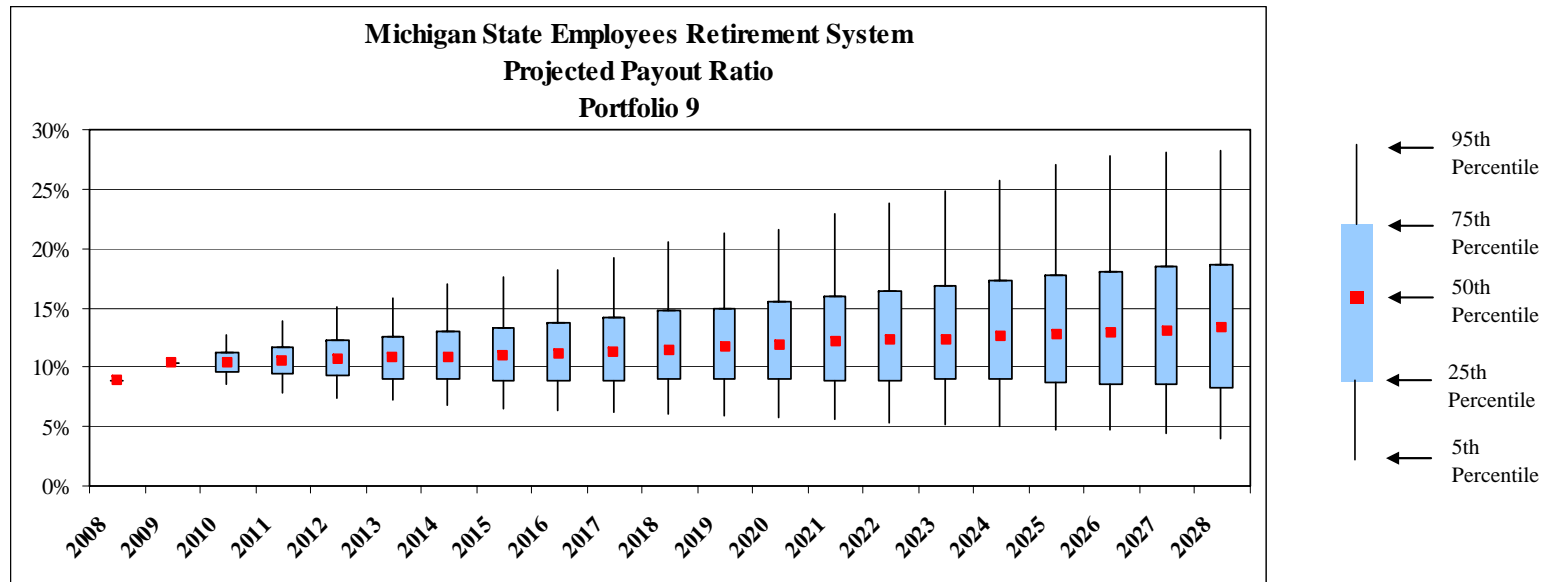
Percentiles indicate the probability of achieving a Payout Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile (median) indicates that 50% of the time the Plan can expect a Payout Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected.

Stochastic Analysis (continued)

Projected Payout Ratio (expected benefit payments/market value of assets); Portfolio 9

The graph below displays the range of possible payout ratios over the next twenty years, assuming the Plan’s assets are allocated according to Portfolio 9 (highlighted on the prior pages). The results below assume the current contribution policy remains unchanged for all projection years.

The annual median benefit payment is expected to be approximately 9 to 13 percent of the market value of assets in any given year. The worst-case scenario could reach 28% or higher. However, if the capital market returns produce worst-case results, the contribution level would have to increase, or benefits decrease, to keep the Plan viable. Therefore, a payout ratio of 28% is unlikely over much of the forecast period. However, in the later years of the forecast period (circa 2021 to 2028) and beyond, the accelerating financial maturity of the closed MSERS Plan will make the payout ratio highly sensitive to the volatility of the Plan’s assets. This has significant implications for the Plan’s asset allocation and is discussed in more detail in the findings section of this report.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Median	8.8%	10.3%	10.4%	10.5%	10.7%	10.7%	10.9%	10.9%	11.0%	11.3%	11.4%	11.6%	11.8%	12.1%	12.3%	12.3%	12.5%	12.8%	12.9%	13.1%	13.2%

Percentiles indicate the probability of achieving a Payout Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile (median) indicates that 50% of the time the Plan can expect a Payout Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected.

Stochastic Analysis (continued)

Projected Payout Ratio (expected benefit payments/market value of assets); 20 Years

The table below displays the projected payout ratio twenty years from now, under the worst-case scenario (95th percentile), assuming the Plan’s assets are allocated at target, as well as the four additional mixes (highlighted on the prior pages).

These figures are displayed graphically on the previous 5 pages, but are summarized below to highlight the potential effects that the expected volatility of each mix can have on the payout ratio. Note, however, if the capital market returns produce worst-case results, the contribution level would have to increase, or benefits decrease, to keep the Plan viable. Therefore, the payout ratios shown below are unlikely over much of the forecast period. However, in the later years of the forecast period (circa 2021 to 2028) and beyond, the accelerating financial maturity of the closed MSERS Plan will make the payout ratio highly sensitive to the volatility of the Plan’s assets. This has significant implications for the Plan’s asset allocation and is discussed in more detail in the findings section of this report.

Michigan State Employees Retirement System Worst Case Payout Ratio Comparison September 30, 2028	
Current Target	30%
Potential Policy Target	28%
Illustrative Portfolio	28%
Portfolio 2	28%
Portfolio 9	28%

Drawing Inferences

The table below compares the projected actuarial funded ratio 20 years from now, under the median (50th percentile), worst-case (5th percentile), and best-case (95th percentile) scenarios, assuming the five different asset mixes highlighted on the prior pages. The table also displays for comparative purposes the median, peak, and trough projected payout ratios over the 20 year period, assuming the same five asset mixes being examined.

	Funded Ratio in Year 20			Payout Ratios 2008-2028		
	50th	5th	95th	Median	Peak	Trough
Current Target	84.4%	44.4%	252.4%	11.8%	29.6%	4.5%
Potential Policy Target	84.6%	45.8%	237.2%	11.8%	28.2%	4.8%
Illustrative Portfolio	77.3%	45.9%	166.9%	12.4%	28.3%	6.7%
Portfolio 2	74.5%	46.0%	142.7%	12.7%	28.4%	7.8%
Portfolio 9	88.8%	45.6%	287.0%	11.4%	28.2%	4.0%

Summary of Impact from Using Actual Return and Inflation for Year 1

Below is a summary of the results in this Asset Liability Study that are a product of using the actual 2009 plan return (-6.27%) and observed inflation (-1.29%) in both the Deterministic and Stochastic models, rather than the actuarial assumptions and stochastically determined Year 1 outcomes. The comments below summarize the resulting differences from using the override compared to the standard deterministic and stochastic assumptions for the first year of the projections.

Deterministic Analysis

- Projected contributions are higher when using the known values for plan return and inflation for Year 1, increasing every year after Year 0 to cover the losses that occurred during Year 1
- The Plan's deficit increases during Year 1 substantially due to a decrease in the Plan's asset base
- The Plan's projected Actuarial Funded Ratio ranges from 63% to 76% using the "known Year 1 experience" assumption set, compared to 72% to 83% using the standard assumption set

Stochastic Analysis

- Projected Actuarial Funded Ratios decrease for all considered asset allocations in all years when using the known values for plan return and inflation for Year 1
- The Worst Case Actuarial Funded Ratio falls by approximately 3 – 4% for each considered allocation
- The Worst Case Payout Ratio increases by approximately 1 – 3% for each considered allocation

Appendix 1: Sensitivity Analysis: “Effect of Higher Volatility”

This section provides a sensitivity analysis of the original stochastic analysis by assuming the risk (as measured by standard deviation) of each asset class is doubled. These modified assumptions are outlined in the table below, compared to the original values:

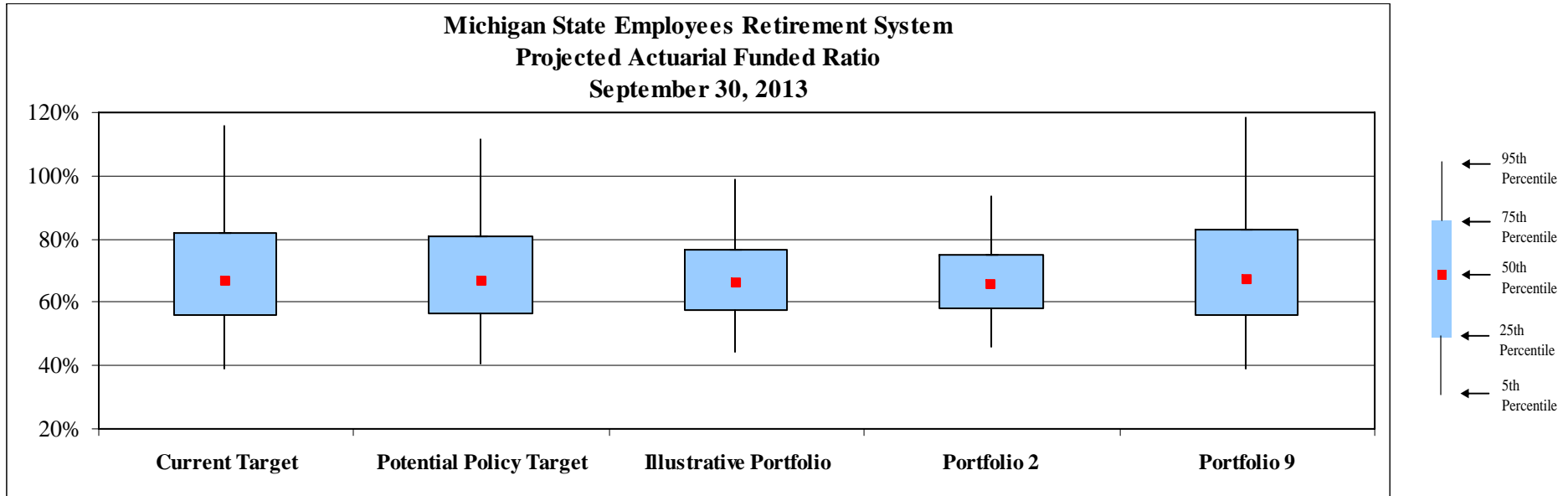
Asset Class	Return Assumption (Annualized)	Risk Assumption (Standard Deviation) Original	Risk Assumption (Standard Deviation) Doubled
Broad US Equity	8.45%	17.25%	34.50%
Broad Int'l Equity	8.85%	18.10%	36.20%
US Core Fixed Income	5.25%	4.50%	9.00%
Real Estate - Core	7.00%	9.25%	18.50%
Real Estate - Opportunistic	12.00%	27.75%	55.50%
Absolute Return	8.00%	7.75%	15.50%
Private Equity	12.50%	29.75%	59.50%
Real Return	7.00%	9.25%	18.50%
Cash Equivalents	3.25%	2.00%	4.00%

RVKuhns supports recommendations based on the original assumptions shown in the Stochastic Analysis section of this report. However, this stress-testing illustrates that potential increased capital market volatility does not change the asset allocation recommendations, based on the current status of the Plan. Instead it simply widens the range of potential results, exacerbating the potential best and worst-case scenarios.

Appendix 1: Sensitivity Analysis: “Effect of Higher Volatility” (continued)

Projected Actuarial Funded Ratio (actuarial assets/actuarial accrued liability); 5 Years

The graph below shows the distribution of possible actuarial funded ratios five years from now, assuming the five different asset mixes highlighted on the prior pages. The results below assume the current contribution policy remains unchanged for all projection years.



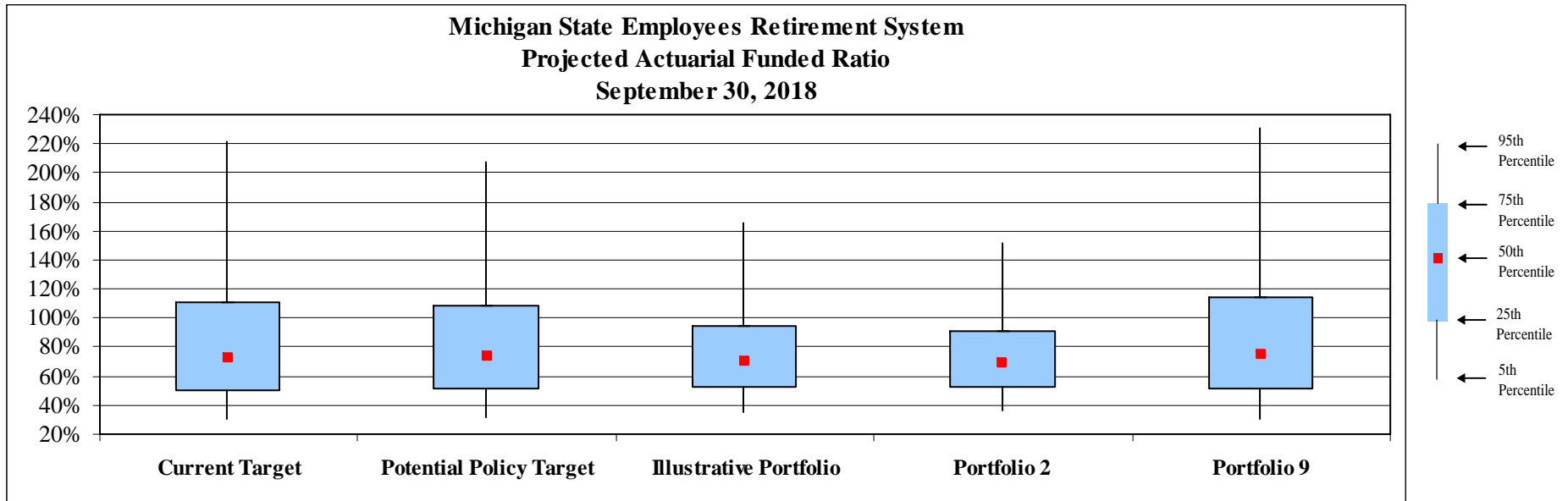
	Current Target		Potential Policy Target		Illustrative Portfolio		Portfolio 2		Portfolio 9	
	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio
5th Percentile	\$8,191,314,169	38.9%	\$7,964,459,715	40.6%	\$7,506,916,292	44.3%	\$7,336,070,468	45.7%	\$8,179,838,482	39.3%
25th Percentile	\$6,294,037,307	55.8%	\$6,158,420,065	56.5%	\$5,970,617,606	57.5%	\$5,886,531,219	58.2%	\$6,223,708,897	56.1%
50th Percentile	\$4,977,407,869	66.6%	\$4,929,425,347	66.8%	\$5,036,951,257	66.1%	\$5,078,644,705	65.6%	\$4,859,131,636	67.2%
75th Percentile	\$3,094,680,488	81.8%	\$3,222,576,792	80.6%	\$3,844,603,996	76.6%	\$4,067,340,780	75.2%	\$2,967,498,670	82.8%
95th Percentile	(\$1,287,435,572)	115.5%	(\$713,332,355)	111.6%	\$1,122,184,851	98.7%	\$1,923,489,499	93.7%	(\$1,959,908,902)	118.4%

Percentiles indicate the probability of achieving a Funded Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile indicates that 50% of the time the Plan can expect a Funded Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected. For further example, the 25th percentile indicates that 25% of the time the Plan can expect a Funded Ratio lower than the ratio shown, and 75% of the time a higher ratio is expected.

Appendix 1: Sensitivity Analysis: “Effect of Higher Volatility” (continued)

Projected Actuarial Funded Ratio (actuarial assets/actuarial accrued liability); 10 Years

The graph below shows the distribution of possible actuarial funded ratios ten years from now, assuming the five different asset mixes highlighted on the prior pages. The results below assume the current contribution policy remains unchanged for all projection years.



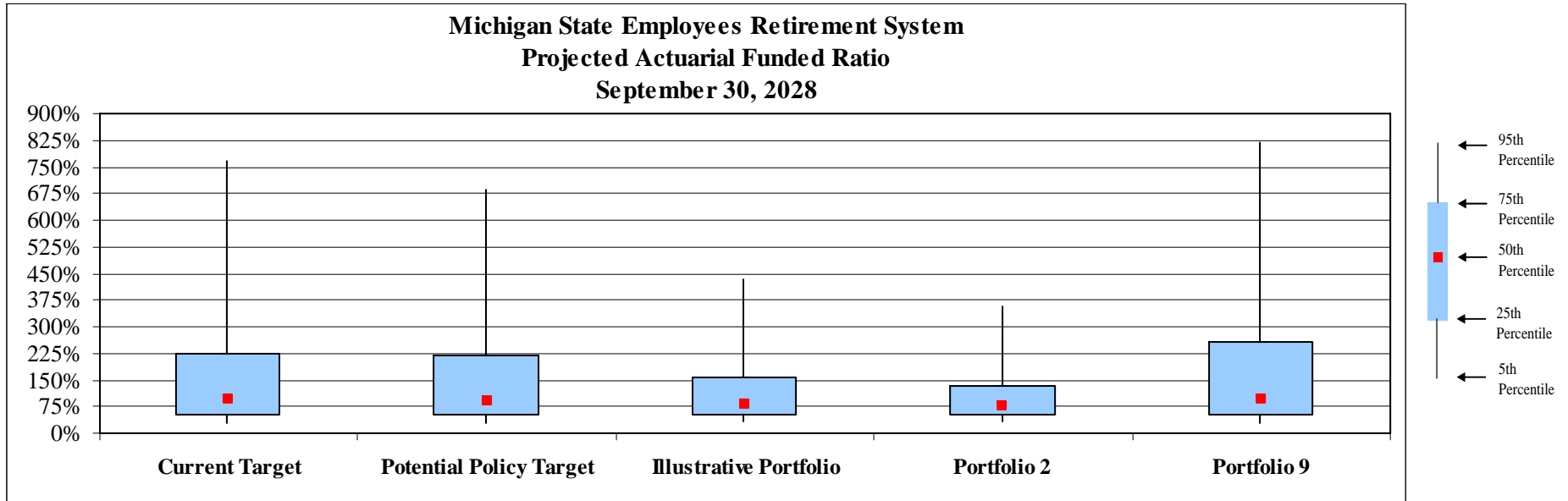
	Current Target		Potential Policy Target		Illustrative Portfolio		Portfolio 2		Portfolio 9	
	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio
5th Percentile	\$9,073,613,317	30.8%	\$8,871,354,733	32.0%	\$8,472,133,219	35.0%	\$8,298,032,835	36.1%	\$8,993,820,419	30.7%
25th Percentile	\$7,052,184,399	50.0%	\$6,862,162,002	51.3%	\$6,797,014,010	52.1%	\$6,766,218,031	52.4%	\$6,912,626,319	51.6%
50th Percentile	\$4,060,742,990	72.8%	\$4,069,253,568	73.3%	\$4,565,494,935	70.2%	\$4,754,180,708	68.5%	\$3,723,666,606	74.9%
75th Percentile	(\$1,074,774,438)	110.5%	(\$652,370,339)	107.9%	\$1,039,345,055	94.7%	\$1,684,500,309	91.6%	(\$1,650,787,150)	114.5%
95th Percentile	(\$18,498,464,452)	221.3%	(\$15,648,870,763)	207.4%	(\$8,815,958,562)	165.9%	(\$6,500,359,068)	151.0%	(\$19,670,117,373)	230.7%

Percentiles indicate the probability of achieving a Funded Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile indicates that 50% of the time the Plan can expect a Funded Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected. For further example, the 25th percentile indicates that 25% of the time the Plan can expect a Funded Ratio lower than the ratio shown, and 75% of the time a higher ratio is expected.

Appendix 1: Sensitivity Analysis: “Effect of Higher Volatility” (continued)

Projected Actuarial Funded Ratio (actuarial assets/actuarial accrued liability); 20 Years

The graph below shows the distribution of possible actuarial funded ratios twenty years from now, assuming the five different asset mixes highlighted on the prior pages. The results below assume the current contribution policy remains unchanged for all projection years.



	Current Target		Potential Policy Target		Illustrative Portfolio		Portfolio 2		Portfolio 9	
	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio
5th Percentile	\$7,038,132,269	28.9%	\$6,886,819,926	30.3%	\$6,748,690,096	31.7%	\$6,663,801,451	32.6%	\$7,019,936,670	29.4%
25th Percentile	\$5,109,326,498	51.5%	\$4,970,028,712	53.4%	\$5,194,749,297	51.3%	\$5,207,944,793	50.9%	\$4,868,785,923	53.2%
50th Percentile	\$815,043,104	93.0%	\$876,834,924	91.6%	\$2,239,177,305	80.8%	\$2,676,174,388	77.7%	\$59,532,898	97.4%
75th Percentile	(\$15,012,897,208)	223.9%	(\$13,748,106,784)	217.2%	(\$6,086,192,303)	155.3%	(\$3,527,642,094)	134.0%	(\$18,790,113,374)	255.1%
95th Percentile	(\$77,655,558,708)	765.7%	(\$70,043,793,273)	684.1%	(\$40,139,173,464)	432.3%	(\$30,624,344,093)	355.3%	(\$89,173,901,974)	820.3%

Percentiles indicate the probability of achieving a Funded Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile indicates that 50% of the time the Plan can expect a Funded Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected. For further example, the 25th percentile indicates that 25% of the time the Plan can expect a Funded Ratio lower than the ratio shown, and 75% of the time a higher ratio is expected.

Appendix 1: Sensitivity Analysis: “Effect of Higher Volatility” (continued)

Projected Actuarial Funded Ratio (actuarial assets/actuarial accrued liability); 20 Years

The table below displays the projected actuarial funded ratio 20 years from now, under a worst-case scenario (5th percentile), assuming the Plan’s assets are allocated at target, as well as the four additional mixes (highlighted on the prior pages).

These figures are displayed graphically on the prior page, but are summarized below to highlight the potential effects that the expected volatility of each mix can have on the Plan’s actuarial funded ratio. Note, however, if the capital market returns produce worst-case results, the contribution level would have to increase, or benefits decrease, to keep the Plan viable. Therefore, the funded ratios shown below are highly unlikely, if not impossible from a practical standpoint. They are shown for illustrative purposes.

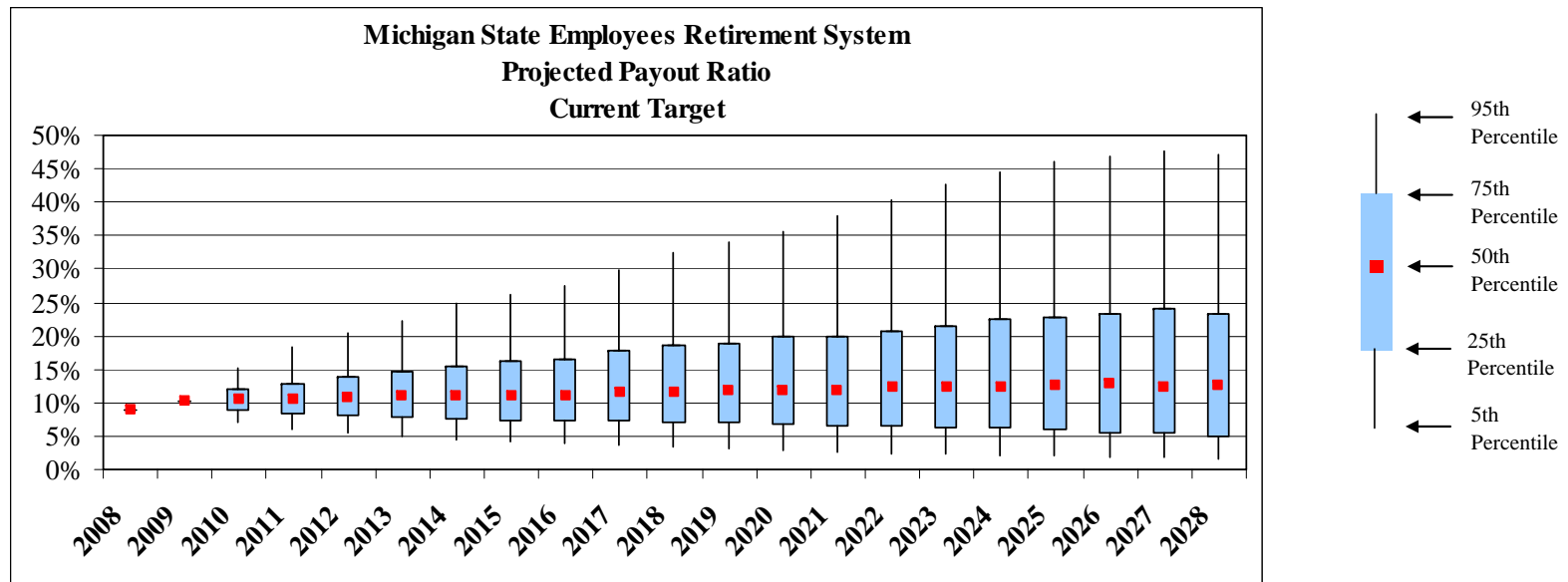
Michigan State Employees Retirement System Worst Case Actuarial Funded Ratio Comparison Septmeber 30, 2028	
Current Target	39%
Potential Policy Target	41%
Illustrative Portfolio	44%
Portfolio 2	46%
Portfolio 9	40%

Appendix 1: Sensitivity Analysis: “Effect of Higher Volatility” (continued)

Projected Payout Ratio (expected benefit payments/market value of assets); Current Target

The graph below displays the range of possible payout ratios over the next twenty years, assuming the Plan’s assets are allocated according to the current target. The results below assume the current contribution policy remains unchanged for all projection years.

The annual median benefit payment is expected to be approximately 9 to 13 percent of the market value of assets in any given year. The worst-case scenario could reach 48% or higher. However, if the capital market returns produce worst-case results, the contribution level would have to increase, or benefits decrease, to keep the Plan viable. Therefore, a payout ratio of 48% is unlikely over much of the forecast period. However, in the later years of the forecast period (circa 2021 to 2028) and beyond, the accelerating financial maturity of the closed MSERS Plan will make the payout ratio highly sensitive to the volatility of the Plan’s assets. This has significant implications for the Plan’s asset allocation and is discussed in more detail in the findings section of this report.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Median	8.8%	10.3%	10.4%	10.5%	10.7%	10.9%	10.9%	11.1%	11.0%	11.4%	11.6%	11.9%	11.8%	11.9%	12.3%	12.2%	12.3%	12.5%	12.8%	12.4%	12.4%

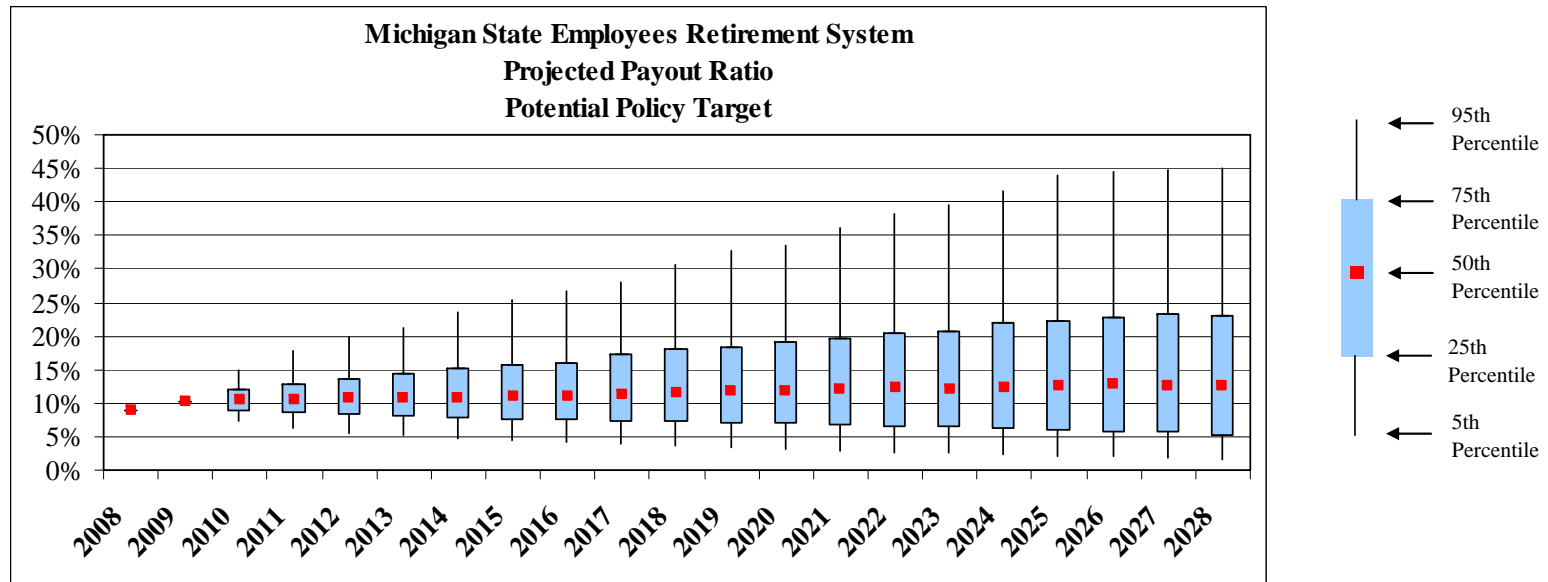
Percentiles indicate the probability of achieving a Payout Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile (median) indicates that 50% of the time the Plan can expect a Payout Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected.

Appendix 1: Sensitivity Analysis: “Effect of Higher Volatility” (continued)

Projected Payout Ratio (expected benefit payments/market value of assets); Potential Policy Target

The graph below displays the range of possible payout ratios over the next twenty years, assuming the Plan’s assets are allocated according to the Potential Policy Target (highlighted on the prior pages). The results below assume the current contribution policy remains unchanged for all projection years.

The annual median benefit payment is expected to be approximately 9 to 13 percent of the market value of assets in any given year. The worst-case scenario could reach 45% or higher. However, if the capital market returns produce worst-case results, the contribution level would have to increase, or benefits decrease, to keep the Plan viable. Therefore, a payout ratio of 45% is unlikely over much of the forecast period. However, in the later years of the forecast period (circa 2021 to 2028) and beyond, the accelerating financial maturity of the closed MSERS Plan will make the payout ratio highly sensitive to the volatility of the Plan’s assets. This has significant implications for the Plan’s asset allocation and is discussed in more detail in the findings section of this report.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Median	8.8%	10.3%	10.4%	10.5%	10.7%	10.8%	10.8%	11.0%	11.1%	11.4%	11.5%	11.8%	11.9%	11.9%	12.3%	12.1%	12.3%	12.6%	12.9%	12.7%	12.7%

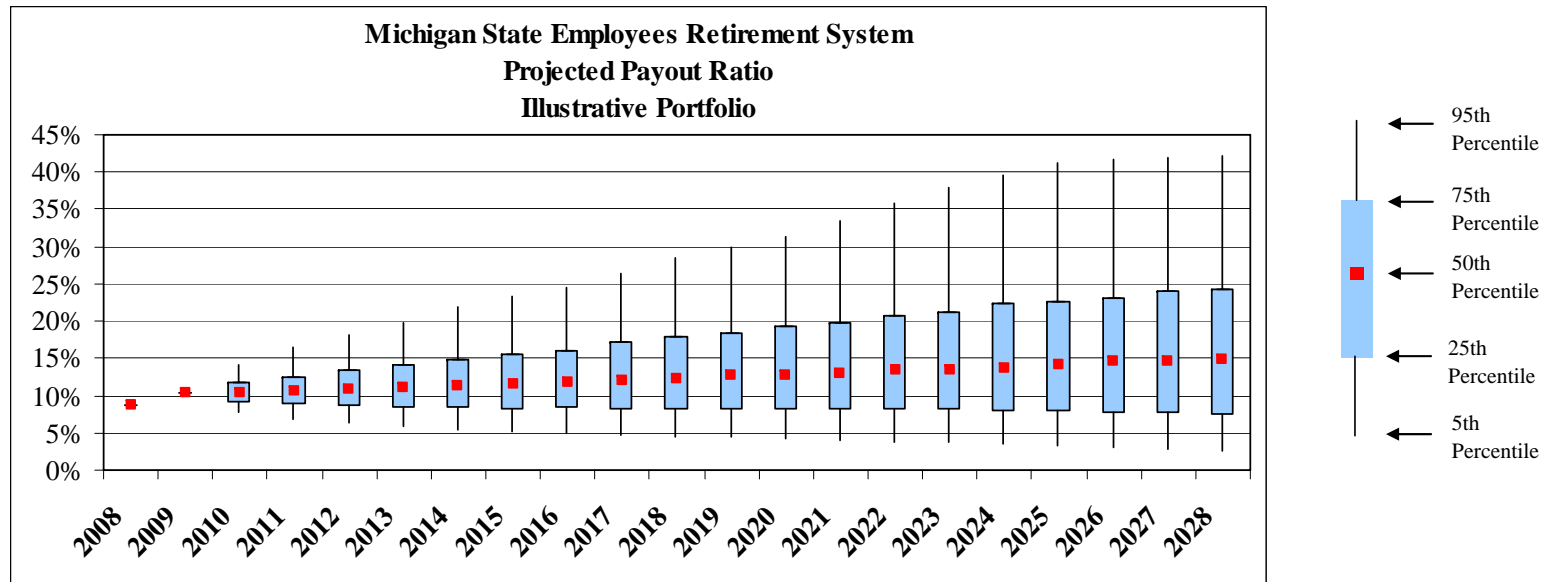
Percentiles indicate the probability of achieving a Payout Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile (median) indicates that 50% of the time the Plan can expect a Payout Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected.

Appendix 1: Sensitivity Analysis: “Effect of Higher Volatility” (continued)

Projected Payout Ratio (expected benefit payments/market value of assets); Illustrative Portfolio

The graph below displays the range of possible payout ratios over the next twenty years, assuming the Plan’s assets are allocated according to the Illustrative Portfolio (highlighted on the prior pages). The results below assume the current contribution policy remains unchanged for all projection years.

The annual median benefit payment is expected to be approximately 9 to 15 percent of the market value of assets in any given year. The worst-case scenario could reach 42% or higher. However, if the capital market returns produce worst-case results, the contribution level would have to increase, or benefits decrease, to keep the Plan viable. Therefore, a payout ratio of 42% is unlikely over much of the forecast period. However, in the later years of the forecast period (circa 2021 to 2028) and beyond, the accelerating financial maturity of the closed MSERS Plan will make the payout ratio highly sensitive to the volatility of the Plan’s assets. This has significant implications for the Plan’s asset allocation and is discussed in more detail in the findings section of this report.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Median	8.8%	10.3%	10.5%	10.6%	10.9%	11.1%	11.2%	11.5%	11.7%	12.1%	12.2%	12.6%	12.7%	12.9%	13.4%	13.5%	13.7%	14.1%	14.5%	14.6%	14.8%

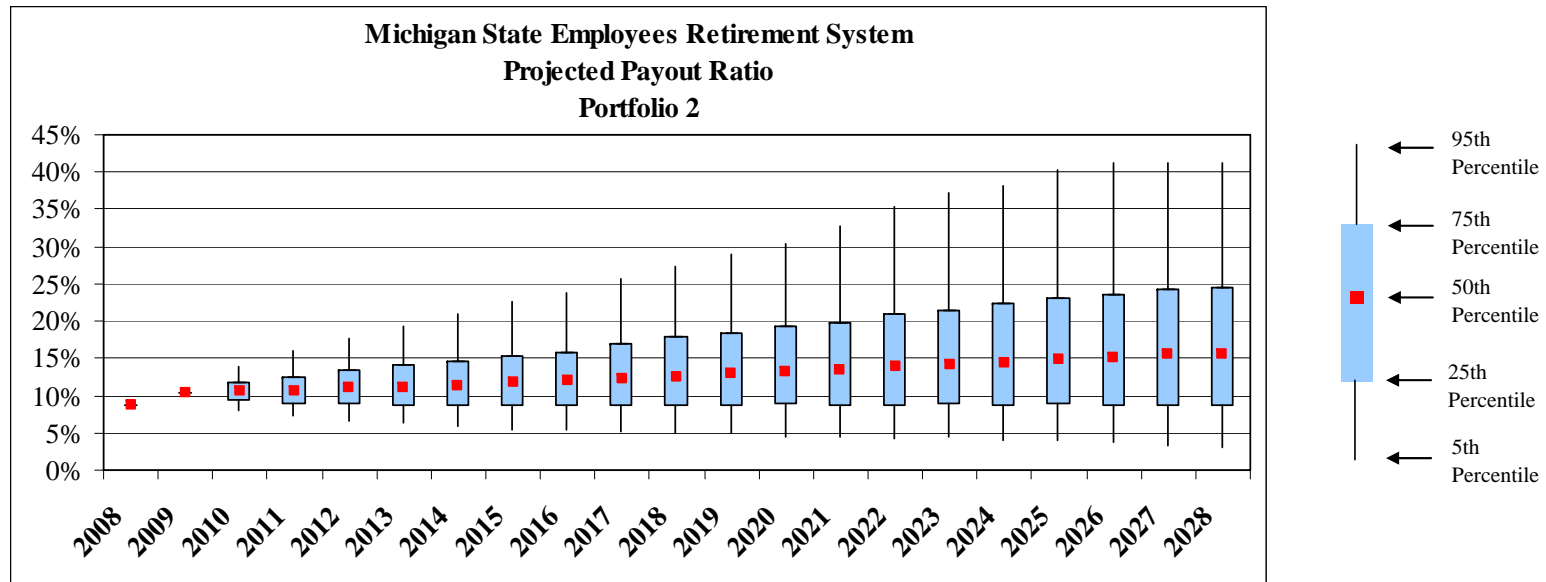
Percentiles indicate the probability of achieving a Payout Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile (median) indicates that 50% of the time the Plan can expect a Payout Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected.

Appendix 1: Sensitivity Analysis: “Effect of Higher Volatility” (continued)

Projected Payout Ratio (expected benefit payments/market value of assets); Portfolio 2

The graph below displays the range of possible payout ratios over the next twenty years, assuming the Plan’s assets are allocated according to Portfolio 2 (highlighted on the prior pages). The results below assume the current contribution policy remains unchanged for all projection years.

The annual median benefit payment is expected to be approximately 9 to 16 percent of the market value of assets in any given year. The worst-case scenario could reach 41% or higher. However, if the capital market returns produce worst-case results, the contribution level would have to increase, or benefits decrease, to keep the Plan viable. Therefore, a payout ratio of 41% is unlikely over much of the forecast period. However, in the later years of the forecast period (circa 2021 to 2028) and beyond, the accelerating financial maturity of the closed MSERS Plan will make the payout ratio highly sensitive to the volatility of the Plan’s assets. This has significant implications for the Plan’s asset allocation and is discussed in more detail in the findings section of this report.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Median	8.8%	10.3%	10.5%	10.6%	11.0%	11.2%	11.4%	11.7%	12.0%	12.2%	12.5%	12.9%	13.2%	13.3%	13.8%	14.1%	14.3%	14.8%	15.2%	15.5%	15.6%

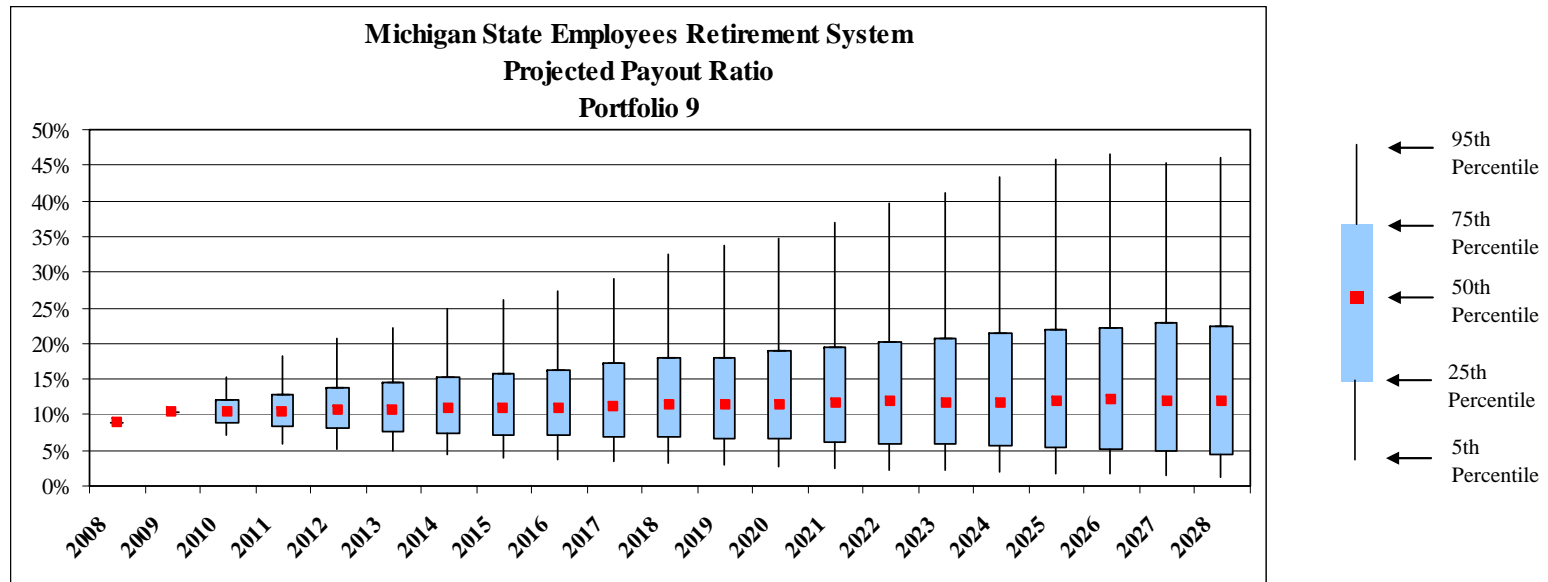
Percentiles indicate the probability of achieving a Payout Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile (median) indicates that 50% of the time the Plan can expect a Payout Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected.

Appendix 1: Sensitivity Analysis: “Effect of Higher Volatility” (continued)

Projected Payout Ratio (expected benefit payments/market value of assets); Portfolio 9

The graph below displays the range of possible payout ratios over the next twenty years, assuming the Plan’s assets are allocated according to Portfolio 9 (highlighted on the prior pages). The results below assume the current contribution policy remains unchanged for all projection years.

The annual median benefit payment is expected to be approximately 9 to 12 percent of the market value of assets in any given year. The worst-case scenario could reach 46% or higher. However, if the capital market returns produce worst-case results, the contribution level would have to increase, or benefits decrease, to keep the Plan viable. Therefore, a payout ratio of 46% is unlikely over much of the forecast period. However, in the later years of the forecast period (circa 2021 to 2028) and beyond, the accelerating financial maturity of the closed MSERS Plan will make the payout ratio highly sensitive to the volatility of the Plan’s assets. This has significant implications for the Plan’s asset allocation and is discussed in more detail in the findings section of this report.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Median	8.8%	10.3%	10.4%	10.4%	10.6%	10.7%	10.8%	10.7%	10.8%	11.2%	11.2%	11.4%	11.4%	11.5%	11.8%	11.5%	11.6%	11.8%	12.0%	11.8%	11.7%

Percentiles indicate the probability of achieving a Payout Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile (median) indicates that 50% of the time the Plan can expect a Payout Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected.

Appendix 1: Sensitivity Analysis: “Effect of Higher Volatility” (continued)

Projected Payout Ratio (expected benefit payments/market value of assets); 20 Years

The table below displays the projected payout ratio twenty years from now, under the worst-case scenario (95th percentile), assuming the Plan’s assets are allocated at target, as well as the four additional mixes (highlighted on the prior pages).

These figures are displayed graphically on the previous 5 pages, but are summarized below to highlight the potential effects that the expected volatility of each mix can have on the payout ratio. Note, however, if the capital market returns produce worst-case results, the contribution level would have to increase, or benefits decrease, to keep the Plan viable. Therefore, the payout ratios shown below are unlikely over much of the forecast period. However, in the later years of the forecast period (circa 2021 to 2028) and beyond, the accelerating financial maturity of the closed MSERS Plan will make the payout ratio highly sensitive to the volatility of the Plan’s assets. This has significant implications for the Plan’s asset allocation and is discussed in more detail in the findings section of this report.

Michigan State Employees Retirement System Worst Case Payout Ratio Comparison September 30, 2028	
Current Target	48%
Potential Policy Target	45%
Illustrative Portfolio	42%
Portfolio 2	41%
Portfolio 9	46%

Appendix 1: Sensitivity Analysis: “Effect of Higher Volatility” (continued)

Drawing Inferences

The table below compares the projected actuarial funded ratio 20 years from now, under the median (50th percentile), worst-case (5th percentile), and best-case (95th percentile) scenarios, assuming the five different asset mixes highlighted on the prior pages. The table also displays for comparative purposes the median, peak, and trough projected payout ratios over the 20 year period, assuming the same five asset mixes being examined.

	Funded Ratio in Year 20			Payout Ratios 2008-2028		
	50th	5th	95th	Median	Peak	Trough
Current Target	93.0%	28.9%	765.7%	11.6%	47.5%	1.5%
Potential Policy Target	91.6%	30.3%	684.1%	11.5%	45.0%	1.7%
Illustrative Portfolio	80.8%	31.7%	432.3%	12.2%	42.3%	2.5%
Portfolio 2	77.7%	32.6%	355.3%	12.5%	41.3%	3.0%
Portfolio 9	97.4%	29.4%	820.3%	11.2%	46.5%	1.3%

Appendix 2: Sensitivity Analysis: “Effect of Higher Correlations”

This section provides a sensitivity analysis of the original stochastic analysis by assuming that all asset classes are perfectly positively correlated (i.e. correlation = 1.00). A correlation matrix reflecting these modified assumptions is provided below:

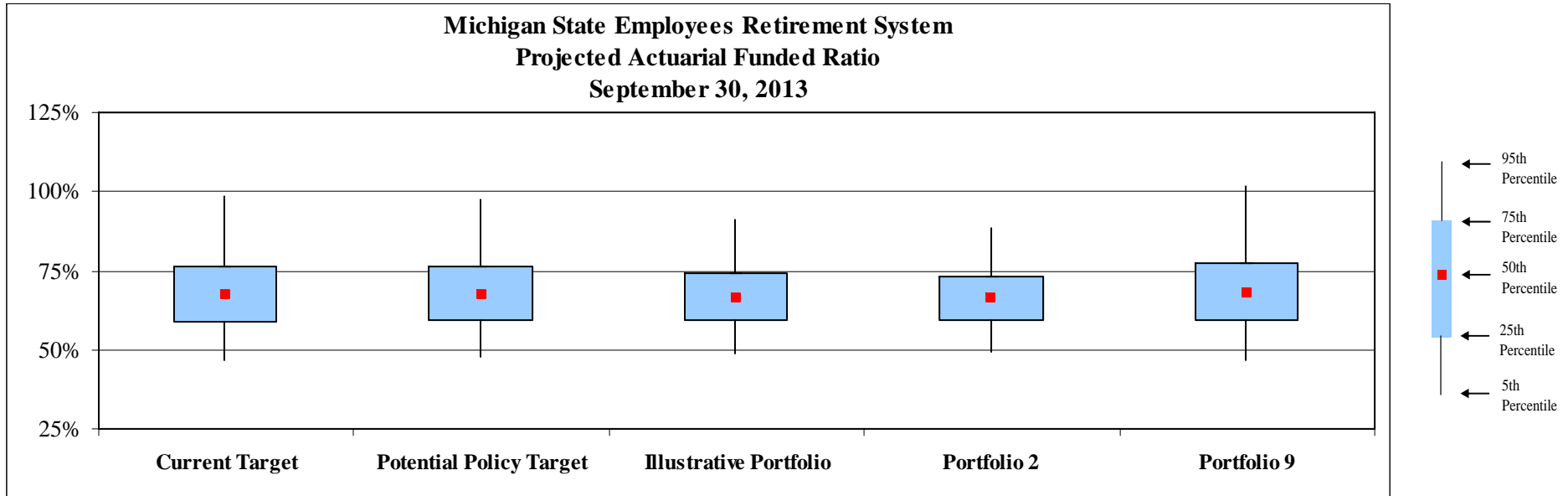
	Broad US Equity	Broad Int'l Equity	US Core Fixed Income	Real Estate - Core	Real Estate - Opp	Absolute Return	Private Equity	Real Return	Cash Equivalents
Broad US Equity	1.00								
Broad Int'l Equity	1.00	1.00							
US Core Fixed Income	1.00	1.00	1.00						
Real Estate - Core	1.00	1.00	1.00	1.00					
Real Estate - Opp	1.00	1.00	1.00	1.00	1.00				
Absolute Return	1.00	1.00	1.00	1.00	1.00	1.00			
Private Equity	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
Real Return	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Cash Equivalents	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

RVKuhns supports recommendations based on the original assumptions shown in the Stochastic Analysis section of this report. However, this stress-testing illustrates that converging correlations across capital markets do not change the asset allocation recommendations, based on the current status of the Plan. Instead it simply widens the range of potential results, indicating higher risk for all asset mixes given the dampened effects of total fund diversification.

Appendix 2: Sensitivity Analysis: “Effect of Higher Correlations” (continued)

Projected Actuarial Funded Ratio (actuarial assets/actuarial accrued liability); 5 Years

The graph below shows the distribution of possible actuarial funded ratios five years from now, assuming the five different asset mixes highlighted on the prior pages. The results below assume the current contribution policy remains unchanged for all projection years.



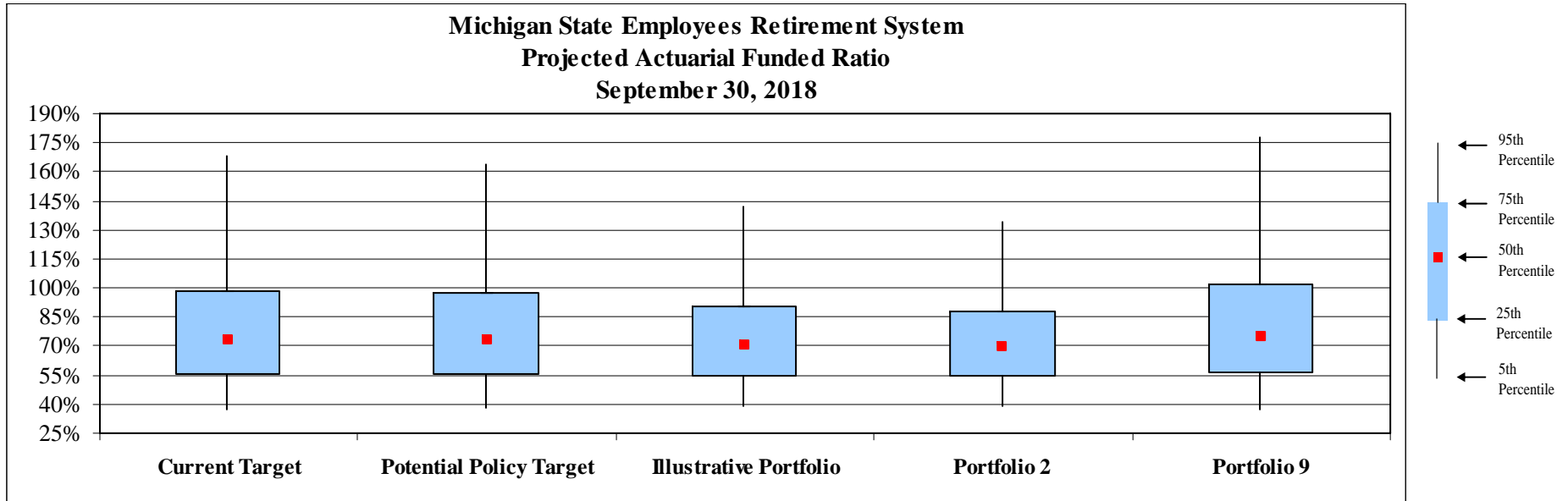
	Current Target		Potential Policy Target		Illustrative Portfolio		Portfolio 2		Portfolio 9	
	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio
5th Percentile	\$7,628,702,224	46.8%	\$7,520,802,423	47.6%	\$7,368,087,250	48.8%	\$7,281,756,334	49.5%	\$7,630,605,153	46.8%
25th Percentile	\$6,021,593,379	59.1%	\$5,974,042,167	59.4%	\$5,967,419,552	59.4%	\$5,957,724,240	59.5%	\$5,987,956,179	59.3%
50th Percentile	\$4,872,340,236	67.2%	\$4,865,138,236	67.2%	\$4,991,684,547	66.4%	\$5,042,498,817	66.0%	\$4,802,824,306	67.6%
75th Percentile	\$3,582,911,735	76.5%	\$3,623,084,637	76.1%	\$3,930,280,037	74.1%	\$4,056,998,052	73.1%	\$3,447,825,228	77.4%
95th Percentile	\$211,216,370	98.7%	\$444,902,578	97.3%	\$1,402,011,908	91.1%	\$1,814,665,842	88.7%	(\$224,969,542)	101.7%

Percentiles indicate the probability of achieving a Funded Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile indicates that 50% of the time the Plan can expect a Funded Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected. For further example, the 25th percentile indicates that 25% of the time the Plan can expect a Funded Ratio lower than the ratio shown, and 75% of the time a higher ratio is expected.

Appendix 2: Sensitivity Analysis: “Effect of Higher Correlations” (continued)

Projected Actuarial Funded Ratio (actuarial assets/actuarial accrued liability); 10 Years

The graph below shows the distribution of possible actuarial funded ratios ten years from now, assuming the five different asset mixes highlighted on the prior pages. The results below assume the current contribution policy remains unchanged for all projection years.



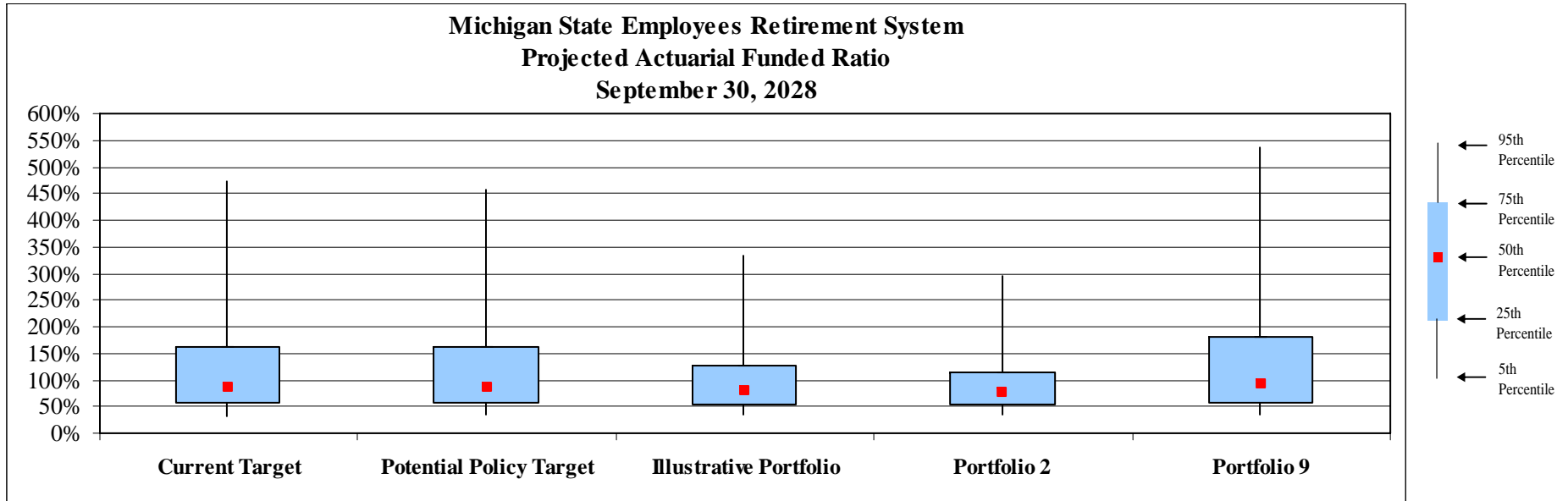
	Current Target		Potential Policy Target		Illustrative Portfolio		Portfolio 2		Portfolio 9	
	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio
5th Percentile	\$9,036,973,091	37.0%	\$8,937,787,373	37.7%	\$8,832,694,051	38.5%	\$8,772,238,993	39.0%	\$9,010,537,894	37.2%
25th Percentile	\$6,660,773,179	55.2%	\$6,572,446,568	55.9%	\$6,702,306,045	55.1%	\$6,746,670,099	54.8%	\$6,523,989,601	56.5%
50th Percentile	\$4,095,494,519	73.0%	\$4,069,175,334	73.2%	\$4,567,512,489	70.2%	\$4,736,542,986	69.1%	\$3,802,404,826	75.1%
75th Percentile	\$271,964,624	98.2%	\$364,809,130	97.6%	\$1,470,927,957	90.3%	\$1,931,260,831	87.8%	(\$243,466,243)	101.5%
95th Percentile	(\$11,038,739,578)	168.4%	(\$10,407,452,766)	164.1%	(\$6,825,499,528)	141.7%	(\$5,505,712,366)	134.3%	(\$12,570,983,233)	178.1%

Percentiles indicate the probability of achieving a Funded Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile indicates that 50% of the time the Plan can expect a Funded Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected. For further example, the 25th percentile indicates that 25% of the time the Plan can expect a Funded Ratio lower than the ratio shown, and 75% of the time a higher ratio is expected.

Appendix 2: Sensitivity Analysis: “Effect of Higher Correlations” (continued)

Projected Actuarial Funded Ratio (actuarial assets/actuarial accrued liability); 20 Years

The graph below shows the distribution of possible actuarial funded ratios twenty years from now, assuming the five different asset mixes highlighted on the prior pages. The results below assume the current contribution policy remains unchanged for all projection years.



	Current Target		Potential Policy Target		Illustrative Portfolio		Portfolio 2		Portfolio 9	
	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio	Unfunded Liability	Funded Ratio
5th Percentile	\$7,444,188,770	33.3%	\$7,335,887,666	33.9%	\$7,369,007,879	33.8%	\$7,361,669,683	34.0%	\$7,367,141,588	33.9%
25th Percentile	\$5,141,548,528	56.0%	\$5,050,523,866	56.8%	\$5,416,988,144	53.8%	\$5,532,767,097	52.6%	\$4,859,743,956	58.3%
50th Percentile	\$1,662,417,314	86.4%	\$1,616,006,203	86.7%	\$2,655,500,215	78.0%	\$3,034,992,465	75.0%	\$912,127,670	92.8%
75th Percentile	(\$7,713,533,998)	161.9%	(\$7,498,400,930)	160.4%	(\$3,295,373,524)	126.0%	(\$1,934,473,198)	115.6%	(\$10,003,064,816)	180.4%
95th Percentile	(\$48,780,413,865)	473.5%	(\$46,218,159,006)	456.0%	(\$30,698,490,386)	334.4%	(\$25,158,020,076)	294.1%	(\$56,873,351,518)	535.2%

Percentiles indicate the probability of achieving a Funded Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile indicates that 50% of the time the Plan can expect a Funded Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected. For further example, the 25th percentile indicates that 25% of the time the Plan can expect a Funded Ratio lower than the ratio shown, and 75% of the time a higher ratio is expected.

Appendix 2: Sensitivity Analysis: “Effect of Higher Correlations” (continued)

Projected Actuarial Funded Ratio (actuarial assets/actuarial accrued liability); 20 Years

The table below displays the projected actuarial funded ratio 20 years from now, under a worst-case scenario (5th percentile), assuming the Plan’s assets are allocated at target, as well as the four additional mixes (highlighted on the prior pages).

These figures are displayed graphically on the prior page, but are summarized below to highlight the potential effects that the expected volatility of each mix can have on the Plan’s actuarial funded ratio. Note, however, if the capital market returns produce worst-case results, the contribution level would have to increase, or benefits decrease, to keep the Plan viable. Therefore, the funded ratios shown below are highly unlikely, if not impossible from a practical standpoint. They are shown for illustrative purposes.

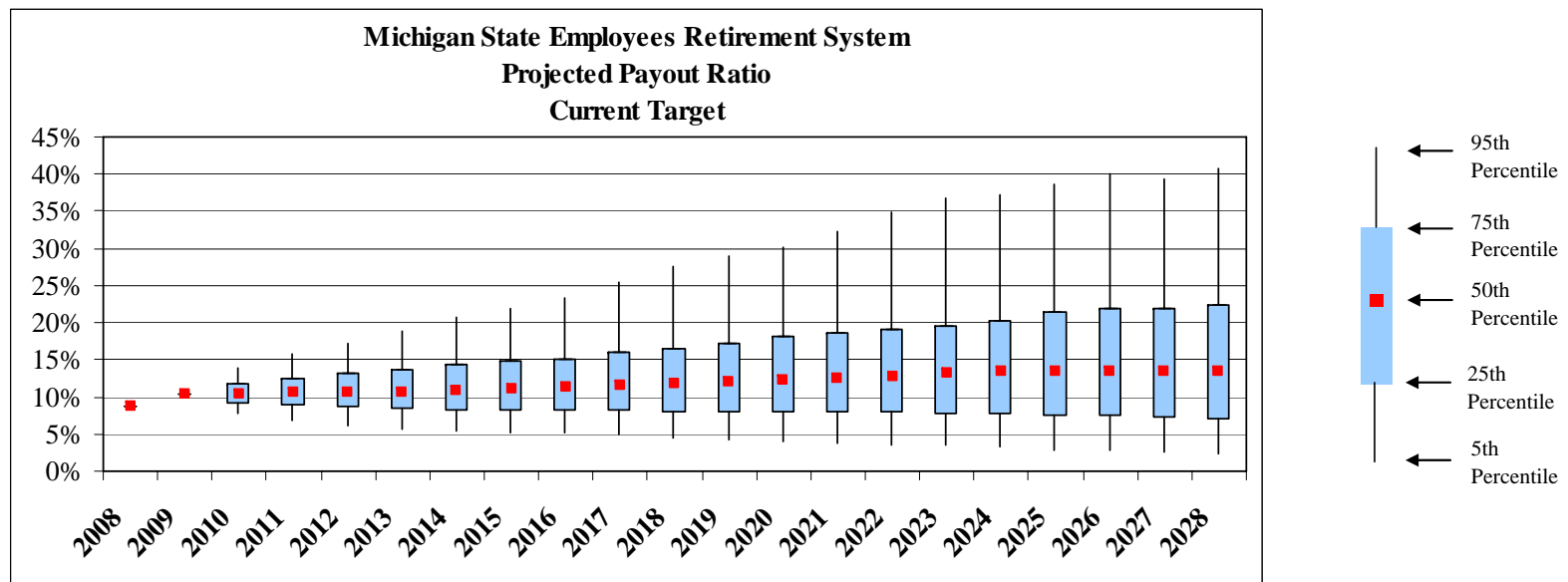
Michigan State Employees Retirement System Worst Case Actuarial Funded Ratio Comparison Septmeber 30, 2028	
Current Target	33%
Potential Policy Target	34%
Illustrative Portfolio	34%
Portfolio 2	34%
Portfolio 9	34%

Appendix 2: Sensitivity Analysis: “Effect of Higher Correlations” (continued)

Projected Payout Ratio (expected benefit payments/market value of assets); Current Target

The graph below displays the range of possible payout ratios over the next twenty years, assuming the Plan’s assets are allocated according to the current target. The results below assume the current contribution policy remains unchanged for all projection years.

The annual median benefit payment is expected to be approximately 9 to 14 percent of the market value of assets in any given year. The worst-case scenario could reach 41% or higher. However, if the capital market returns produce worst-case results, the contribution level would have to increase, or benefits decrease, to keep the Plan viable. Therefore, a payout ratio of 41% is unlikely over much of the forecast period. However, in the later years of the forecast period (circa 2021 to 2028) and beyond, the accelerating financial maturity of the closed MSERS Plan will make the payout ratio highly sensitive to the volatility of the Plan’s assets. This has significant implications for the Plan’s asset allocation and is discussed in more detail in the findings section of this report.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Median	8.8%	10.3%	10.4%	10.6%	10.7%	10.7%	10.9%	11.1%	11.3%	11.4%	11.7%	12.0%	12.1%	12.4%	12.8%	13.1%	13.3%	13.3%	13.5%	13.5%	13.5%

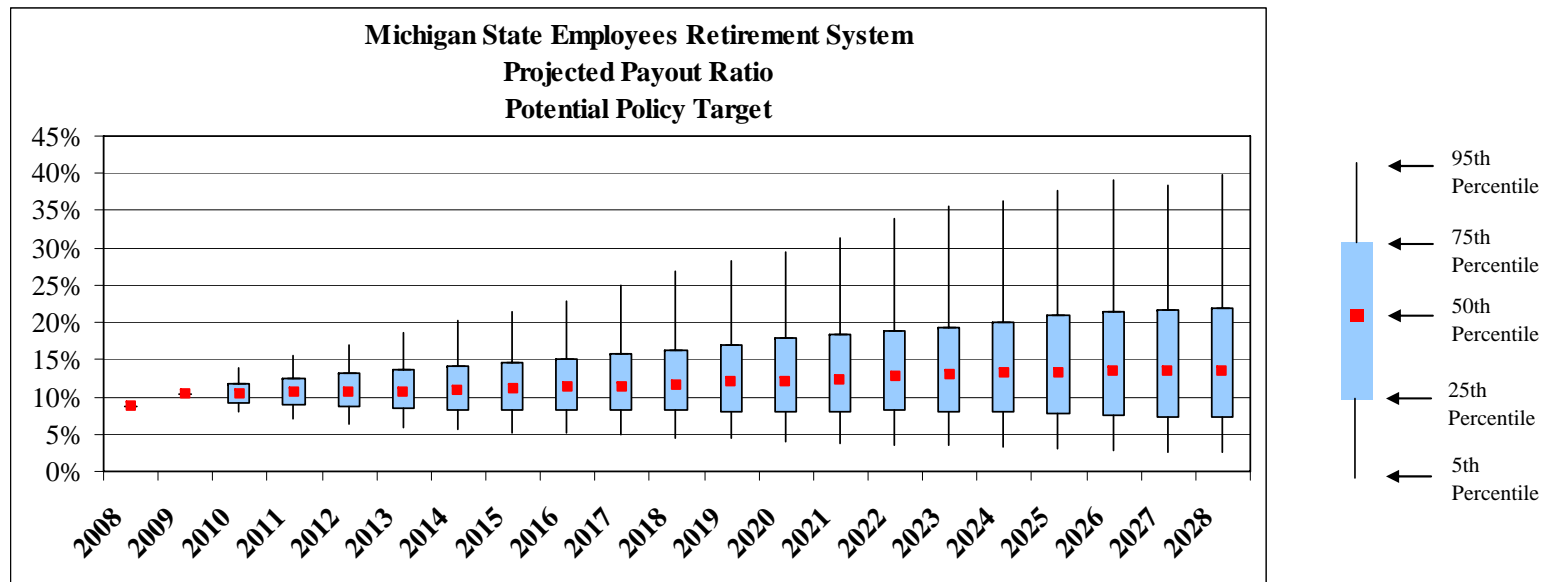
Percentiles indicate the probability of achieving a Payout Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile (median) indicates that 50% of the time the Plan can expect a Payout Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected.

Appendix 2: Sensitivity Analysis: “Effect of Higher Correlations” (continued)

Projected Payout Ratio (expected benefit payments/market value of assets); Potential Policy Target

The graph below displays the range of possible payout ratios over the next twenty years, assuming the Plan’s assets are allocated according to the Potential Policy Target (highlighted on the prior pages). The results below assume the current contribution policy remains unchanged for all projection years.

The annual median benefit payment is expected to be approximately 9 to 13 percent of the market value of assets in any given year. The worst-case scenario could reach 40% or higher. However, if the capital market returns produce worst-case results, the contribution level would have to increase, or benefits decrease, to keep the Plan viable. Therefore, a payout ratio of 40% is unlikely over much of the forecast period. However, in the later years of the forecast period (circa 2021 to 2028) and beyond, the accelerating financial maturity of the closed MSERS Plan will make the payout ratio highly sensitive to the volatility of the Plan’s assets. This has significant implications for the Plan’s asset allocation and is discussed in more detail in the findings section of this report.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Median	8.8%	10.3%	10.4%	10.6%	10.6%	10.7%	10.9%	11.1%	11.2%	11.4%	11.6%	12.0%	12.1%	12.4%	12.7%	13.0%	13.2%	13.3%	13.4%	13.4%	13.4%

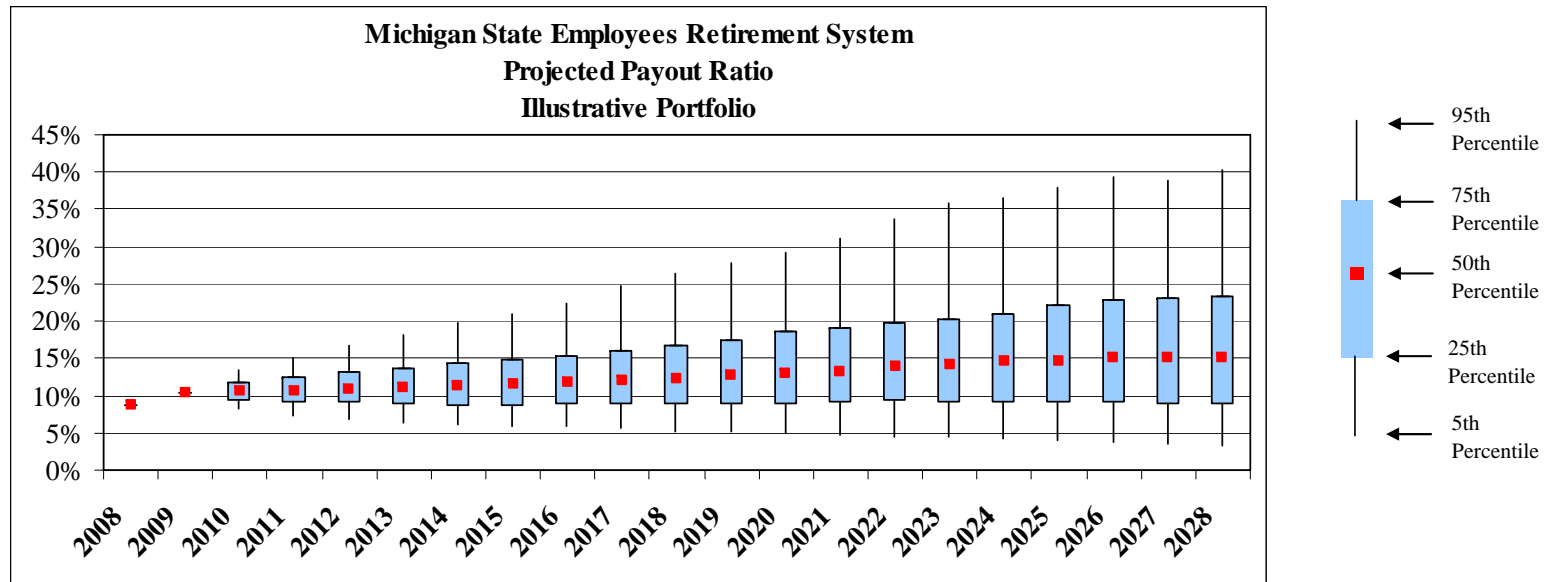
Percentiles indicate the probability of achieving a Payout Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile (median) indicates that 50% of the time the Plan can expect a Payout Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected.

Appendix 2: Sensitivity Analysis: “Effect of Higher Correlations” (continued)

Projected Payout Ratio (expected benefit payments/market value of assets); Illustrative Portfolio

The graph below displays the range of possible payout ratios over the next twenty years, assuming the Plan’s assets are allocated according to the Illustrative Portfolio (highlighted on the prior pages). The results below assume the current contribution policy remains unchanged for all projection years.

The annual median benefit payment is expected to be approximately 9 to 15 percent of the market value of assets in any given year. The worst-case scenario could reach 40% or higher. However, if the capital market returns produce worst-case results, the contribution level would have to increase, or benefits decrease, to keep the Plan viable. Therefore, a payout ratio of 40% is unlikely over much of the forecast period. However, in the later years of the forecast period (circa 2021 to 2028) and beyond, the accelerating financial maturity of the closed MSERS Plan will make the payout ratio highly sensitive to the volatility of the Plan’s assets. This has significant implications for the Plan’s asset allocation and is discussed in more detail in the findings section of this report.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Median	8.8%	10.3%	10.5%	10.7%	10.9%	11.0%	11.2%	11.5%	11.7%	11.9%	12.3%	12.7%	12.9%	13.3%	13.8%	14.2%	14.5%	14.7%	15.0%	15.2%	15.2%

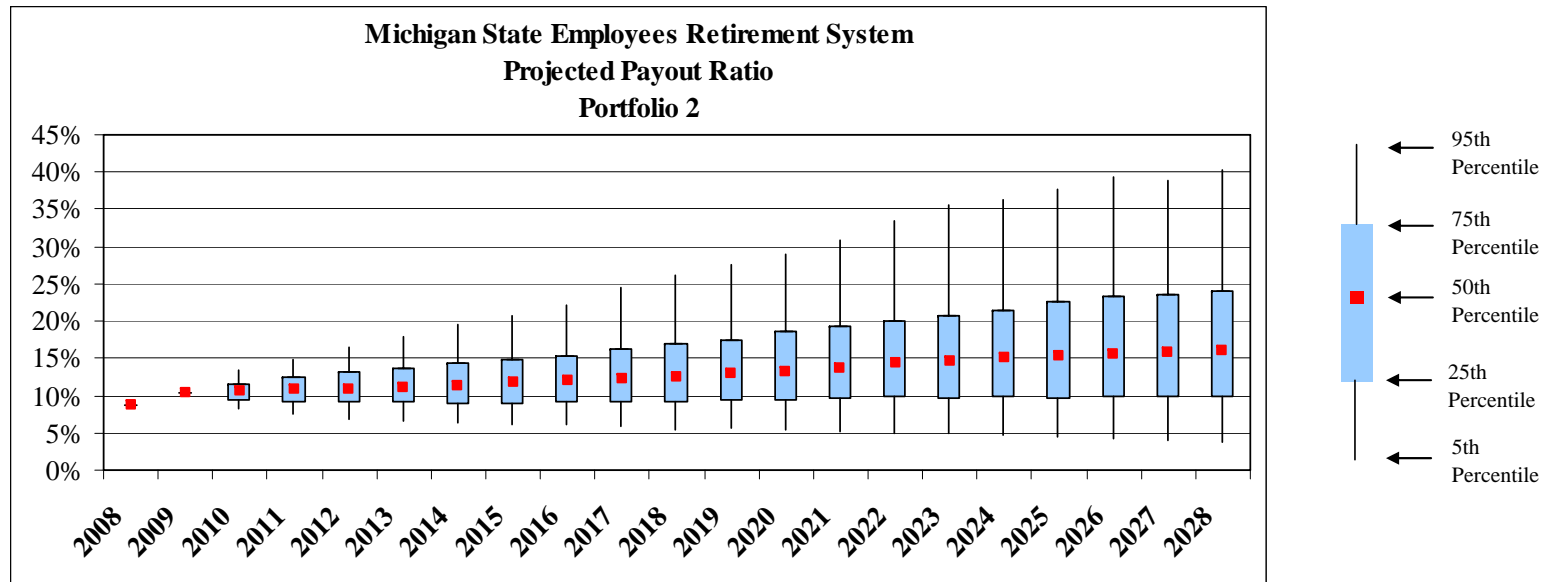
Percentiles indicate the probability of achieving a Payout Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile (median) indicates that 50% of the time the Plan can expect a Payout Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected.

Appendix 2: Sensitivity Analysis: “Effect of Higher Correlations” (continued)

Projected Payout Ratio (expected benefit payments/market value of assets); Portfolio 2

The graph below displays the range of possible payout ratios over the next twenty years, assuming the Plan’s assets are allocated according to Portfolio 2 (highlighted on the prior pages). The results below assume the current contribution policy remains unchanged for all projection years.

The annual median benefit payment is expected to be approximately 9 to 16 percent of the market value of assets in any given year. The worst-case scenario could reach 40% or higher. However, if the capital market returns produce worst-case results, the contribution level would have to increase, or benefits decrease, to keep the Plan viable. Therefore, a payout ratio of 40% is unlikely over much of the forecast period. However, in the later years of the forecast period (circa 2021 to 2028) and beyond, the accelerating financial maturity of the closed MSERS Plan will make the payout ratio highly sensitive to the volatility of the Plan’s assets. This has significant implications for the Plan’s asset allocation and is discussed in more detail in the findings section of this report.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Median	8.8%	10.3%	10.5%	10.7%	10.9%	11.1%	11.4%	11.7%	11.9%	12.2%	12.6%	13.0%	13.3%	13.7%	14.3%	14.7%	15.0%	15.3%	15.6%	15.8%	15.9%

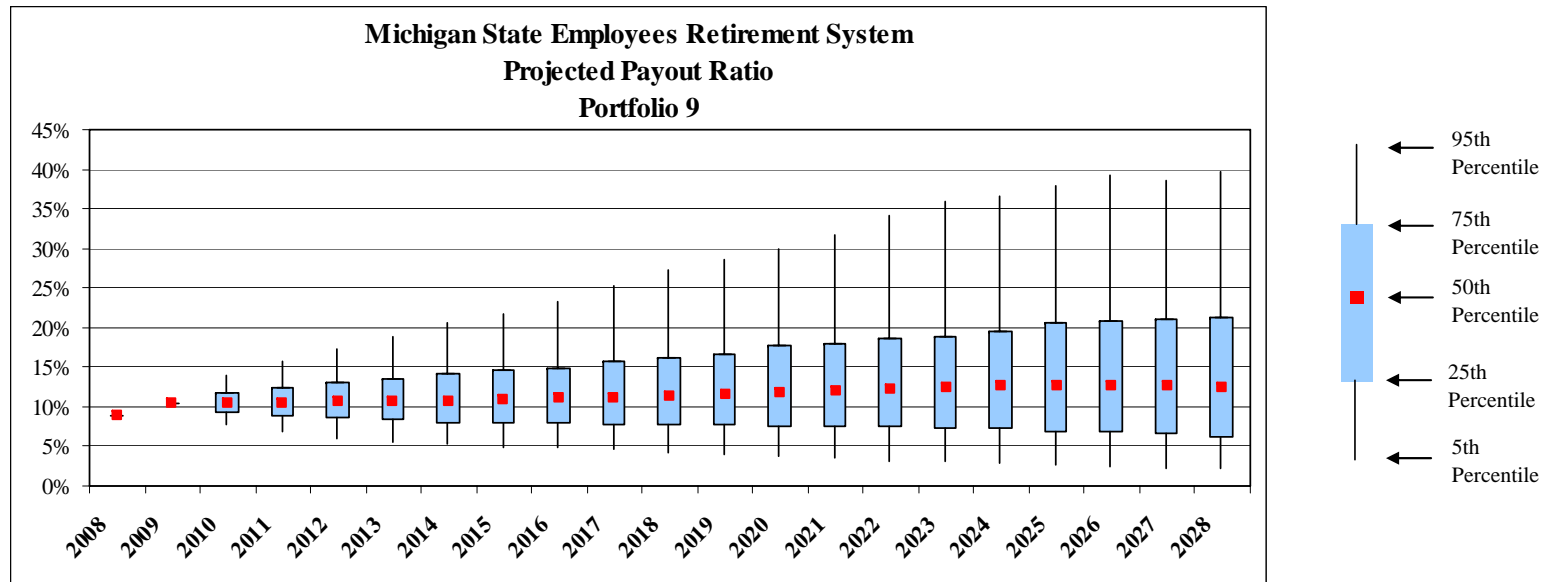
Percentiles indicate the probability of achieving a Payout Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile (median) indicates that 50% of the time the Plan can expect a Payout Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected.

Appendix 2: Sensitivity Analysis: “Effect of Higher Correlations” (continued)

Projected Payout Ratio (expected benefit payments/market value of assets); Portfolio 9

The graph below displays the range of possible payout ratios over the next twenty years, assuming the Plan’s assets are allocated according to Portfolio 9 (highlighted on the prior pages). The results below assume the current contribution policy remains unchanged for all projection years.

The annual median benefit payment is expected to be approximately 9 to 13 percent of the market value of assets in any given year. The worst-case scenario could reach 40% or higher. However, if the capital market returns produce worst-case results, the contribution level would have to increase, or benefits decrease, to keep the Plan viable. Therefore, a payout ratio of 40% is unlikely over much of the forecast period. However, in the later years of the forecast period (circa 2021 to 2028) and beyond, the accelerating financial maturity of the closed MSERS Plan will make the payout ratio highly sensitive to the volatility of the Plan’s assets. This has significant implications for the Plan’s asset allocation and is discussed in more detail in the findings section of this report.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Median	8.8%	10.3%	10.4%	10.5%	10.5%	10.5%	10.7%	10.9%	11.0%	11.1%	11.3%	11.6%	11.7%	11.9%	12.2%	12.5%	12.6%	12.6%	12.6%	12.5%	12.5%

Percentiles indicate the probability of achieving a Payout Ratio higher or lower than the corresponding ratio. For instance, the 50th percentile (median) indicates that 50% of the time the Plan can expect a Payout Ratio lower than the ratio shown, and 50% of the time a higher ratio can be expected.

Appendix 2: Sensitivity Analysis: “Effect of Higher Correlations” (continued)

Projected Payout Ratio (expected benefit payments/market value of assets); 20 Years

The table below displays the projected payout ratio twenty years from now, under the worst-case scenario (95th percentile), assuming the Plan’s assets are allocated at target, as well as the four additional mixes (highlighted on the prior pages).

These figures are displayed graphically on the previous 5 pages, but are summarized below to highlight the potential effects that the expected volatility of each mix can have on the payout ratio. Note, however, if the capital market returns produce worst-case results, the contribution level would have to increase, or benefits decrease, to keep the Plan viable. Therefore, the payout ratios shown below are unlikely over much of the forecast period. However, in the later years of the forecast period (circa 2021 to 2028) and beyond, the accelerating financial maturity of the closed MSERS Plan will make the payout ratio highly sensitive to the volatility of the Plan’s assets. This has significant implications for the Plan’s asset allocation and is discussed in more detail in the findings section of this report.

Michigan State Employees Retirement System Worst Case Payout Ratio Comparison September 30, 2028	
Current Target	41%
Potential Policy Target	40%
Illustrative Portfolio	40%
Portfolio 2	40%
Portfolio 9	40%

Appendix 2: Sensitivity Analysis: “Effect of Higher Correlations” (continued)

Drawing Inferences

The table below compares the projected actuarial funded ratio 20 years from now, under the median (50th percentile), worst-case (5th percentile), and best-case (95th percentile) scenarios, assuming the five different asset mixes highlighted on the prior pages. The table also displays for comparative purposes the median, peak, and trough projected payout ratios over the 20 year period, assuming the same five asset mixes being examined.

	Funded Ratio in Year 20			Payout Ratios 2008-2028		
	50th	5th	95th	Peak	Trough	Median
Current Target	86.4%	33.3%	473.5%	40.7%	2.4%	11.7%
Potential Policy Target	86.7%	33.9%	456.0%	39.8%	2.5%	11.6%
Illustrative Portfolio	78.0%	33.8%	334.4%	40.3%	3.3%	12.3%
Portfolio 2	75.0%	34.0%	294.1%	40.3%	3.8%	12.6%
Portfolio 9	92.8%	33.9%	535.2%	39.8%	2.1%	11.3%

Appendix 3: Assumptions and Methods

Actuarial Assumptions and Methods: (as presented in the Michigan State Employees Retirement System September 30, 2008 Actuarial Valuation, prepared by Gabriel Roeder Smith & Company)

Actuarial Cost Method	Individual Entry-Age Actuarial Cost Method
Liability Discount Rate	8.00% compounded annually
Future Salary Increases	Future salary increases are outlined in the table on page E-2 of the September 30, 2008 Actuarial Valuation for the Michigan State Employees Retirement System
Retirement	Retirement assumptions are outlined in the table on page E-4 of the September 30, 2008 Actuarial Valuation for the Michigan State Employees Retirement System
Mortality	1994 Group Annuity Mortality. Disabled life mortality as described on page E-3 of the September 30, 2008 Actuarial Valuation for the Michigan State Employees Retirement System
Disability	Rates of disability as outlined in the table on page E-6 of the September 30, 2008 Actuarial Valuation for the Michigan State Employees Retirement System
Withdrawal	Rates of separation from active membership as outlined in the table on page E-5 of the September 30, 2008 Actuarial Valuation for the Michigan State Employees Retirement System
Asset Valuation Method	Five-year phase-in of differences between actual and expected investment return

Appendix 3: Assumptions and Methods (continued)

Projection Assumptions: (used in the deterministic and stochastic asset/liability projections)

Total Contributions	Equal to the normal cost under the actuarial cost method plus a payment/(credit) to amortize the unfunded liability.
New Entrants	The Plan is closed to new entrants
Expected Inflation	3.5% compounded annually
Rate of Return on Assets	<u>Deterministic Analysis:</u> 8.00% compounded annually <u>Stochastic Analysis:</u> Returns on the portfolio are based on the expected returns of each asset class and the correlations between each class. These assumptions are detailed in the Stochastic Analysis section of this report.
Other	All other projection assumptions are the same as those chosen by the Fund’s actuary, shown above. The participant data, Plan liabilities, and assets, as of September 30, 2008 were provided by Gabriel Roeder Smith & Company.