MERS Pension Investment Risk Analysis

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Subject: Investment Strategy Review and Risk Assessment

Executive Summary

The purpose of this report is to evaluate the recent performance of the Municipal Employees' Retirement System (MERS) investment portfolio and propose a revised asset allocation strategy to better align with its long-term funding obligations. As of December 31, 2024, MERS faces heightened financial uncertainty following significant losses in 2022 and persistent market volatility through 2023 and 2024. This prompted a reassessment of portfolio resilience in light of pension funding obligations.

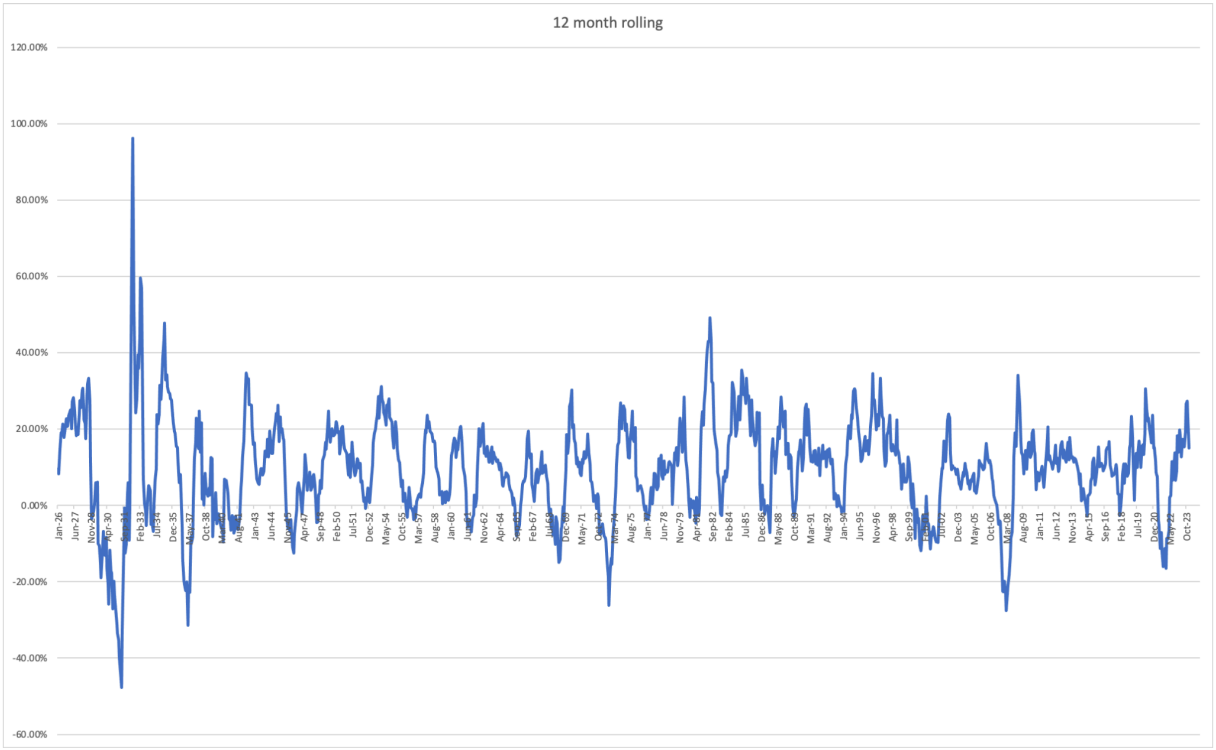
Given that MERS is a closed pension fund that serves retirees with no new inflows from active employees, our primary objective is not aggressive growth, but liability matching and long-term solvency over the next 30 years. The fund currently operates under a traditional 60/40 allocation of 60% U.S. large-cap equities and 40% fixed income (a mix of 65% intermediate-term government bonds and 35% long-term corporate bonds). The project spans a review of historical returns, economic scenario simulations, and a 30-year projection aligned with MERS's closed fund payout schedule.

Our findings have allowed us to identify extreme loss periods, assess the frequency and magnitude of downturns, and evaluate how recent years compare to the broader historical record to determine an investment recommendation for MERS. After adjusting and experimenting with the weights of U.S. large-cap equities and fixed income market investments, MERS may have an opportunity to select a new strategy with a decreased probability of losing 15% or more on their investments. Through the use of the AIRG Economic Scenario Generator, a 45/55 allocation provides MERS with the lowest percent insolvency of 21.9%, the lowest probability of loss of 0.53%, which may be beneficial when making a decision for payouts. However, the average 30-year geometric annual return for the original 60/40 is still slightly larger than the average return for a 45/55, where 7.28% > 7.00%.

Depending on the goal, the MERS fund stands at a critical juncture. Continuing with the current investment approach exposes the fund to risk, potentially jeopardizing its ability to meet retiree obligations. By adopting a more conservative, liability-aware allocation and supporting it with a strategic top-up of $175 million, the city can secure the future of MERS beneficiaries while optimizing public funds, with the percentage of insolvency further decreasing to 0.7% at a 45/55 allocation. These adjustments improve downside protection, reduce drawdown risk, and raise the probability of successfully funding all projected payments through 2054.

Historical Review

We began by reviewing the historical downturn in 2022. The MERS fund experienced one of its steepest one-year losses, besides the 1930s and 2008. These years mark eras of some of the worst annual returns under the 60/40 strategy. In particular, our lowest annual return was -47.71% during June 1932, and our average return across all years was +9.54%. Visually, we can see the intense fluctuation of the returns each year, where we generally see positive returns.

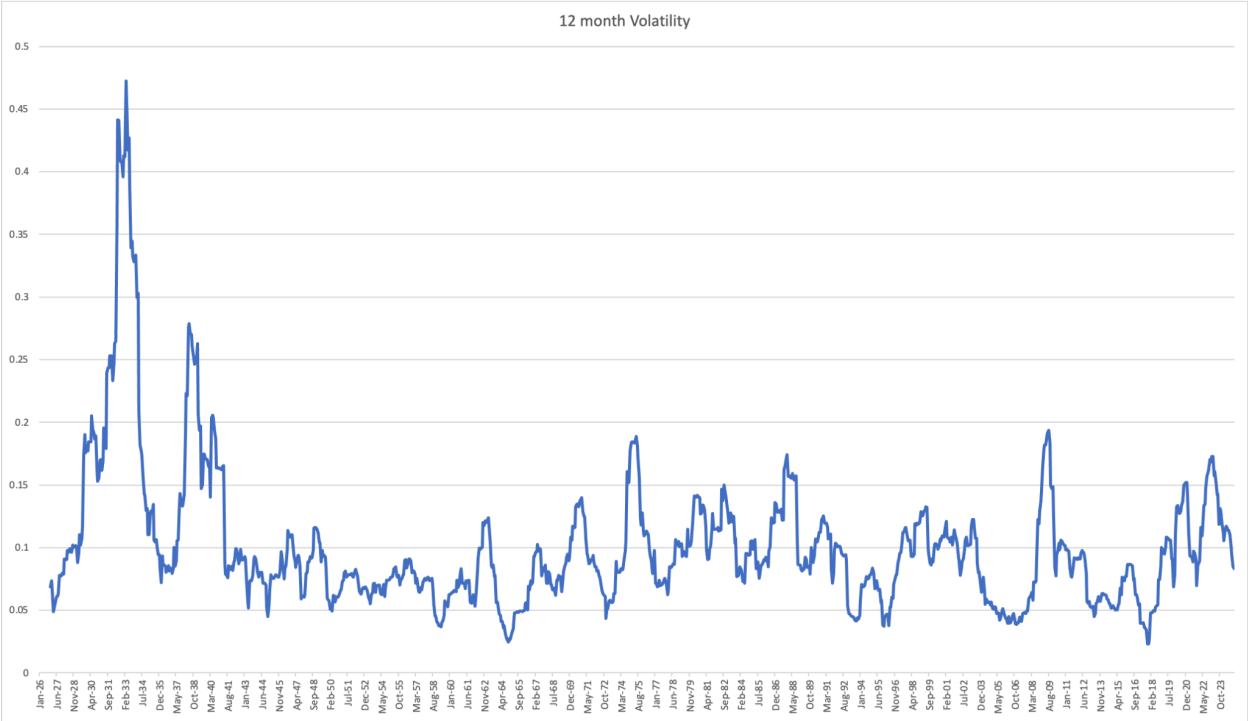


To visualize a side-by-side comparison of the worst months that produced the worst returns, I have also included a table showing the worst 10 rolling 12-month returns for the 60/40 portfolio as well the the best months that produced the highest rolling returns. By examining these extreme cases side-by-side, we can better understand the cyclical nature of market performance, the asymmetry between losses and recoveries, and the importance of maintaining a resilient investment strategy, especially for a closed pension fund like MERS, where long-term solvency is prioritized over short-term gains.

Filtered 12 month rolling Ascending	
Year	12 month rolling
Jun-32	-47.72%
May-32	-43.59%
Apr-32	-39.64%
Mar-32	-35.24%
Feb-32	-33.54%
Jul-32	-32.72%
Mar-38	-31.32%
Jan-32	-30.91%
Feb-09	-27.49%
Dec-31	-27.47%
Sep-31	-27.12%
Sep-74	-26.12%
May-31	-25.87%
Nov-31	-23.54%
Mar-09	-23.23%
Jan-09	-23.13%
May-38	-22.75%
Nov-08	-22.61%
Oct-08	-22.41%
Jan-38	-22.36%
Dec-37	-21.51%
Apr-38	-21.16%
Apr-09	-20.99%
Apr-31	-20.41%
Feb-38	-19.98%
Dec-08	-19.90%
Oct-31	-19.88%
Nov-37	-19.74%
Sep-30	-18.87%
Aug-74	-18.63%
May-09	-18.21%
Oct-74	-17.66%
Jul-31	-17.57%
Aug-31	-17.53%
Aug-32	-17.43%
Dec-22	-16.54%

Filtered 12 month rolling Descending	
Year	12 month rolling
Jun-33	96.16%
May-33	81.35%
Feb-34	59.65%
Mar-34	57.01%
Jul-33	51.25%
Jun-83	49.14%
Mar-36	47.79%
Jan-34	43.79%
Jul-83	43.50%
Feb-36	43.24%
May-83	42.99%
Apr-83	42.94%
Apr-33	41.16%
Mar-83	39.97%
Nov-33	39.50%
Jan-36	38.77%
Feb-83	37.28%
Dec-33	35.91%
Mar-86	35.45%
Apr-43	34.72%
Jul-97	34.54%
May-36	34.18%
Feb-10	34.02%
Apr-86	33.46%
Mar-98	33.36%
Aug-86	33.36%
Aug-29	33.35%
Jun-43	33.14%
May-43	33.02%
Apr-36	32.89%
Aug-83	32.38%
May-85	32.20%
Sep-83	32.04%
Jul-29	31.76%
Jun-85	31.55%
Oct-35	31.44%

Moreover, Volatility in 2023 to 2024 presented continued fluctuations in both equity and bond markets, revealing the fragility of traditional asset mixes during periods of high correlation between US large-cap equities and fixed-income classes. Visually, volatility stretches from 2.31% to 44.7%, indicating that our returns tend to fluctuate a considerable amount across the years from 1929 to 2024.



These fluctuations change rapidly and unpredictably, but we have quantified the number of losses and gains. Across the full historical dataset, we observed a total of 938 months with positive returns and 239 months with negative returns, meaning that approximately 79.7% of all months resulted in gains. While this long-term trend suggests that positive returns are more common, it is still essential to consider the long-term gains and losses over the next few years.

# of months with positive return:		938
# of months with negative return:		239
Min	-0.47721	
Max	0.96163	
Average	0.09546	
StDev	0.12997	

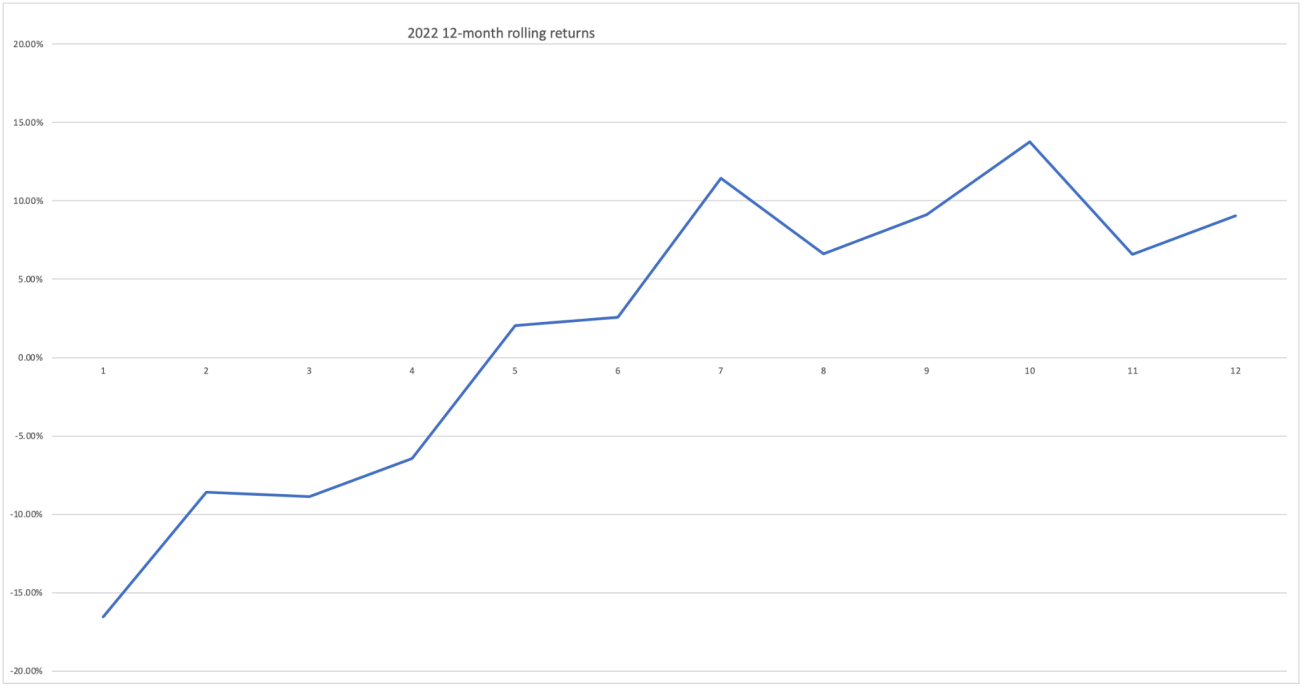
Additionally, to evaluate the tail risk of the 60/40 strategy, we analyzed the distribution of historical rolling 12-month returns from 1926 to 2024. The 5th percentile return is approximately -11%, meaning only 5% of all one-year periods resulted in returns worse than this threshold, and only 1% of all annual, 12-month periods resulted in returns worse than -0.26,% which is not the best, but still not the worst either.

In comparison, the MERS portfolio return in 2022 had a month where it returned -16.54%, placing it in the bottom 0.8% of all historical 12-month periods. This confirms that 2022 was a tail-risk event, comparable in magnitude and rarity to major financial crises like 2008 and the Great Depression in the 1930s.

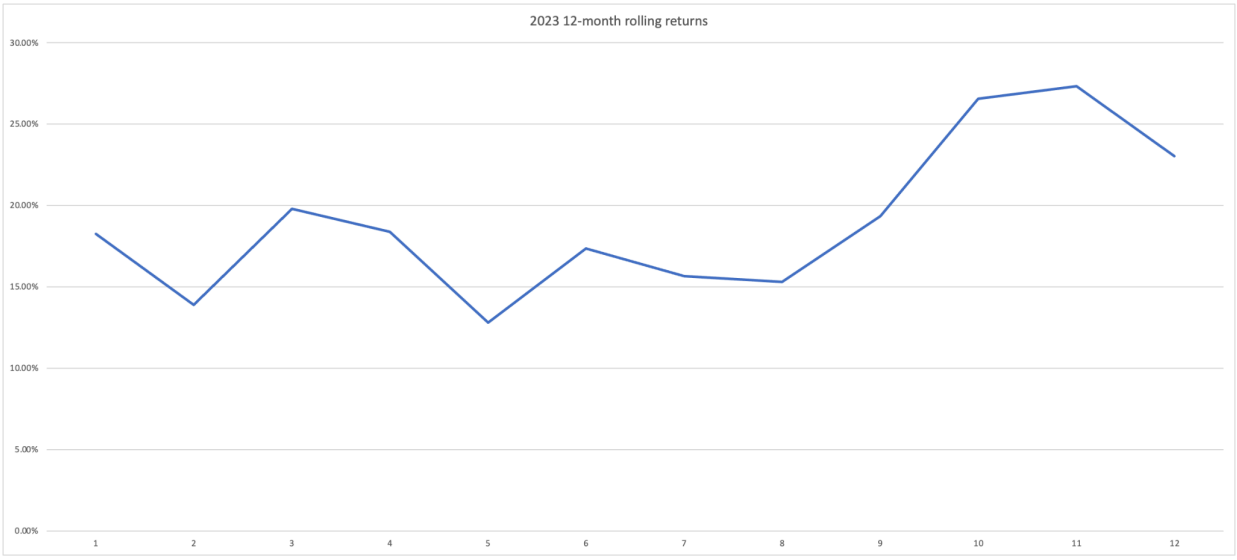
tail risk (5th percentile)	-0.11	
tail risk (1st percentile)	-0.26	
percentile of (-16.54%) during 2022 return		0.007

Now we zoom into 2022. This marks a year of deep negative returns. The chart for 2022 shows a highly volatile year, beginning with rolling returns as low as -16.54%, which places it within the bottom 1% of all historical 12-month periods. The portfolio struggled through a prolonged downturn, with returns staying negative for most of the year, only crossing into positive territory in the middle to the later parts of 2022. This pattern reflects the rare but extreme conditions where the investments of US large-cap equities and fixed-income bonds fell together. This era severely impacted MERS.

During the period from 2022 to 2023, we observed 11 consecutive months of negative returns, reflecting heightened market instability and the failure of the traditional 60/40 portfolio to provide downside protection during that stretch. This was then followed by a strong recovery with 21 months of positive returns from 2023 to 2024, illustrating the market's tendency to rebound quickly after deep drawdowns. However, the timing and magnitude of these recoveries remain highly unpredictable.



Then comes 2023, and the rolling returns are computed in the graph. This era shows early signs of restabilization, and although it still looks somewhat volatile in the early part of the year, where the line hovers from 13% to 20%, the trajectory improved gradually across all months. By the final quarter, returns were reaching upward of 27%, showing a reversal from 2022's losses. This suggests that markets began to normalize, but also shows an additional layer of how volatile the market had been.



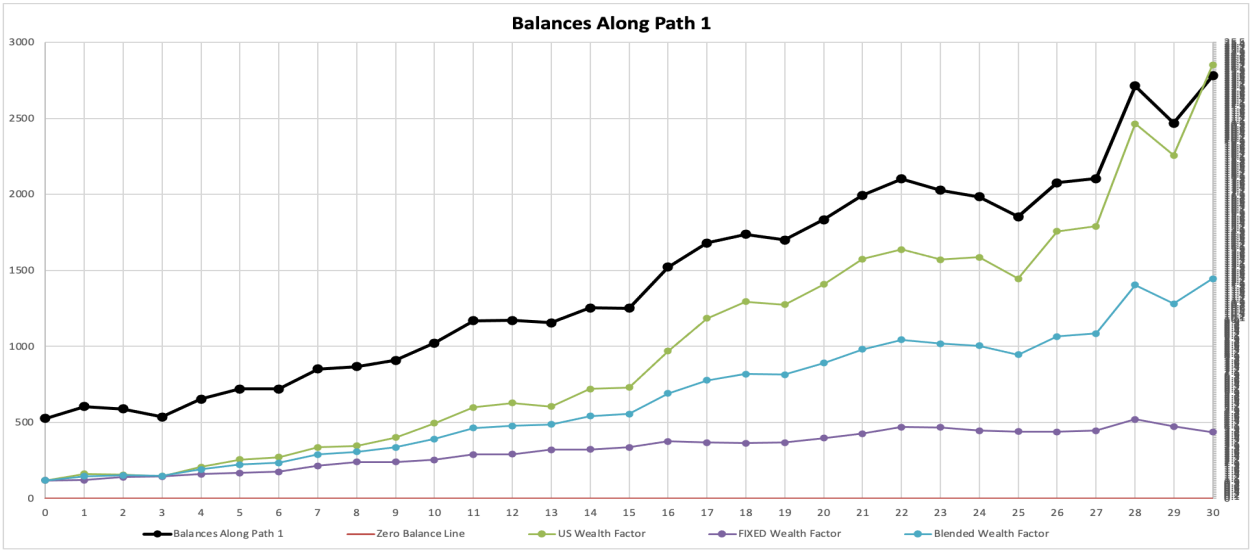
2024 produced some robust performance, but it still shows some uneven growth that continued the recovery trend made in 2023, with high and rising returns, particularly peaking around 29% in September. However, the later months saw a modest decline, settling closer to 15% by December. While the overall return levels remained strong, this late-year dip suggests that while

growth returned, markets remained sensitive. The high fluctuation in 2024 also highlights that volatility persisted even during a positive return environment.

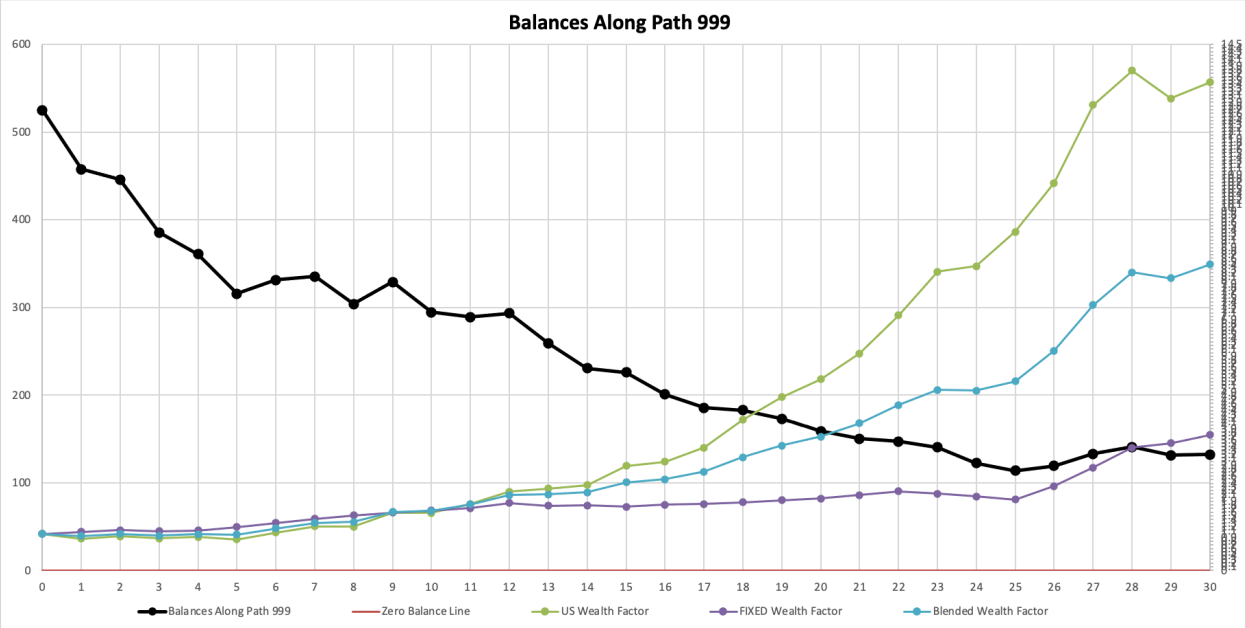
AIRG Economic Scenario Generator Loss Probability

Using the AIRG Economic Scenario Generator, we simulated 1,000 paths of possible one-year return outcomes for a 60/40 portfolio. We calculated the probability of experiencing a loss greater than 15% on a portfolio similar to MERS. Though they do not exactly resemble each other, the large number of paths gives us a general idea of how the balances could fluctuate.

Based on AIRG results, a one-year loss of 15% or more for the MERS portfolio appears extremely rare at 1.51%. The model reflects mean-reverting markets, diversified portfolios, and stable interest rates, not extreme shocks. AIRG is designed for long-term pension projections, so it emphasizes average expected behavior, without considering the risks associated during times of economic downturn or depression. Below is an example of a simulated path (number 1 out of 1000) that shows the surplus, US, FIXED, and BLENDED wealth factors.



Similarly, the one under this is another random simulated path, but it shows different balances (number 999 out of 1000). These particularly resemble the traditional 60/40 allocation, where we are able to view the possibility of the US wealth factor changing over the course of time, mirroring our allocation of the portfolio.



Recent history shows that such losses can happen, and AIRG may underestimate risk in extreme scenarios, such as when 2022 experienced a -16.54% return. Additionally, historical data shows that a loss of -15% or more, while uncommon, is possible, especially when equities and bonds fall together in extreme tail cases (like in 1929, 2008, or 2022).

We might need to complement risk models with the historical stress eras in portfolio design for pension funds. Consequently, while the model is statistically sound, it may provide a slightly optimistic view of downside risk, and pension fund planning should account for these rare but impactful events.

Recommendation

Given the current portfolio risk, we conducted a scenario analysis via AIRG and experimented with the weights of the US large-cap equities and fixed-income funds across 1000 simulation paths. At the current 60/40 weights, the percentage insolvency produced a rate of 22.5% with a probability of 1.51% of experiencing a loss of 15% or more over one year.

On the other hand, for a 45/55 weight, the percent insolvency decreased to 21.9%, and the probability of obtaining a loss of 15% or more drastically decreased to 0.53%, a level of risk that is more reasonable and consistent with the fund's liability-driven objectives. Without changes, the probability of the fund exhausting its assets before completing its 30-year payout horizon remains higher at 60/40 than at the 45/55 framework.

However, if we examine the average 30-year annual geometric return for 60/40, we notice a value of 0.07284, and if we do the same for the 45/55 allocation, the average is computed to return a value of 0.07009, which is slightly less. Although there is a .00275 difference, the contrast is very minor. The simulated geometric annual return for the 45/55 has a larger maximum and a larger minimum than the 60/40, ranging from 0.01435 to 0.13569, compared to a range of 0.01021 to 0.13440. These ranges may indicate the possibility of achieving a slightly larger return with a slightly lowered risk of falling below the minimum, which can be beneficial in determining which method is the more optimal choice.

alpha: Weight for US (i.e. Large Cap Equity)			0.4500
Implicit Weight for FIXED			0.5500
Min	1.53314	0.01435	
Max	45.47207	0.13569	
Average	8.54273	0.07009	
StDev		0.01711	
		0.07009	

BALANCE(0) MM	525
Top-Up Amount MM	
Insolvency Lending Rate	0.0700
	BALANCE(30) MM
Percent Insolvent	21.9%
AVG Terminal Insolvency	-264.00

Additionally, in order to determine an investment recommendation for MERS, we have computed the alpha (weight of the US large cap equities) levels compared to other levels to describe portfolio allocation insolvency rates. A level of 45% compared to the other options seemed to have produced the lowest percentage, which might serve as evidence that the probability of an individual or business becoming unable to pay their obligations is low.

Currently, MERS has the option to resolve its previously higher insolvency percentage through measures like improved financial management in terms of its allocation strategy. In this chart, we have inputted different alpha levels and computed side-by-side comparisons to understand how they differ, and if changing the allocation is a good decision to make.

Alpha	0.2	0.3	0.4	0.45	0.5	0.55	0.6	0.7	0.8
Min	-641.7457	-733.10142	-833.73497	-885.23901	-935.32862	-985.58772	-1035.387	-1135.6909	-1237.39
Max	6634.8501	7415.1885	8059.1178	8320.4642	8541.2219	8721.5648	9229.5601	13415.212	19082.54
Average	421.37778	559.92128	713.03964	795.65162	882.53652	973.87876	1070.0676	1278.0984	1508.531
StDev	686.73468	810.554	978.10986	1080.8828	1197.9197	1330.5706	1480.1098	1836.0121	2279.794
Percent Insolvent	25.3%	22.9%	22.3%	21.9%	22.2%	22.7%	22.5%	23.0%	24.5%
AVG Terminal Insolvency	-181.9399	-203.34261	-237.93671	-264.00193	-284.25655	-305.50637	-337.69363	-392.34763	-432.418
Prob (Annual Weighted TR <= -0.15)	0.053%	0.127%	0.347%	0.530%	0.793%	1.120%	1.510%	2.490%	3.700%

Top-up Option

As part of this investment strategy review for MERS, a critical component of the analysis involves evaluating the financial and strategic impact of a proposed $175 million one-time top-up using unspent COVID-19 relief funds allocated by the city. The objective of this top-up

scenario analysis is to determine whether the additional capital would significantly improve the fund's long-term solvency outlook and reduce the risk of shortfall over 30 years.

MERS is a closed pension system with no new employee contributions, making the reliability of its investment performance crucial to fulfilling future benefit obligations. Although we are given the starting fund balance of $525 million, there is potential in allowing this fund value to be increased to $700 million. This analysis assesses how the top-up option affects key metrics such as the probability of insolvency and the surplus at the end of the projection period.

Again, using the AIRG ESG, simulated paths of 1000 allowed us to gain a general idea of what the returns would look like, and we examined the average balances for when we chose not to top-up and when we chose to add that $175 million to our MERS fund.

In particular, for the option of not topping up, the percentage insolvent is 21.9%, as reviewed in previous sections. Additionally, the average balance or surplus of this option presents a value of $795.65 million. However, when the city chooses to allocate the $175 million in COVID relief funds to the MERS portfolio, the percentage insolvent is decreased dramatically to 0.7%, which means that the likelihood of the fund failing to meet its 30-year payout obligations is virtually eliminated. This option would also create a larger surplus balance. We examine the average value as $2285.06 million, which indicates that the city overcontributed to the fund by squeezing out other expenditures that the city could have allocated towards.

BALANCE(0) MM	525
Top-Up Amount MM	-
Insolvency Lending Rate	0.0700
	BALANCE(30) MM
Percent Insolvent	21.9%
AVG Terminal Insolvency	-264.00
	BALANCE(30) MM
Min	-885.24
Max	8320.46
Average	795.65
StDev	1080.88

BALANCE(0) MM	525
Top-Up Amount MM	175.00
Insolvency Lending Rate	0.0700
	BALANCE(30) MM
Percent Insolvent	0.7%
AVG Terminal Insolvency	-174.54
	BALANCE(30) MM
Min	-289.62
Max	16278.08
Average	2285.06
StDev	1797.25

Ultimately, this task is designed to help the city make an informed decision about whether the top-up represents a prudent investment in financial stability or an unnecessary overextension of limited municipal funds.

While the top-up option dramatically improves solvency and reduces downside risk, it also raises the potential concern of overfunding. A surplus of this size may indicate that the City has

tied up public funds that could have been allocated toward other essential expenditures, such as infrastructure, education, or emergency reserves so even though it gives a layer of financial security for MERS, it must be considered against the opportunity cost of locking in excess capital.

The $175 million top-up significantly enhances MERS's solvency outlook and virtually guarantees long-term payout stability. However, it results in a large surplus, suggesting a trade-off between fiscal security and resource efficiency. The City must weigh the value of eliminating risk against the opportunity cost of overfunding, especially if surplus funds are not recoverable, distributable, or reusable.

Conclusion

The Municipal Employees' Retirement System stands at a critical turning point. The analysis presented in this report demonstrates that while the traditional 60/40 allocation has historically delivered competitive returns, its vulnerability to systemic market shocks, especially during periods of correlated equity and bond downturns, has been exposed in recent years.

Historical analysis confirms that the severe losses in 2022 and the continued volatility in 2023 to 2024 are not only statistically significant but also indicative of broader structural risks facing traditional portfolio strategies. Through the AIRG Economic Scenario Generator and a 30-year solvency model, we evaluated multiple asset allocations and found that a 45/55 equity-to-fixed income portfolio provides a more stable risk profile for a closed pension fund like MERS, with a lower insolvency rate (21.9%) and significantly reduced short-term loss probability (0.53%).

Although the potential new reallocation of a 45/55 entails a slight trade-off in long-term average returns compared to the existing 60/40 strategy, the difference in expected return is outweighed by the reduction in downside risk. For a fund with no new contributions and new obligations, this might be an essential consideration.

Additionally, the optional $175 million COVID relief top-up offers a unique opportunity to enhance the fund's strength, decreasing insolvency risk to just 0.7% under the proposed 45/55 allocation. This contribution positions MERS to meet its obligations with much greater certainty, while also giving the city some flexibility to avoid overfunding. Therefore, the top-up is a great suggestion, for great long term solvency that MERS relies on.

To develop our final thoughts, we recommend that MERS adopt the 45/55 allocation strategy immediately and work with city officials to consider the top-up option. These strategic adjustments will provide MERS with the stability needed to protect retiree benefits through 2054 and beyond.