ALM Results TSERS

Stress testing

North Carolina Retirement System

Board Meeting | February 25, 2026

Agenda

- Process
- Recap
- Stress test 1 – deterministic scenarios
- Stress test 2 – scenario filtering
- Conclusions

Process

ALM process

Overview

Assumptions & objectives	Evaluation of outlook Going Concern	Asset allocation analyses	Sensitivity analyses and stress testing

Main objective of the ALM study is to define a new Strategic Asset Allocation

ALM process

Today

Assumptions & objectives → Evaluation of current status → Strategic Asset Allocation analyses → Sensitivity analyses and stress testing

Stress scenarios

Scenario filtering

Today

- Quick recap
- Presenting final results
- Study conclusions

Recap

Recap

Summary of Board meeting December 17, 2025

- The fund shows healthy growth to being fully funded in the long-term, helped by investment returns and deficit amortizations.
- Downside risks are moderate but can result in low funding ratios (around 70%) and high employer contributions (around 23% of payroll).
  - Investment risk (especially equity risk) is by far the largest risk driver.
- For retired members, inflation reduces their purchasing power (-20% in 10-years time). While discretionary Cost Of Living Adjustments (COLA) can be granted, this only partially offset inflation risks.

- Through optimization runs we learn that the Strategic Asset Allocation (SAA) can be adjusted to improve the central expectation (higher funding ratio, lower contributions, higher COLA) and/or reduce risk.
  - We find that Private Equity, Real Estate, Investment Grade (IG) Fixed Income, Natural Resources and Infrastructure are attractive asset classes.
  - Relatively high interest rates make IG fixed income attractive, while public equity is less attractive compared to private investments. Credit shows mixed results, depending on the horizon we look at.

- Based on these results, constraints on illiquidity, and qualitative considerations, NCRS presents 2 Model Portfolios:
  - Model Portfolio 1 (MP1) contains more Private Equity, Infrastructure, Energy, Credit, and Multi Strategy.
    - Less Public Equity, Cash, and Real Estate – compared to the SAA. Focus is on Return increase.
  - Model Portfolio 2 (MP2) contains more Private Equity, Infrastructure, Commodities, Credit, IG Fixed Income, and Multi Strat.
    - Less Public Equity, TIPS, and Real Estate. Focus is on downside Risk reduction.

Deterministic stress scenarios

Stress scenarios

Introduction

- Up until now, we have shown results using stochastic projections, a probabilistic approach using 2000 *real-world* scenarios. These scenarios provide an integrated representation of the dynamics of risk and return at different horizons. In addition, they reflect the range of uncertainties, rather than only one or a few possible outcomes.
  - Stochastic scenarios → quantify risk-return trade-offs and distributions of outcomes

- Now, we zoom in on a number of deterministic stress scenarios. Deterministic stress scenarios are narrative-driven, forward-looking stress tests that trace a single, coherent economic path from today's market conditions to assess how robust a balance sheet is under severe but plausible economic regimes. They stimulate outside-the-box thinking on risk.
  - Deterministic stress scenarios → test robustness under specific extreme regimes

- We analyze 5 scenarios over a 5-year period:
  - Stagflation
  - Financial repression
  - Growth-driven inflation
  - Deflation
  - Trade war

- Results are compared against a deterministic baseline projection

Stress scenarios

Narratives 1/2

Stagflation

A cocktail of inflationary forces and perceived lack of price stability triggers a confidence crisis represented by a sharp correction in equity markets. Also, high-yield credit spreads widen as default risks increase. In response, central banks are reluctant to raise interest rates. Nevertheless, the persistence of the inflationary shock increase in break-even inflation expectations and an initial decline in real interest rates. The economy slowly recovers with real interest rates slowly rising while entering (close-to) positive territory in year 5 of the scenario horizon.

Financial Repression

In the first year of the scenario horizon, economic activity falls as consumers sharply cut back on their spending in response to lower real disposable income and weak confidence. Although financial conditions remain accommodative, investors lose trust in the fiscal and monetary policy response, which, in combination with falling economic activity, leads to the deflation of an equity price bubble and a global financial crisis in year 1 of the scenario horizon. In the following years, interest rates remain low, while inflation slowly declines, the stock market slowly recovers, and credit spreads narrow again.

Growth-driven Inflation

Revolutionary innovations, such as AI, lead to higher than expected productivity growth. With higher productivity, the wages increase, leading to a lower unemployment rate. Since more people work at higher wages, the demand is increasing. Tightness in the labor market fuels wage growth and inflation through the wage-price spiral even further. Central banks are responding with interest rate hikes. In turn making bonds more attractive. The market expects the higher inflation to be temporary and that central banks will get it under control in the foreseeable future. As a result, long-term interest rates rise less quickly than short-term interest rates and the interest rate term structure is flatter.

Stress scenarios

Narratives 2/2

Deflation

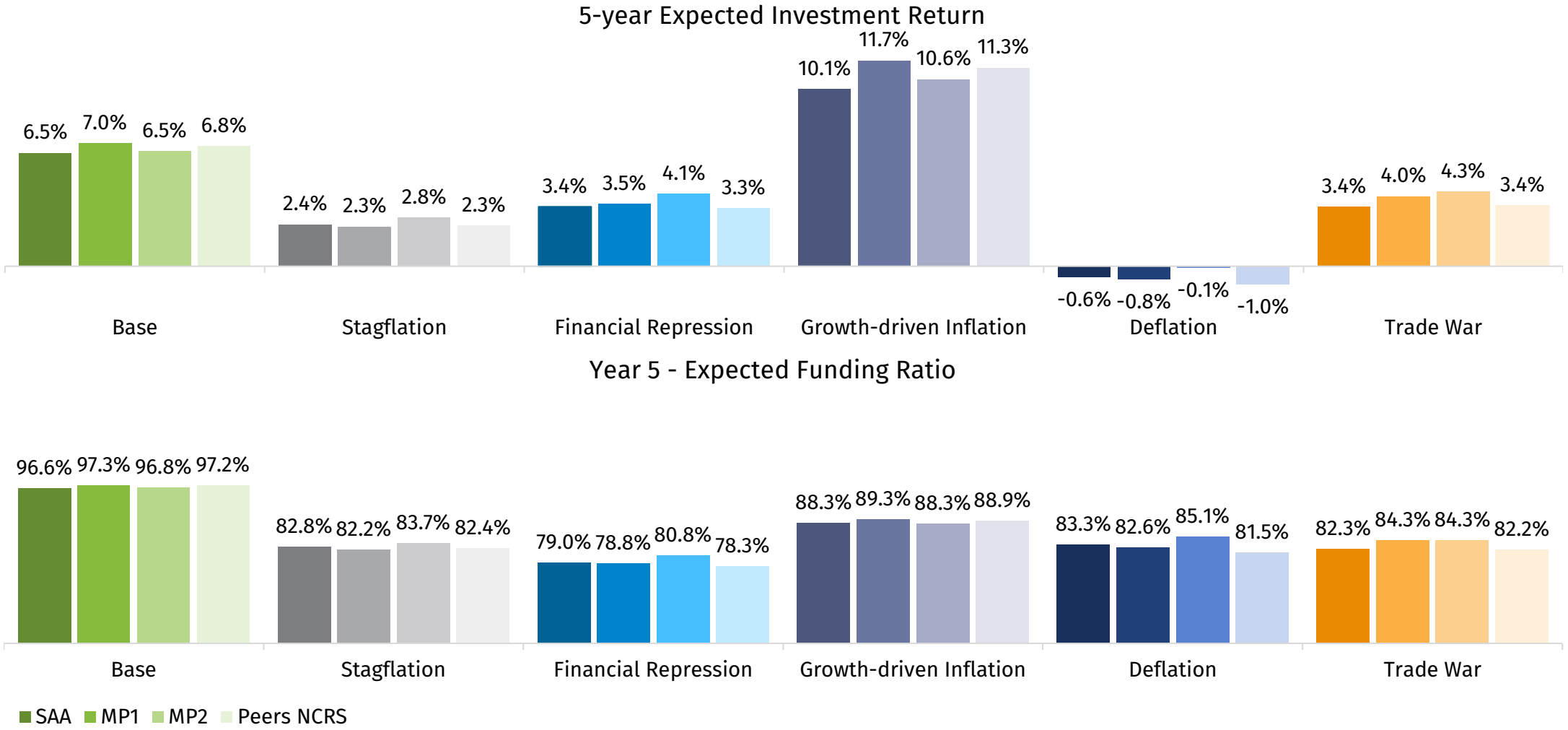
The commodity shock due to geopolitical tensions and the contraction monetary policy to fight inflation leads to a substantial negative economic shock. The economy is shrinking, and producer and consumer confidence are falling sharply. Companies and consumers are reluctant to invest, the demand for goods and services is declining and prices are falling. Unemployment is increasing rapidly, which also puts wages under pressure. In such a situation, interest rates will become negative, while equities show strongly negative returns. Credit spreads rise in this situation.

Trade War

In response to the shock to the global economic and geopolitical order, risk premia rise across asset classes causing a selloff in equities and credits. On the other hand, commodities, especially energy, metals, and agricultural goods outperform, reflecting persistent scarcity and supply bottlenecks. Over the scenario horizon, the global economy transitions into a more fragmented, inflation-prone, and politically steered environment. Investors face an investment landscape marked by regional divergence, shifting trade dynamics, and elevated policy uncertainty – requiring a reassessment of long-held assumptions about globalization, inflation, and cross-border capital flows.

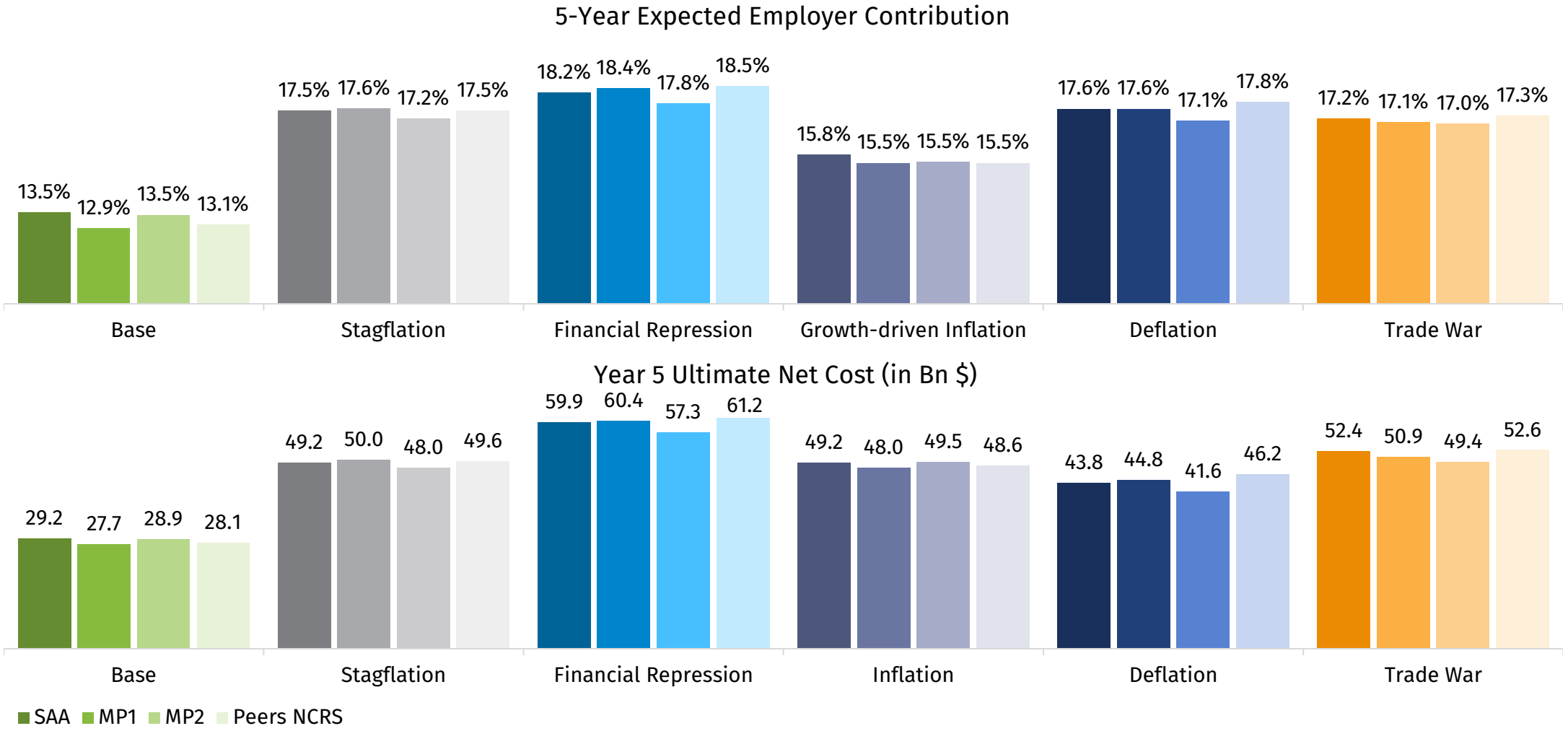
Stress scenarios

Geometric return and funding ratio, as at 30 June 2025



Stress scenarios

Employer contribution and ultimate net cost, as at 30 June 2025



Stress scenarios

Commentary

- For TSERS, the financial repression scenario is the most unfavorable stress scenario analyzed, evident through the low expected funding ratio and high ultimate net cost. In this scenario, US inflation increases to 10%. In turn US treasury yields decline from ~4.5% to 2%. Liabilities rise steeply whilst GDP & asset growth is muted for the first 3 years.
- Stagflation is a comparable scenario (low GDP growth & high inflation), but with increasing rates. Wage growth is lower, leading to a better Ultimate Net Cost.
- While the growth-driven inflation scenario shows excellent (equity) returns, the fund is also faced by low returns on its fixed income portfolio due to increasing rates. Following high profit margins and low unemployment, high wage growth increases the Ultimate Net Cost through both higher contributions and higher liabilities.
- An escalating trade war shows lower funding and higher contributions. Wages are up due to reshoring and industrial policy. Inflation is high, but less extreme than in the stagflation scenario. Real assets perform well (supply side pressures and strategic sectors especially).
- While the deflation scenario shows the worst portfolio returns, the increase in Ultimate Next Cost is limited as liability growth is muted through negative/low inflation and wage growth.
- MP1 shows to be more resilient in the growth-driven inflation and trade war scenarios thanks to private equity and real assets, resp. credits and private infrastructure. The reduced exposures to public equity also helps protect the fund from market volatility in scenarios other than growth-driven inflation.
- MP2 performs similar or better than the other portfolios in scenarios (except growth-driven inflation) thanks to a greater allocation to IG fixed income, multi-strategy, and commodities, and less to public and private equity and energy.

Scenario filtering

Scenario filtering

Introduction

- As an additional sensitivity test, we analyze the far ends of the economic quadrant.
- For this analysis we go back to the stochastic projection, which contains the full range of economic environments, and apply a filtering technique to sift out the four far ends of the quadrant and assess their impact on the fund.
- We filter on portfolio return instead of growth (GDP) as this has a more direct impact on the fund's performance and financial stability.

Scenario filtering

Setup

- The conditions applied are the following:
  - The 10% scenarios with the **highest** cumulative portfolio return & 10% scenarios with the **highest** cumulative inflation
  - The 10% scenarios with the **highest** cumulative portfolio return & 10% scenarios with the **lowest** cumulative inflation
  - The 10% scenarios with the **lowest** cumulative portfolio return & 10% scenarios with the **highest** cumulative inflation
  - The 10% scenarios with the **lowest** cumulative portfolio return & 10% scenarios with the **lowest** cumulative inflation

- The conditions are evaluated in year 5.

- Below is an overview of the number of scenarios left after filtering, out of a total of 2000:

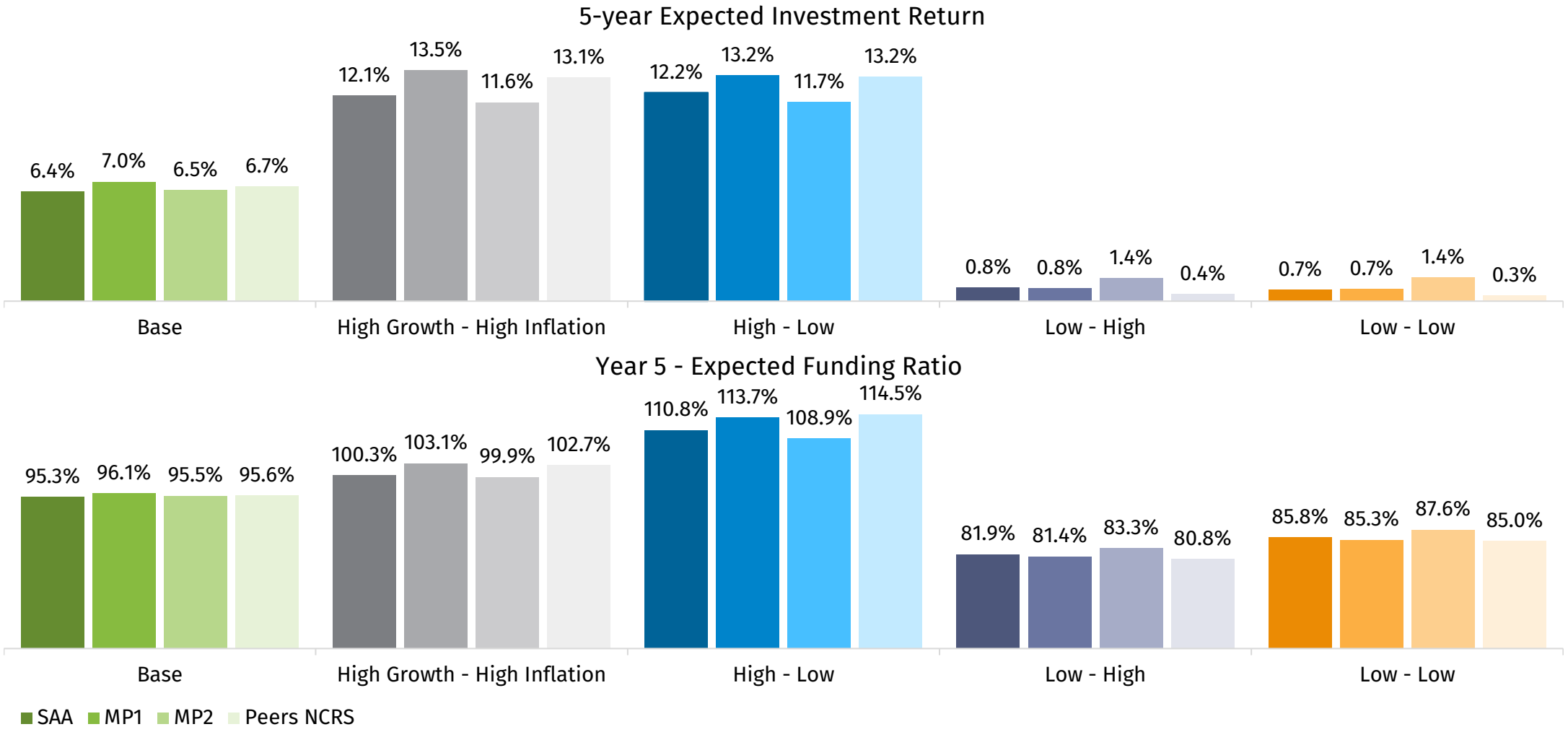
Number of Scenarios		Inflation	
		High	Low
Growth	High	61	109
	Low	92	77

- This is a sufficient number of scenarios for further analysis. Furthermore, this translates to a probability of ending up in one of these corners of between 3.0 and 5.5%.

- Baseline (OFS) expectations are added for reference.

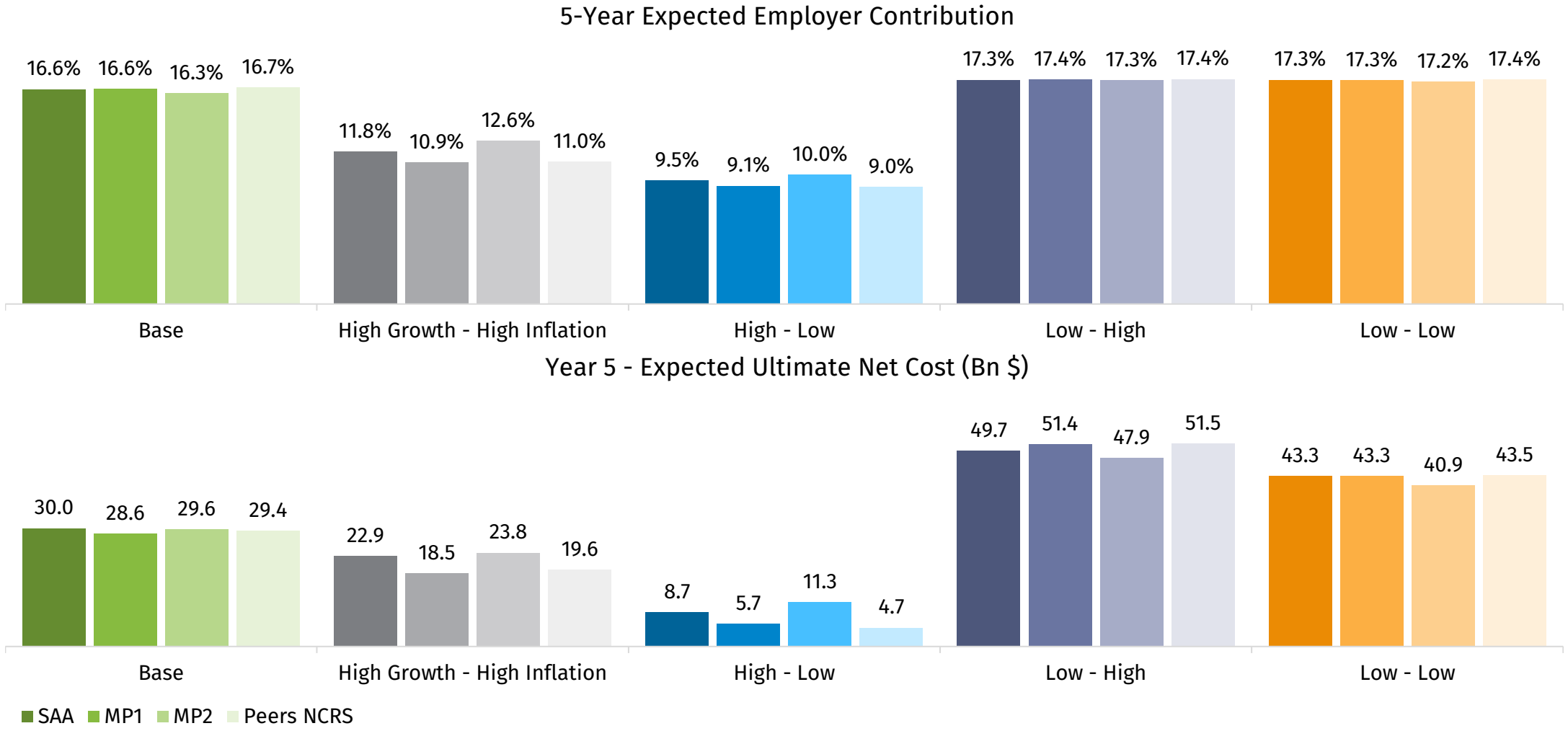
Scenario filtering

Geometric return and funding ratio



Scenario filtering

Employer contribution and ultimate net cost



Scenario filtering

Commentary

- Consistent with the deterministic stress scenarios, the low growth and high inflation scenarios hurt the fund the most. Losses are largely driven by exposures public and private equity.

- Growth (portfolio return) has a much more profound impact on the fund than inflation (returns have a greater amplitude than inflation, and inflation effects on the liabilities are dampened). In scenarios with low growth, the impact of inflation is especially muted.

- MP2 performs slightly better during periods of low growth compared to the other portfolios, due to its lower allocation to equity and higher allocation to IG fixed income. IG fixed income correlates less with growth and tends to outperform if rates remain stable.

- In high growth scenarios, MP1 performs slightly better due to higher allocation to private equity, energy and infrastructure. However, MP1 has slightly worse performance compared to MP2 and SAA in unfavorable scenarios. Hence, picking MP1 is a tradeoff between risk and return.

Conclusions

Conclusions

ALM study

- This study has shown that the fund shows healthy growth to being fully funded in the long-term.
  - Downside risks are moderate but can result in low funding ratios and high employer contributions.
- Our analysis show that both MP1 and MP2 can further improve this outlook, especially in terms of ALM-metrics such as funding ratio, employer contributions, and indexation, as these portfolios are designed against the liabilities of the fund.
- In addition to the long-term analyses, shorter term stress testing confirms that MP1 and MP2 are both robust portfolios, that perform similar or better than the SAA and peer group average portfolio.
- MP1 targets a higher return than MP2. On the 5-year horizon, the additional risks of MP1 over MP2 seem manageable. In the long-term, this portfolio achieves better outcomes in the central expectation. This comes at the cost of higher risks. However, risk metrics such as probability and size of deficit contributions (which given the current funding position are largely return driven) show that the additional risks of MP1 pay off in many scenarios.
  - Governance: point of attention is the illiquidity scoring, with 37% for MP1 and 30% for MP2. Market swings can push MP1 above the 40% illiquidity ratio threshold.
- Post-ALM reporting: for continuous strategic risk management Ortec Finance will deliver a Navigator report on a quarterly basis, to monitor forward looking ALM risk metrics and expected performance.
  - The first Navigator report will be produced as at 31 December 2025.

Appendix

Strategic Asset Allocation

Allocations – detailed

Allocations	SAA	MP1	MP2	Peers NCRS
Global Public Equity	42.0%	32.0%	30.0%	43.0%
Private Equity	6.0%	12.0%	7.0%	13.0%
Private Equity Buy-Out US	2.7%	8.0%	5.0%	5.9%
Private Equity Venture Capital US	1.5%	4.0%	2.0%	3.2%
Distressed Debt	1.8%	0.0%	0.0%	3.9%
Real Estate	8.0%	7.0%	7.0%	9.0%
Value Added Real Estate US	1.1%	2.0%	1.0%	1.2%
Opportunistic Real Estate US	2.0%	5.0%	3.0%	2.2%
Core Real Estate US	5.0%	0.0%	3.0%	5.6%
Credits	7.0%	9.0%	9.0%	7.5%
Performing Corporate	5.3%	3.0%	3.0%	5.6%
High-Yield (dur 3.9)	2.1%	1.0%	1.0%	2.2%
Leveraged Loans US	2.1%	1.0%	1.0%	2.2%
Direct Lending US	1.1%	1.0%	1.0%	1.1%
Distressed Debt (dur 3.3)	1.8%	3.0%	3.0%	1.9%
Asset Based Financing (dur 6.6)	0.0%	3.0%	3.0%	0.0%
IG Fixed Income & Cash (dur 7.3)	28.0%	25.0%	30.0%	19.0%
US Treasuries 5+ (dur 8.8)	7.6%	8.3%	10.0%	5.1%
IG Corporate Credits US 5+ (dur 8.8)	8.8%	8.3%	9.0%	6.0%
Mortgages US (dur 6.8)	8.8%	8.3%	10.0%	6.0%
IG Non Core Cash	2.8%	0.0%	1.0%	1.9%
Pension Cash	1.0%	1.0%	1.0%	1.0%
Real Assets	6.0%	11.0%	9.0%	5.5%
US TIPS (dur 2.1)	1.5%	0.0%	0.0%	1.4%
Private Natural Resources	3.0%	5.0%	3.0%	2.8%
Commodities (Bloomberg)	0.0%	0.0%	1.0%	0.0%
Gold	0.0%	0.0%	0.0%	0.0%
Timberland	2.0%	0.0%	0.0%	1.8%
Farmland	0.0%	0.0%	0.0%	0.0%
Agriculture	0.0%	0.0%	0.0%	0.0%
Energy	1.0%	5.0%	2.0%	0.9%
Private Infrastructure	1.5%	6.0%	6.0%	1.4%
Multi-Strategy	2.0%	3.0%	7.0%	2.0%

Appendix

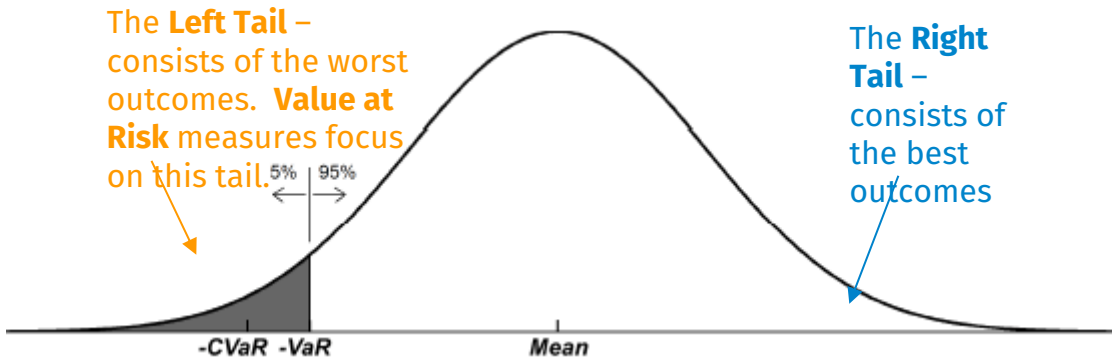
ALM risk measures – years 1-20

Risk Measures	SAA	MP1	MP2	Peers NCRS	65/35
Investment Return					
Geometric Mean	6.4%	7.0%	6.6%	6.7%	6.1%
Volatility	10.8%	11.7%	10.0%	12.0%	11.8%
5% CVaR (Annualized)	-15.3%	-16.1%	-13.6%	-17.1%	-17.8%
Probability of Return > 6.5%	49%	55%	50%	52%	49%
Funding Ratio*					
Median Funding Ratio	98.5%	105.9%	99.3%	102.3%	97.5%
5% CVaR Funding Ratio	66.0%	66.5%	68.6%	65.1%	58.5%
Probability FR > 85%	76%	81%	79%	78%	68%
Indexation*					
Purchasing Power Median	70.8%	73.0%	70.7%	72.3%	70.9%
Purchasing Power 95% CVaR	89.5%	91.3%	89.1%	91.0%	90.4%
Contributions					
Median Employer Contribution Rate	10.4%	9.1%	10.0%	9.9%	11.1%
95% CVaR Employer Contribution Rate	25.6%	25.7%	23.9%	26.6%	30.0%
Median Deficit Contribution (in Million USD)	730	380	657	557	792
Probability of Deficit Contribution	62%	56%	62%	58%	61%
Median Ultimate Net Cost (in billion USD)*	89	72	87	82	96
95% CVaR Ultimate Net Cost (in billion USD)*	209	201	197	210	245
Illiquidity					
Illiquidity %	21.3%	37.0%	30.4%	29.0%	0.0%

*End of period

Appendix

Definitions 1/2



The loss can be expressed either in dollar terms or in percentage terms.

- Distribution – asset returns occur over a range of outcomes or values. A distribution notes the likelihood of observing a certain value. Typically the mean is the most common with fewer observations farther from the mean. Typically, the distributions look like a bell. The ends of a distribution are often referred to as the "tails".
- Arithmetic Mean– is just the average of all the possible outcomes. Computed as the sum of all the numbers in the series divided by the count of all numbers in the series.
- Geometric mean - sometimes referred to as compounded annual growth rate, is the average value which signifies the central tendency of the set of numbers by finding the product of their values.
- Median – value separating the higher half from the lower half of all outcomes. You can think of it as the 'the middle'
- Risk – is a generic term referring to the likelihood of a loss. Higher risk generally refers to an increased likelihood of large losses.
- Volatility – is a measure depicting the range of possible return outcomes. In mathematical terms, it is referred to as the standard deviation of a distribution. The higher the volatility, the larger the range of outcomes, there is an increased likelihood of extreme outcomes.
- VaR or Value at Risk – Refers to a specific likelihood of a loss. For example, 5% VaR of $1B refers to a 5% likelihood of losing at least $1B. In mathematical terms, this would be referred to as the 5th percentile.
- CVaR – Conditional Value at Risk – refers to the average loss expected for a specific likelihood. For example, 5% CVaR of $1.5B refers to a 5% likelihood of losing, on average, $1.5B.

Appendix

Definitions 2/2

- SAA – Strategic Asset Allocation
- CAA – Current Asset Allocation
- OP – Optimized Portfolio
- MP – Model Portfolio
- OFS – Ortec Finance Scenarios – the stochastic scenario set used in this study

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