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ORTEC FINANCE

ALM Study 2023

United Nations Joint Staff Pension Fund

Final Report

UNJSPF

United Nations Joint Staff Pension Fund

Contents

1. Executive summary

Study objectives

In January 2023, the United Nations Joint Staff Pension Fund (UNJSPF) selected Ortec Finance for an asset liability management (ALM) study to assist the United Nations Secretary-General and United Nations Joint Staff Pension Board (Board) on the management of investments, funding obligations and liabilities.

The goal of the study was to assess the impact of key investment and solvency-related decisions (such as the funding policy) upon the long-term financial condition and performance of the UNJSPF. In addition, Ortec Finance was asked to make recommendations on long-term investment strategies.

Current situation

At the end of 2021 the UNSJPF had a small actuarial surplus, meaning that expected future contributions were slightly higher than needed. The plan's current contribution rate is 23.70% of annual pensionable earnings; a rate that has been in place since 1990. Based on the latest official actuarial valuation, dated 31 December 2021, 21.40% of the net present value of future annual pensionable remuneration was required to fully fund the pension plan. This rate is known as the Required Contribution Rate (RCR). A RCR greater than the actual contribution rate of 23.70% indicates a deficit, while an RCR below 23.70% points to a surplus.

At the end of 2022, Ortec Finance estimated that the present value of all future benefits payable was $177.5 billion, while the actuarial assessed value of plan assets plus present value of future expected contributions was $183.6 billion. This indicated an estimated surplus of $6.1 billion, or 1.48% below the 23.70% current contribution rate. However, the negative investment returns from the recent past are yet to be fully amortized in the actuarial valuation (via the actuarial value of assets methodology). This makes it likely that the required contribution rate will increase in the coming years, all other things being equal.

Comparing to the 2019 ALM study

In an ALM study, using the capital market and actuarial valuation assumptions, plan assets and actuarial valuations are projected 2,000 times and statistically analyzed. For the UNJSPF there have not been significant changes in participant data and fund regulations between the two studies. However, there are significant differences in the economic environment between the time that the 2019 ALM study was carried out and this most recent ALM study.

These differences shape the current situation as well as the projections, and with that our observations and recommendations.

The 2019 economic environment was characterized by historically low interest rates. The world was influenced by trade tensions and political uncertainty. Economic uncertainty was high. On the one hand there were risks of moving into a prolonged period of low interest rates, low growth, and low inflation (secular stagnation). On the other hand, there was upward pressure on (wage) inflation and rates driven by long-term demographic changes.

At the start of 2023, the aftermath of extraordinary pandemic-related policy stimulus combined with negative supply shocks (arising from the Covid-19 pandemic and Russia-Ukraine war) led to inflation hitting a 40-year high in developed economies. This triggered the quickest pace of monetary tightening since the 1980's. These extraordinary events altered the landscape for investors who had become accustomed to an extended low interest rate period. The relative attractiveness of fixed income has risen sharply, while for equities it has declined.

The long-term expected nominal portfolio return on the current strategic asset allocation (SAA) is about 1% lower now, than it was in 2019. This will have its impact on investment strategy decisions and the development of the Required Contribution Rate.

Economic scenarios

To reflect possible future economic scenarios and test the veracity of the sustainability of the fund, this ALM study was conducted using multiple sets of capital market assumptions (CMA). Three primary stochastic scenarios were used:

- The Ortec Finance Scenarios (OFS) forms the baseline. This scenario, developed independently by Ortec Finance, assumes a moderate growth outlook, driven by technological progress (productivity growth) which is counteracted by demographic headwinds. Risk premia are lower than the historical average.
- The Strong Growth Scenario is a positive scenario that is built on the narrative of a drop in energy prices, causing a steep reduction in inflation. This improves purchasing power of households, allows central banks to cut rates, and enables strong growth globally.
- The Net Zero – Financial Crisis scenario is a negative scenario (from a financial perspective) that is developed around a climate change narrative. Sudden divestments to align portfolios to the Paris Agreement goals will have disruptive effects on financial markets with abrupt repricing in the period 2025-2030 followed by stranded assets and a sentiment shock.

In addition to the three primary sets of CMAs, multiple other scenarios for sensitivity and stress testing were used.

Key observations

One of the key goals of this study has been to identify an investment strategy that enables the UNJSPF to maintain the required contribution rate within a corridor of +/-2%. For nearly three decades, the biennial actuarial valuation has assessed the solvency of the Fund using a real rate of return assumption of 3.5% per year. In two out of the three main economic world views analyzed – the baseline Ortec Finance Scenario (OFS) and the Positive growth scenario – the UNJSPF may be able achieve a 3.5% real return over the next 10 years but with a lower probability compared to the 2019 ALM Study. In the third main scenario – the Net Zero Financial Crisis scenario – the UNJSPF is unlikely to achieve 3.5% real rate of return, no matter the asset mix. Were such a scenario to unfold, it is presumed to be a long-term situation. A lower assumed long-term real rate of return assumption in the actuarial valuation would then become appropriate.

Using the OFS capital market assumptions with the current strategic asset allocation (SAA), results in the median Required Contribution Rate (RCR) to remain within the required contribution corridor of 21.7% to 25.7% that is used by the Pension Board to monitor funded status. However, while the projected RCR median remains within the corridor, the great majority of the scenarios will break out of it (up or down). This uncertainty is driven by inflation (impacting liabilities) and investment volatility. Investment volatility is dominated by public equity risk. Currency risk, interest rate and credit risk, as well as private equity and real assets risk are relatively small. Overall, we note that the fund could benefit from greater diversification.

Results using the current SAA under the Net Zero Financial Crisis scenario indicate a growing deficit. The fund may wish to study this further and develop long-term strategies should the Pension Board believe this scenario may become more of a reality.

Based on the study results, we conclude that the +/- 2% corridor is a suitable funding target for the short-term horizon. That is, the +/-2% corridor is an appropriate level to monitor the *current* Required Contribution Rate and the *expected* Required Contribution Rate for a 2-4 year period following an actuarial valuation. For long-term risk measuring, such as the 10, 20, and 30-year horizons used in this ALM study, the +/-2% corridor is not a suitable funding target, given the wide distribution of the scenarios.

Ideally, it may be helpful if the UNJSPF could specify a risk tolerance, to be monitored consistently. For instance, what is an acceptable probability of breaking out of the corridor in 2 years' time, until the next valuation?

In comparing contributions to benefit payments, the UNJSPF becomes increasingly cash flow negative over the long-term. This is an expected result for any mature pension fund. As a percentage of assets, the net liability cash flows change from just below zero to a range of -1% to -4% over the next ten years. These levels should be easily manageable.

Liquidity risk remains low both with the current SAA and the proposed allocations (discussed below). We have analyzed severe liquidity stress scenarios, with market shocks, large private asset capital calls, a contribution stop, and adverse Two-Track scenarios. With these simultaneous events, the need for liquidity becomes significantly larger but poses no direct risk. We do advise to always maintain a minimum allocation of 10% to *very liquid assets* (i.e cash and US treasuries). This should provide sufficient liquidity even under severe stress events. Note that while liquidity risk is limited, rebalancing the portfolio may be problematic.

Ortec Finance estimated the expected cost of Two-Track to be 1.6% of the present value of future payroll, based on recent experience. If we apply the same loadings of the calculation performed by the Consulting Actuary in 2015 to derive a longer-term view of the cost of the Two-Track, the expected cost is 2.3% (for reference, the Consulting Actuary reported 2.24% at the time). Note that Two-Track costs are highly uncertain – it is an option with no cap and costs are therefore (theoretically) unlimited. In this study, we analyzed several approaches to limit the risk for future consideration, should the need arise.

The key objective of the study is to recommend strategic asset allocations that improve the long-term financial outlook of the UNJSPF. An important contributor in making informed recommendations is the result of optimizations, wherein we tried to improve the fund's expected solvency by adjusting the asset mix. To test for parameter sensitivity and to find robust portfolios, dozens of optimizations were carried out, varying optimization targets, start and end dates of the optimization, risk metrics, allocation constraints, and economic scenarios. All results were considered in the final recommendation. Generalizing outcomes, we found that the following high-level trends would enhance the fund's performance when comparing to the 2021 SAA:

- Reduction in public equities
- Increases in fixed income

- Increases in real assets considering the Ortec Finance Scenarios and positive scenario. Similar allocations or a reduction under the Net Zero Financial Crisis scenario

On an asset class level, we conclude the following:

- Spread-based investments generally perform well
- US treasuries perform well in neutral to defensive portfolios
- Infrastructure and timber- & farmland perform well in most portfolios
- Real estate performs well under the Ortec Finance Scenarios and positive scenario, but less so in the Net Zero Financial Crisis scenario.
- Private equity performs well under Ortec Finance Scenarios, somewhat less in the positive scenario. In the Net Zero Financial Crisis scenario it is favored only in the most aggressive portfolios

Recommendations

The recommendations in this report are based on the combined results of the ALM study: optimizations, sensitivity analyses, and qualitative assessments. Leading in our advice is the objective to preserve long-term sustainability, while also considering both the UNJSPF's investment criteria (safety, profitability, convertibility, and liquidity) and practical limitations. We propose the following strategic asset allocations, rebalancing bandwidths, and portfolio benchmarks (new benchmarks in bold):

ALM 2023	2021 SAA	2023 Proposal A	2023 Proposal B	Delta bandwidths Minimum	Delta bandwidths Maximum	Benchmarks (Current All ESG, Custom)
Equity and Private Assets	**69.0%**	**60.0%**	**66.0%**	8%	8%	
Global Public Equities	53.0%	43.0%	46.0%	8%	8%	
Developed Markets Equity	46.9%	35.0%	38.0%	8%	8%	MSCI North America/Europe/Pacific IMI All Cap
Emerging Markets Equity	6.1%	8.0%	8.0%	4%	4%	MSCI Emerging Markets All Cap
Private Equity	7.0%	7.0%	9.0%	4%	4%	MSCI ACWI IMI ESG Custom + 2%
Real Assets	9.0%	10.0%	11.0%	5%	5%	
Real Estate	8.0%	8.5%	8.0%	4%	4%	NCREIF Open End Diversified Core Equity (Non-core +2%)
Infrastructure	1.0%	1.5%	2.0%	2%	2%	US CPI + 4%
Timberland and Farmland	0.0%	0.0%	1.0%	1%	2%	**NCREIF Timberland Index / NCREIF Farmland Index**
Private Debt	0.0%	0.0%	0.0%	0%	2%	**Cliffwater Direct Lending Index (CDLI)**
Fixed Income and Cash	**31.0%**	**40.0%**	**34.0%**	8%	8%	
Fixed income	29.0%	39.0%	33.0%	8%	8%	
US Core Bonds	28.0%	35.0%	28.5%	8%	8%	Bloomberg US Aggregate Bond Index (Proposal B)
US Securitized	8.3%	10.0%	8.5%	3%	3%	Bloomberg US Securitized
US Treasuries	13.0%	14.0%	13.3%	3%	3%	Bloomberg US Treasury
US Corporates	5.9%	10.0%	6.0%	3%	3%	Bloomberg US Corporates
US Govt Related	0.8%	1.0%	0.8%	1%	2%	Bloomberg US Government Related
Non Core Bonds	1.0%	4.0%	4.5%	3%	3%	
US High Yield	0.0%	2.0%	2.5%	2%	2%	**US High Yield: Bloomberg high yield index**
EMD Local Currency	1.0%	2.0%	2.0%	2%	2%	Bloomberg EM local currency government
Cash & Equivalents	2.0%	1.0%	1.0%	0.5%	2%	Bloomberg 1-3 month US Treasury

Both proposals A and B improve the financial sustainability of the UNJSPF compared to the current SAA. The expected return increases (to 3.5% under the OFS) and the expected RCR decreases, while reducing overall risk levels. Proposal A, with a larger exposure to fixed income, works especially well in the current interest rate environment. Long-term it may be

challenging to rely on fixed income returns, depending on interest rate movements. Proposal B, with a more modest increase in fixed income, is more suitable when rates and spreads compress.

Currently OIM meets with a monthly frequency to discuss portfolio rebalancing. We recommend the UNJSPF rebalances the benchmark less frequently than monthly and rebalance the portfolio to midway within the bandwidths. We recommend that OIM maintain the ability to make discretionary rebalancing decisions.

We find that hedging developed markets' currency risk can be advantageous from a risk and return perspective. After analyzing the plan's liabilities, such hedging is not linked to the Two-Track but strictly as an investment strategy. Whether or not to implement a hedging strategy is also dependent on implementation and management of administrative cost and risk. We recommend the OIM to further analyze and weigh the advantages and disadvantages of currency hedging.

2. Introduction

2.1. Summary of engagement

In January 2023, the United Nations Joint Staff Pension Fund (UNJSPF) selected Ortec Finance for an asset liability management (ALM) study to assist the United Nations Secretary-General and United Nations Joint Staff Pension Board (Board) on the management of investments, funding obligations and liabilities.

Ortec Finance is honored to be contracted by the UNJSPF for an ALM study. The study was carried out using stochastic projections of the UNJSPF's assets and liabilities.

2.2. Study objectives

The goal of the ALM Study was to assess the impact of key investment and solvency-related decisions on the long-term financial condition and performance of the UNJSPF. To ensure the Fund's safety, a comprehensive risk analysis was conducted, which includes:

a. assessing the current and alternative asset allocations to achieve the optimal balance of risk and reward;
b. recommending optimal long-term strategic asset allocation(s) based on the Fund's liability, risk appetite and risk tolerance;
c. determining whether the current assumed asset return can be achieved in the long term;
d. forecasting the likelihood of the current contribution rate remaining sufficient;
e. validating the risk tolerances to be used in the UNJSPF's Funding Policy; and
f. forecasting the likelihood that future funded ratios and solvency metrics within an acceptable range, including the risks of under- and over-funding within the long-term asset allocation strategies recommended and under the current investment strategy.

The ALM Study aims to determine the appropriate asset classes for the UNJSPF on a global scale. It will also establish a long-term target weight for each asset class, taking into account both broad asset classes and their underlying strategic investment segments.

2.3. ALM process

In the study we differentiated between four main phases.

1. CMAs and assumptions: The study started with modelling current assets and potentially new asset classes. We used data from the UNSJPF on asset class characteristics, benchmarks, and

maturity profiles. We show the expected risks and returns per asset class driven by the various economic outlooks of the study. In this phase, we also modelled the liabilities of the plan based on the participant and beneficiary data, actuarial and economic assumptions.

2. Evaluation of current status: we analyzed the UNJSPF's progress toward its long-term objectives and assess the level of risk involved based on the modelling and assumptions from the previous phase.
3. Asset allocation analyses: in this phase, we analyzed different investment strategies to increase the likelihood of achieving long-term goals while minimizing risk.
4. Sensitivity analysis and stress testing: we analyzed different scenarios and stress events to verify the resilience of both the current and proposed portfolios. Additionally, we explore the impact of potential changes to pension benefits on the liability side.

Assumptions and results of each phase were discussed with the UNJSPF Internal Working Group, the Committee of Actuaries, the Investment Committee, and the Fund Solvency and Assets and Liabilities Monitoring Committee. The final results of the study were then prepared for presentation to the Pension Board.

2.4. United Nations Joint Staff Pension Fund

The United Nations Joint Staff Pension Fund was established in 1949 by a resolution of the General Assembly, to provide retirement, death, disability, and related benefits for staff upon cessation of their services with the United Nations and the other 24 organizations admitted to membership in the Fund, under Regulations that, since then, have been amended at various times.

As an independent inter-agency entity, the Fund operates under its own Regulations as approved by the General Assembly. In accordance with its governance structure, it is administered by the United Nations Joint Staff Pension Board, the Chief Executive of Pension Administration, and the Staff Pension Committees of the member organizations. The General Assembly, through the Fund's Regulations, has given the fiduciary responsibility of the investment of the Fund's assets to the Secretary-General who, in turn, has delegated this responsibility to their Representative. The Office of Investment Management (OIM) assists the Representative of the Secretary-General (RSG) in investing the assets of the Fund. Thus, the UN Secretary-General and the Board work in tandem to support the General Assembly's responsibility to manage the long-term solvency of the Fund.

As of 31 December 2022, the UNJSPF had 143,612 participants and 83,988 beneficiaries in receipt of a periodic benefit, with assets of $78bn in market value. The Fund operates as a

multiple employer defined benefit plan with a fixed contribution rate of 23.7% of pensionable remuneration, paid 1/3 by staff participants and 2/3 by their employing organizations.

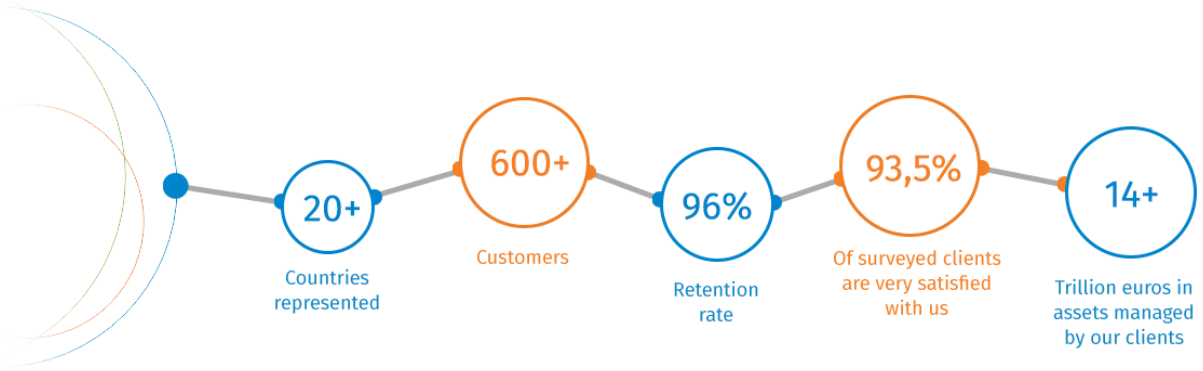
2.5. Ortec Finance

Ortec Finance is a leading global provider of technology and solutions for risk and return management, enabling you to manage your investment decisions.

We model and map the relevant uncertainties in order to help you monitor your goals and decisions. Founded by leading experts in the fields of Econometrics and Technology, we have in 35 years achieved an outstanding reputation, built on reliability and independence. With over 600 clients in 20+ countries, we play a vital role in helping our clients improve investment decision making and managing uncertainty.

Ortec Finance is a privately held, employee-owned company. Headquartered in Rotterdam, The Netherlands, we also have offices in Amsterdam, London, Toronto, Zurich, New York, and Melbourne.

Ortec Finance is an UN-PRI signatory.



3. Methodology

In an Asset Liability Management (ALM) study, the focus is on the total balance sheet. By taking into account the liabilities and cash flows, the assets can be managed in such a way that the goals of the fund can be better achieved than in an asset-only analysis. The foundation of this ALM study is the stochastic projection of the UNJSPF balance sheet. The simulation of the modelled assets and liabilities, driven by economic scenarios, steered by UNJSPF policies, is ultimately dependent on the underlying assumptions and methodology that we employ at Ortec Finance, in agreement with the client.

Our methodology is based on years of research and development, is well documented, and is highly flexible so it can be tailored to the client's needs. We can facilitate alignment with the previous ALM study, for a consistent continuation of quantifying risk and opportunities for the UNJSPF. At the same time, we continuously innovate our solutions and can tailor to new insights, model improvements, and emerging themes such as stochastic scenario sets that consider climate change and a path to net zero carbon emissions.

In this section of the report, we set forth our techniques and assumptions to simulate and analyze the UNJSPF balance sheet, starting with the economic and portfolio scenario generation.

3.1. Ortec Finance portfolio scenario modelling

3.1.1. Introduction

An essential part of the ALM study is the modelling of portfolio investment risk. The quality of such modelling has a direct impact on how successful investors and asset owners will be in achieving their objectives. Based on more than 30 years of building and applying portfolio investment risk models, our approach is characterized by 2 unique points:

- A one-of-a-kind economic scenario generator that ensures consistency across economies, asset classes, short, medium, and long-term investment horizons as well as over time.
- Time-varying risk and return with a superior out-of-sample performance.

Ortec Finance provides full transparency about the assumptions underlying the scenarios and clients can incorporate their own risk and return assumptions in a consistent way. The scenarios are available for the end of every month, for projection periods from one month to many decades.

3.1.2. Broad approach

Broadly speaking our scenario-based portfolio modelling logic consists of two components:

1. Our **Economic Scenario Generator (ESG)** which produces realistic and up-to-date scenarios (or Monte Carlo simulations) of economic growth, inflation, equity benchmarks, real and nominal yield curves, credit spread curves, commodity prices, real estate benchmarks, implied volatilities, and exchanges rates.
2. The modelling of **asset classes and investment strategies**. This entails:

- Combining yield and spread curve scenarios with maturity, country, and rating profiles to produce fixed income benchmark and portfolio return scenarios
- Transforming local currency portfolio values into any desired reporting currency based on exchange rate scenarios while hedging strategies are simulated based on FX forward contracts
- Rebalancing portfolios based on static, time, or state-dependent asset allocation strategies
- Using interest rate derivatives to hedge interest risk across the curve, possibly against pension liabilities

Together these components produce realistic and up-to-date projections of expected returns and risks of (alternative) investment portfolios.

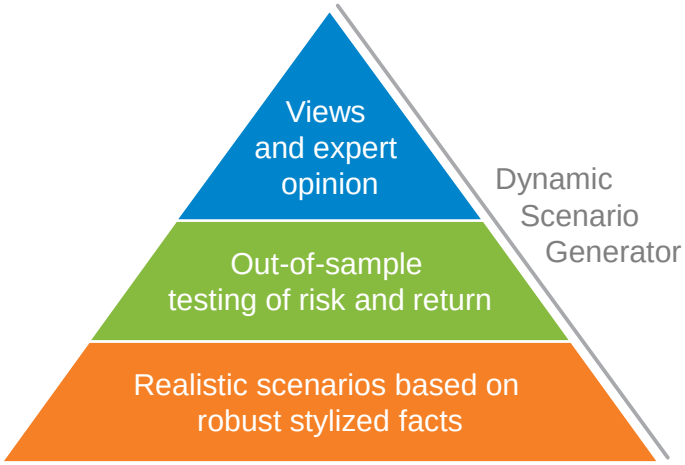
3.1.3. Based on robust stylized facts

Our economic and asset return scenarios, as used by pension funds, insurance companies, sovereign wealth funds, banks, and asset managers across the globe, are founded on a list of robust stylized facts. Our methodology is unique in dealing with all these stylized facts at the same time, allowing us to generate scenarios that as realistic as possible describe what might happen in the future.

Term structure of risk and return	Risk and return vary with the investment horizon, e.g. equity – inflation correlation higher on longer horizons
Business cycles	Medium term fluctuations inherent to economies and markets, e.g. equities leading on real economy, prices lagging
Time varying volatility	E.g. low volatility in years preceding the financial crisis
Tail risk	Correlations increase in times of crisis (less diversification)
Non-normal distributions	Skewed and fat-tailed distributions
Yield curves	E.g. parallel and tilt movements across maturities

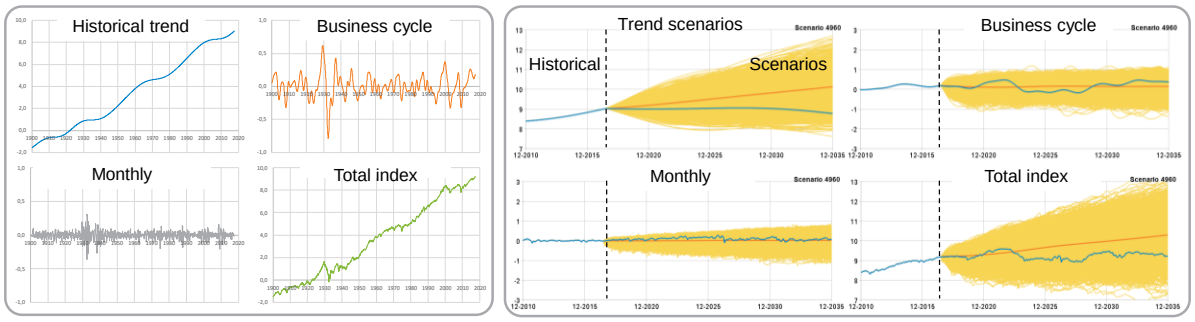
To ensure that our scenarios are as realistic as possible, we augment our data and model-driven approach with thorough **back-testing** research and by imposing **views** and expert opinion where needed (e.g. to incorporate the impact of monetary policy).

Methodological foundations



We employ a unique combination of **techniques and models** to generate our scenarios: frequency domain filters, spectral analysis, non-normal Dynamic Factor Models (DFMs), Principal Component Analysis (PCA), kernel density estimators, stochastic (realized) volatility and extended Nelson & Siegel yield curve modelling.

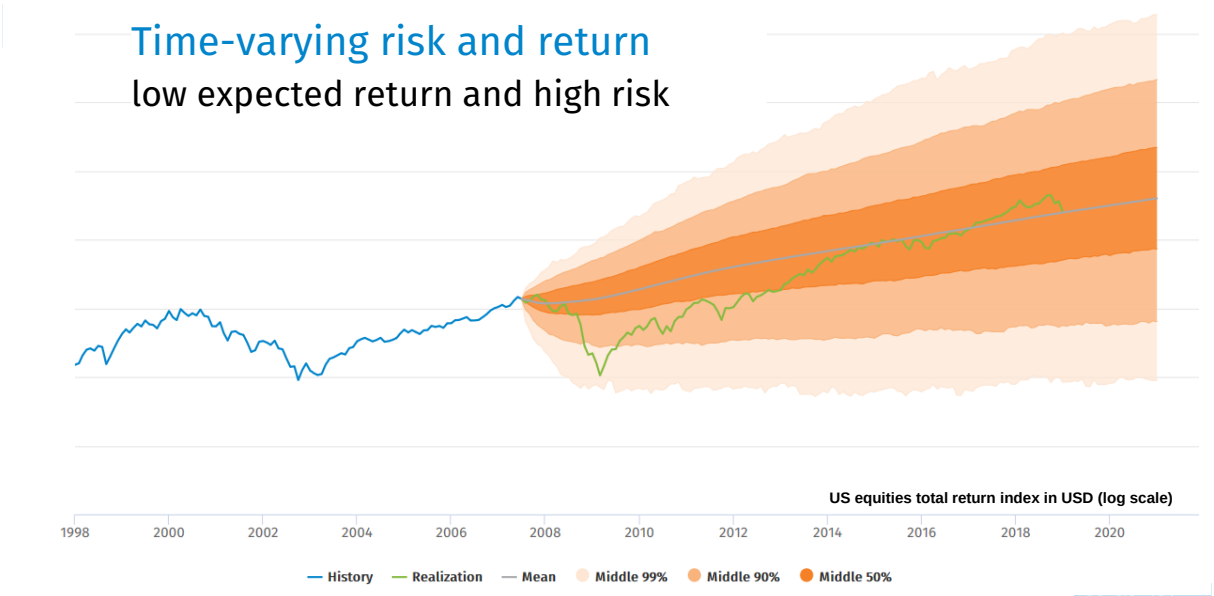
Integrated long, medium, and short-term scenarios (US equities total return index log scale)

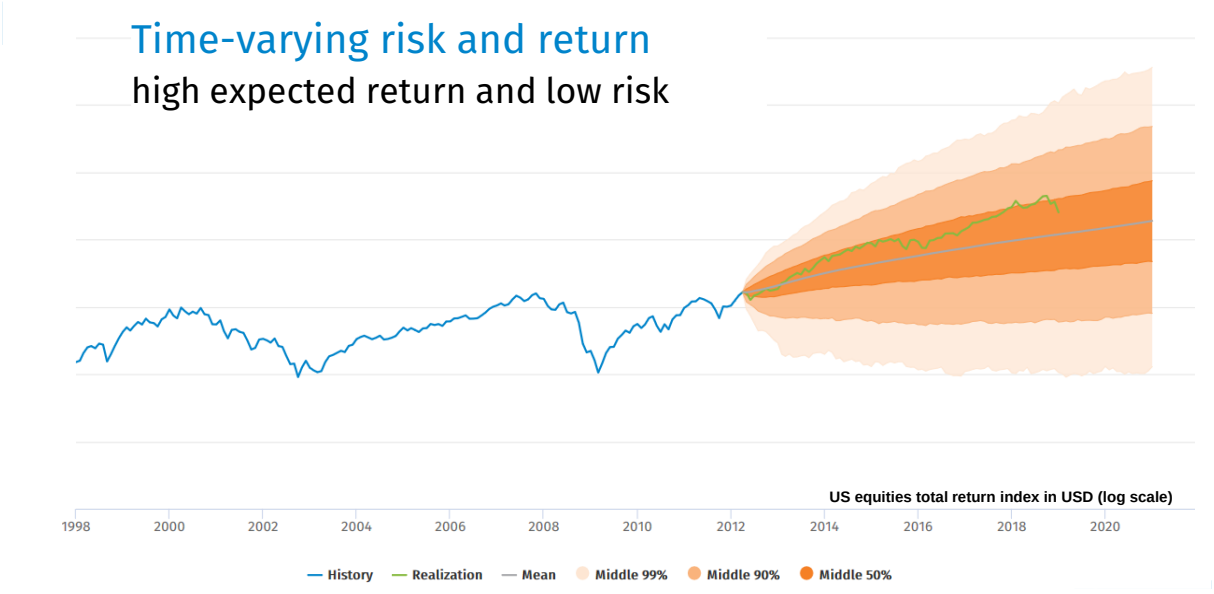


3.1.4. Dynamic risk and return

The frequency domain dynamic factor modelling approach, which constitutes the cornerstone of our portfolio risk management approach "automatically" also produces portfolio risk which is dynamic as it adjusts to **changes in economic and financial market conditions**. These dynamics are driven by well know market forces as momentum, return reversal, valuation, and business cycle dynamics. The dynamic portfolio risk of our approach

has been extensively back-tested and is continuously monitored on an out-of-sample basis. See, for example, https://www.ortecfinance.com/en/insights/blog/a-true-out-of-sample-back-test-of-the-ortec-finance-scenarios.

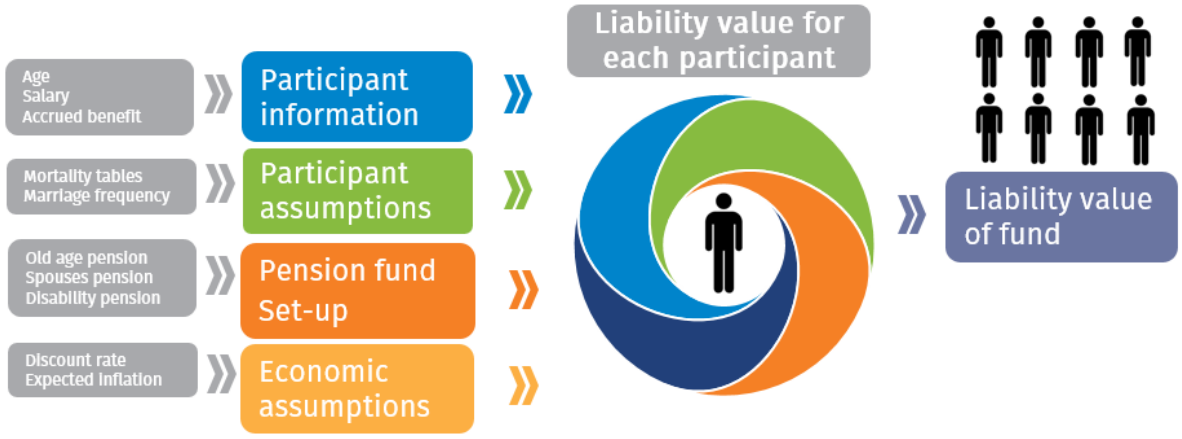




3.2. Ortec Finance liability modelling

The UNJSPF liabilities were modelled in accordance with the latest actuarial valuation (as at 31 December 2021), based on liability replication of underlying membership data. This not only lays the foundation for asset-liability management; it also allows actuarial sensitivity analyses. In modelling the liabilities, we do not only focus on the current liability profile but also take into account the evolution of the liabilities towards the future.

The Actuarial Pension Module is an enhanced modelling approach of pension liabilities and relies on the simulation of each participant in the pension fund. In the figure below the process of simulating liability values is visualized. Participant information and the setup of the pension fund were combined with actuarial and economic assumptions to calculate the liability value for the participants. Afterwards forward-looking assumptions were added to create a liability projection in the simulation.



3.2.1. Detailed modelling of liabilities

For the UNJSPF ALM study we applied the member-by-member approach to create detailed cash flows on a currency-by-currency basis for any projection period from 1 year to many decades. This allowed modeling modelling the policies of the Two-Track system with much greater accuracy than can be achieved with the Expected Cash Flow approach: with the member-by-member module, the currency element can be considered, as we simulated the currency exposure (USD and local) for every individual member in the Two-Track system. Current and future active members who opt into the Two-Track were also explicitly modelled in this detailed way.

The liability module used by Ortec Finance is highly flexible in estimating future developments of the participants, salaries, benefits, and the liabilities. The initial objective of this module was the generation of the liabilities to be used in ALM studies. Over time however, the module has developed into a complete liabilities prognosis system, which can also be used for contribution calculations, prognoses of costs, evaluation of the effects of changes to the plan, calculation of the effects of different discount rates, etc. All these aspects can be analyzed for the whole population or at the level of the single individual as well as groups of individuals with same characteristics (e.g., older than 50 years, salary higher

than 100,000, currency exposure). The relevant information of the current and future members together with forward-looking information on the development of the plan, such as salary policies and specific plan rules (e.g., the members with different Normal Retirement Ages), were modeled to build a sound and detailed basis for the simulation of Fund's cash flows and liabilities.

The development of the participants file – the members' life cycles – was meticulously modelled using UNJSPF assumptions on 'mutation probabilities':

- Career: wage structure for new entrants and merit scales
- Marital status
- Mortality or life projection tables
- Disability probabilities
- Resignation probabilities for men/women
- Population growth / shrinkage (expectation and realization can be different)
- Age and gender distribution of new entrants
- Home currency

Based on the life cycles generated in the prognosis and the regulations indicated in the plan setup in the model, the actuarial amounts, or cash flows (benefits, liabilities, service costs, benefit payments, expected payroll, etc.) of the various benefit forms were then be calculated.

For every benefit type it can be indicated with which kind of index (e.g. CPI or wage inflation for different regions in the world) the different components (such as salary, and the accrued benefits) are indexed. At each time step for each participant and beneficiary an explicit valuation of his liabilities was performed. All these assumptions combined ensured that we reflected the development of the participants and beneficiaries in detail in our system.

3.2.2. Two-Track system

The UNSJPF employs a Two-Track benefit system. Participants leaving the 'Active status', can opt to join this system provided their place of residence is outside the US. The goal of the Two-Track is to protect the benefits of a member living in a non-USD country from inflation and exchange rate risk. A member can only opt into the Two-Track. It is not possible to opt back to the single (USD) track, although countries may be suspended from the Two-Track as a whole under certain conditions.

At separation, three important values are determined, i.e.:

- The USD Track. This is equal to the benefit accrued up to that date. It will increase with US CPI inflation.
- The minimum Base amount. At separation, this amount is equal to the USD track. This amount, however, will not increase with inflation; it remains at the same level.
- The Local Track. At separation, this amount is based on the USD Track converted to the Local currency by multiplying it with the 36-month average exchange rates between the local currency and the USD currency. For Professional staff members the benefit is increased with the Cost-of-Living Differential (COLD) factor if there is price differential between the country of residence and New York at the time of separation. This local benefit (including any COLD factor) will increase over time with the CPI in the specific country.

Furthermore, a floor of 80% of the USD Track and a Cap of either 110% or 120% of the Local Track play a role in the calculation of the benefit amount to be paid.

The actual payment to the member is based on the following rules.

1. Is Local-Track (LT) amount bigger than (Local Equivalent of) Dollar-Track amount?
    a. "Yes"
        i) Is Base US Amount > LT - Pay Base US
        ii) Is Base US Amount < LT - Pay LT Amount
    b. "No" – go to step 2
2. Is Guaranteed amount (= max(Base US Amount, 80% of DT)) bigger than Maximum Cap (=110/120% of LT)?
    a. "Yes" – pay Guaranteed amount
    b. "No" – go to step 3
3. Is Dollar-Track Amount bigger than Maximum Cap?
    a. "Yes" – pay Maximum Cap
    b. "No" – pay Dollar-Track amount

These rules are executed to determine the amounts to be paid to the member. In our model we execute these rules on an annual basis throughout the entire simulation.

Thanks to the member-by-member liability approach and our previous experiences with valuations of liabilities of the UNJSPF plan, the GLASS software of Ortec Finance supports the Two-Track system.

3.2.3. Implementation of the Two-Track

For the non-active members, the three base factors (USD track, Base Amount and Local Track) are known. Furthermore, the country of residence and the separation year are known.

For the active members no Two-Track specific information is available because the option is exercised after separation. To model the Two-Track correctly, the exchange rate and local price inflation in the economic scenario generator are required. Due to these data requirements, modelling all countries is too complex and resource consuming. Therefore, we needed to select the most relevant countries. Based on the data, we made assumptions about the countries of residence. The table below shows the benefit-weighted allocation to the different countries. Based on this analysis, the most important currency zones were selected (CHF, EUR, GBP, JPN, CAD). With these countries we capture 90% of the Two-Track benefit. We apply a loading to compensate for the missing countries. All other countries not covered by these currencies were assumed to be USD based for the purpose of modelling.

Country	Non-Actives (%)
USA	67.2%
CHE	9.8%
FRA	7.4%
AUT	3.8%
ITA	3.4%
GBR	1.2%
ESP	1.0%
CAN	0.7%
DEU	0.6%

For current actives, the future country of residence is unknown to us. In the model we assumed that, in line with the current distribution in the table above, that 67.2% would reside in the USA and the remaining 32.8% would reside a country outside of the USA. Moreover, we assumed that this would be one of the countries covered by the currencies CHE, EURO, GBP, JPN, CAD and in the same proportion as in the table above.

In the model members are clustered to be able to calculate the value of the Two-Track. We clustered members by:

- Separation year (the moment they left active service and when the Two-Track calculation starts, even if they did not opt in)
- Currency zone
- Professional or General staff (required because of the COLD factor applied)
- The applicable cap (110%/120%)

Without loss of accuracy the Two-Track components of these members were aggregated. Based on their aggregated Two-Track components (USD Track, Local Track and Base amount),

the actual aggregated pay-out was determined. The underlying assumption was that the exchange rate was constant during the year of separation.

3.2.4. Valuation Methods

In this ALM study the focus was on the Open Group valuation because this informs UNJSPF of the future sustainability of the Fund. This method includes future accruals and payments, both of current and future members of the fund. For the Open Group valuation, in each simulation year, a projection was made of current participants (at that moment in time) plus new members entering the plan in the future. This produced the liability value that could be compared to current assets increased with expected contributions of this same group of current and future members.

The valuation is based on the USD-track of each member. The costs of the Two-Track are considered by means of a loading on the liabilities. In the UNJSPF's actuarial valuation, the cost of the Two-Track is assumed to be 2.1% of the net present value of the total payroll of all current and future members together. These costs are then transformed based on the Open Group valuation to loading factors on the active, non-active and future active groups. The loads are assumed to be 1.5% for Non-Actives and 6.1% for Actives & future Actives.

In calculating the liability values, the ALM study utilized the demographic and economic assumptions from the last UNJSPF actuarial valuation (as of 31 December 2021). General wage increases on payroll were assumed to be 3.0%. Increases in benefits for non-actives were assumed to be 2.5%. The only exception was deferred benefits, do not increase with inflation until the deferred member reaches the age of 55. The nominal discount rate used was 6.0%.

The Open Group valuation assumes an inflow of future members into infinity. The value of the liability of all future members does not increase to infinity but has a limit value due the effect of the discounting. In the last actuarial valuation, the UNJSPF Consulting Actuary assumed 30 years of inflow and then determined the limit value of all remainder inflows based on a standardized inflow profile. In the GLASS model we simulated 70 years of future members inflow and assumed that the remainder term is close to 0.

For the contribution rate we assume 23.32%. It is assumed that the difference between the actual paid contribution rate of 23.7% and 23.32% is spent on costs.

3.3. Total balance sheet simulation

Ortec Finance's GLASS system contains a sophisticated and truly integrated approach for modelling pension liabilities and assets. A stochastic modelling approach is applied to generate future financial projections of the asset and liability values over the projected horizon under various scenarios. For the UNJSPF, we configured GLASS to model the Fund's liabilities and specific investments. Multi-horizon simulations in GLASS can be conducted in terms of both months and years. GLASS provided a detailed picture of the balance sheet for each scenario and for each time step as shown in the illustration below.

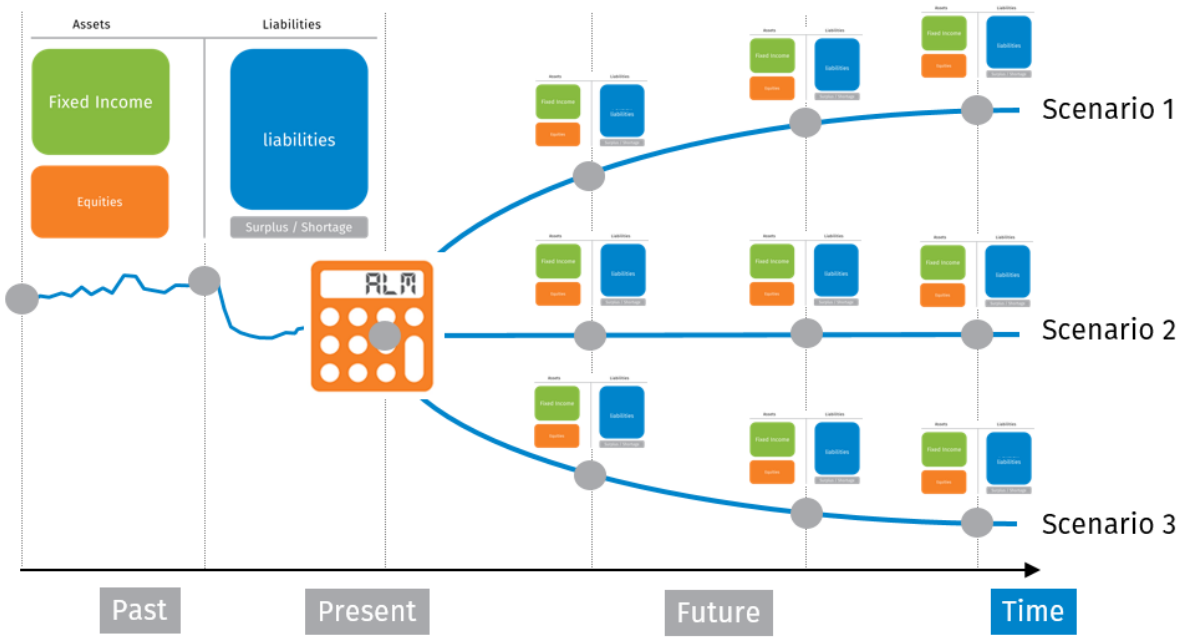
The special international nature of the UNJSPF means that the benefits are paid out in several currencies. However, the multiple currencies on benefit payments are only relevant to the extent of the uptake of the Two-Track option. We took this into account by simulating the Two-Track system for the eligible members.

On the asset side of the balance sheet, GLASS considered the OIM's Investment Policy. The system supports multiple dynamic strategies, both time and state dependent. For the Open Group valuation, the UNJSPF uses an actuarial value of assets for the purpose of calculating the required contribution rate. This is based on smoothing investment gains and losses over a 5-year averaging period.

The liabilities for current members and future entrants to the scheme (taking into account population growth assumptions) were calculated. At the same time, the expected payroll of all these members was determined. Multiplying this with the actual contribution rate of 23.70% provided the total expected contributions to be received.

A required contribution could then be calculated utilizing the results from each side of the balance sheet. The excess contribution rate (required minus current contribution rate) is a measure which expresses the over and underfunding status of the plan on a long-term going concern basis. This excess contribution is required to remain within the 2% corridor.

In the GLASS model, the calculations of these open group valuations are implemented in a detailed manner. In each simulation year and each economic scenario, the different balance sheet components are calculated on a member-by-member basis.



Simulating the entire balance sheet, with GLASS virtually any client-specific objective and measure can be defined. It supports all metrics specified by the UNSJPF, such as the level of the Required Contribution Rate. The scenario framework was then employed to assess the probability of reaching those objectives as well as the risks associated with the different strategies. Examples are the probability of falling below a Funding Ratio of x% cannot exceed y% or the 5% conditional value at risk (CVaR) value of nominal return should not be lower than y%.

All measures, such as probabilities, path probabilities and tails of distributions were tailored to the specifics of UNJSPF. The analyses were performed on multiple horizons with a focus on the 10-, 20-, and 30-year point.

4. Capital Market Assumptions

We have developed various Capital Market Assumptions (CMA) based on the assumptions and methodology outlined earlier for this study. We assess the current status and optimize asset allocation using three primary economic scenarios. Apart from the three primary sets of CMAs, we also employ several other scenarios for sensitivity and stress testing purposes.

This chapter focuses on the economic narratives that are utilized and explains the resulting risk and return traits of each scenario.

The CMAs were endorsed by the UNJSPF's Investment Committee.

4.1. Economic outlook

4.1.1. Three primary economic scenarios

The Ortec Finance Scenarios (OFS) forms the baseline. This scenario assumes a moderate growth outlook. In addition, we used two alternative CMAs: one more negative and one more positive compared to the OFS.

As a negative scenario (from an economic perspective) we use a scenario that is based on a climate change driven narrative: the Net Zero – Financial Crisis (NZFC) scenario.

As a positive scenario, we created a bespoke scenario, based on input by the UNJSPF. The central narrative of this scenario is receding inflation, with relatively cheap energy prices driving strong economic growth.

Ortec Finance Scenarios (OFS)	Net Zero Financial Crisis (NZFC)	Growth picking up
Baseline – neutral scenario	Negative scenario	Positive scenario (POS)
Moderate growth outlook *Risk premia lower than historical average* *Rates remain higher than past 2 decades*	*Sudden divestments to align portfolios to the Paris Agreement goals (net zero 2050 – 2070) have disruptive effects on financial markets with abrupt repricing in the period 2025 – 2030 followed by stranded assets and a sentiment shock*	*A more optimistic outlook.* *Energy prices drop, causing a steep reduction in inflation* *This will improve purchasing power of households, and allows central banks to cut rates, which will restart global growth in 2024*

The three primary scenarios are described below in more detail.

4.1.1. Ortec Finance Scenarios

The current market situation has been shaped by recent events, which have created a new environment for investors who had become used to low interest rates. Unfortunately, due to the factors such as high inflation, weak purchasing power, and rising interest rates, the economic cycle is expected to remain below average in the near future.

In the medium-term (0-10 years), long interest rates are expected to either stabilize around current levels or converge to just below trend levels reflecting moderate growth prospects and sluggish structural economic drivers, such as weak productivity growth and demographic headwinds. Inflation and interest rates are currently above trend levels, which is negatively affecting short-term equity returns. However, there are signs of improvement in the medium-term outlook. The fixed income outlook is more favorable than we have seen over the last years due to the higher rates and spreads and the expected further normalization of these.

In the long-term (30 years), we assume positive, yet lower than historical economic growth. This growth is driven by continuing technological progress (productivity growth), which is counteracted by limited population growth. Interest rates will slowly increase and normalize in the long-term yet stay at lower levels than the historical average.

4.1.2. Positive scenario

The starting point of all our scenarios is the current economic reality: the aftermath of extraordinary pandemic-related policy stimulus combined with negative supply shocks (arising from the Covid-19 pandemic and the Russia-Ukraine war) which led to inflation hitting a 40-year high in developed economies and triggered the quickest pace of monetary tightening since the 1980's.

The positive outlook starts with a more optimistic energy scenario, wherein energy prices drop, causing a steep reduction in inflation. This reduction will improve the purchasing power of households, which will restart global growth 2024. The drop in inflation will also allow central banks to cut rates, thereby providing further support for growth.

Compared to the OFS baseline scenario, equity returns, and risk premia will be higher and more aligned with historical averages. Spreads too, will be close to historical values. In the medium-term, the elevated growth levels may again increase inflation somewhat, albeit at levels close to central bank targets. Compared to the OFS baseline scenario, in this scenario

we also expect a stronger Euro against the US Dollar and Swiss Franc as there is less of a 'flight to safety' tendency.

The key differences between the positive scenario and the OFS baseline scenario arise in the first few years. We consistently project this further into the future, to also allow long-term analyses. This positive scenario is the third stochastic scenario set that will be used in the study to optimize the asset allocation.

4.1.3. Climate Scenarios / Net Zero – Financial Crisis

The third primary set of CMAs used is the Net Zero – Financial Crisis scenario, which is part of a larger group of scenarios known as Climate MAPS. These scenarios assess the impact of various climate pathways on the relevant measures.

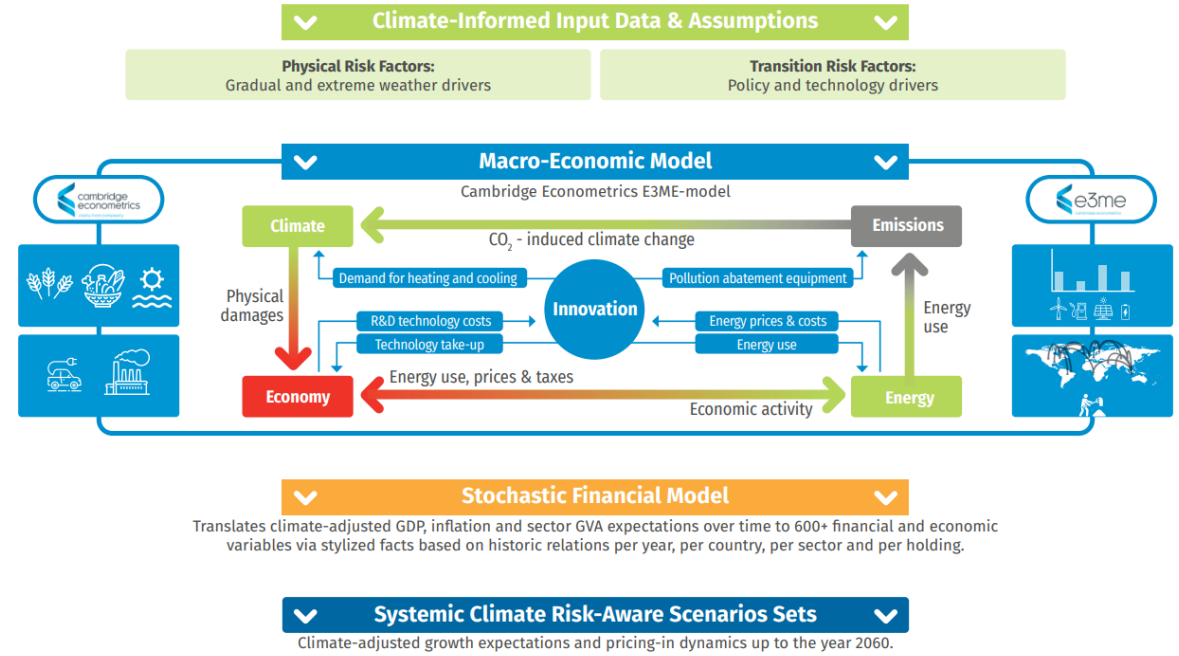
Climate MAPS are stochastic scenarios that quantify your portfolio's exposure to systemic climate-related financial risks and opportunities across different climate scenarios. Our solution equips investors with climate-informed risk-return metrics, including in absolute dollar value, that quantify exposure to systemic climate risks & opportunities across asset classes, regions, sectors, and holdings. This enables investors to consistently integrate climate risk into risk management, strategic asset allocation and asset liability management for investment decision-making.

Climate Risks are Systemic: Transmission channels and dynamic feedback loops between companies, sectors and countries amplify risk. Climate risk will, therefore, fundamentally impact how economies and markets perform as a whole. That is why financial regulatory bodies recommend that investors take these risks into account.

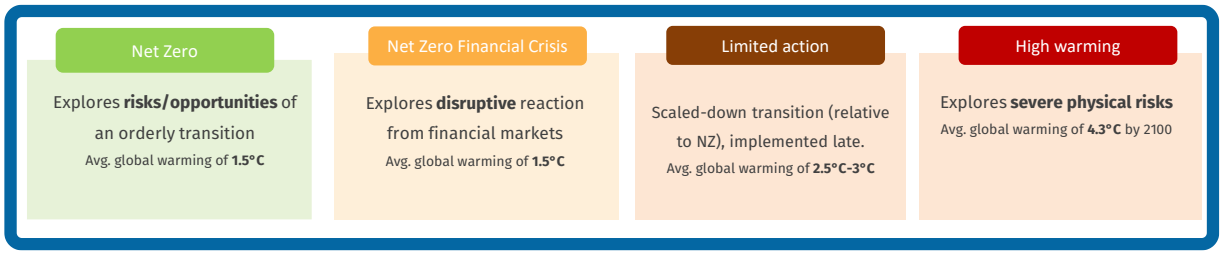
Our global warming pathways align with the Representative Concentration Pathway (RCP) scenarios by the UN Climate Change's (UNFCCC) appointed scientific body the Intergovernmental Panel on Climate Change (IPCC).

Our Methodology at A Glance

In partnership with Cambridge Econometrics



Climate MAPS uses scenario analysis to provide insights into potential macroeconomic and financial outcomes. Scenario analysis is a powerful method for assessing uncertainty and to help you gain insight into what lies ahead, whether the coming period will be one of high growth or high volatility. Climate MAPS aims to help you determine the most suitable asset mix for a range of possible scenarios. Ortec Finance has the capability to offer bespoke scenarios or to model a range of standard scenarios designed by regulatory or policy bodies.



The chart above shows the four current pathways modelled, with the resulting capital market assumptions outlined under section 4.2.5

For more information: https://www.ortecfinance.com/en/insights/product/climate-maps

In the ALM study, the Net Zero Financial Crisis scenario will be used as a negative scenario (from a financial impact point of view). It is one of three stochastic scenario sets that will be used in optimizations. All four climate scenarios will be used for sensitivity analyses.

4.1.4. Economic stress scenarios

Stress tests and alternative worldviews provide valuable insights into the impact of uncertain future economic and financial market developments to support investment decision making. The purpose of stress testing is to create risk awareness and to test robustness of investment strategies. In the study we used three economic stress scenarios: stagflation, secular stagnation, and deflation.

Stagflation

In the stagflation worldview, inflation is elevated, while economic growth remains low. Economic growth suffers from the aftermath of the Covid-19 pandemic. Additionally, escalation of the war in Ukraine and a surge in geopolitical tensions damages the economic recovery.

During the Covid-19 pandemic, governments increased their spending, leading to higher debt levels. Central banks applied accommodative policies such as increasing the money supply and applying interest-rate cuts. Stocks of products after the lockdown were low and production was still restrained. As soon as the economy reopened, combined with the low rates from the central banks, consumers and businesses spent more aggressively after being in quarantine. This will give another shock to the supply-demand balance and will increase the cost of production, leading to a state of stagflation with accelerating prices and slow output growth. In addition, rising energy costs fuel inflationary pressure.

Central banks are taking the middle road by pursuing a moderate accommodative policy and gradually raising interest rates in order to dampen high inflation and avoid further economic slowdown. In this scenario, inflation is elevated, resulting in rising nominal interest rates. There are slightly negative returns on risk-bearing investments, such as equities, due to low economic growth.

Secular stagnation

Secular stagnation refers to a state of chronic (long-term) lack of demand, resulting in low or little real economic growth. The long-term inflation is damped by the low growth environment and limited effectiveness of the central bank's monetary policy.

The outbreak of the Covid-19 pandemic caused a severe global recession, which led to lower growth, lower inflation, and a slower normalization of interest rates. The high levels of debt caused by the Covid-19 pandemic need to be repaid, causing a limiting effect on spending.

Central banks are not able to reach their target inflation and/or economic growth levels and keep interest rates low.

In this environment, interest rates and inflation will remain low. Equity returns remain low due to low economic growth.

Deflation

In the deflation stress scenario, a substantial negative economic shock occurs, triggered by a renewed financial crisis after the Covid-19 pandemic. The crisis is not just a local problem but attains global proportions. 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.

Central banks are cutting interest rates, but are limited to do so, because interest rates are already low due to the legacy of the Quantitative Easing programs in the recent past and accommodative policies to support the economy during the Covid-19 pandemic. Governments fail to reach consensus and are unwilling or unable to allow budget deficits to rise further. In such a situation, interest rates will become negative, while equities show strongly negative returns. Credit spreads rise in this situation.

4.2. Risk and return

Aggregated numbers are based on the current (2021) SAA. Returns shown are nominal.

4.2.1. Baseline scenario: Ortec Finance Scenarios

Risk and return statistics Dec22 OFS (USD, net of fees)	Year 1-10 Geometric return	Year 1-10 Arithmetic return	Year 1-10 Volatility	Year 1-20 Geometric return	Year 1-20 Arithmetic return	Year 1-20 Volatility	Year 1-30 Geometric return	Year 1-30 Arithmetic return	Year 1-30 Volatility
Total assets	**5.7%**	**6.3%**	**11.8%**	**5.5%**	**6.2%**	**11.8%**	**5.6%**	**6.2%**	**11.9%**
Equity and Private Assets	**5.8%**	**7.0%**	**16.6%**	**6.0%**	**7.3%**	**16.6%**	**6.0%**	**7.3%**	**16.6%**
Global Public Equities	5.5%	6.9%	18.1%	5.6%	7.1%	18.0%	5.7%	7.2%	18.0%
Developed Markets Equity	5.1%	6.6%	18.2%	5.3%	6.8%	18.0%	5.4%	6.9%	18.0%
Emerging Markets Equity	6.7%	9.6%	25.8%	6.4%	9.6%	26.1%	6.4%	9.6%	26.2%
Frontier Markets Equity	6.5%	10.3%	30.4%	6.4%	10.4%	30.5%	6.4%	10.5%	30.6%
Private Equity	6.5%	9.0%	24.2%	6.6%	9.2%	24.4%	6.6%	9.3%	24.4%
Real Assets	5.0%	6.1%	15.5%	5.3%	6.4%	15.6%	5.4%	6.5%	15.7%
Real Estate	4.9%	6.1%	16.2%	5.2%	6.5%	16.4%	5.3%	6.6%	16.5%
Absolute Return Strategies	2.8%	3.1%	8.4%	2.9%	3.2%	8.3%	2.9%	3.3%	8.3%
Infrastructure	5.2%	6.3%	15.9%	5.3%	6.4%	15.9%	5.3%	6.4%	15.9%
Timberland and Farmland	4.6%	5.2%	13.6%	4.6%	5.2%	13.8%	4.5%	5.2%	13.8%
Gold	1.0%	3.0%	21.9%	1.5%	3.7%	22.5%	1.6%	3.8%	22.8%
Commodities	2.2%	3.4%	17.0%	2.1%	3.4%	17.4%	2.1%	3.5%	17.6%
Private Debt	4.2%	4.4%	7.7%	3.8%	4.1%	7.9%	3.8%	4.1%	7.9%
Real Estate Debt	3.6%	3.7%	4.0%	3.2%	3.3%	4.1%	3.1%	3.2%	4.2%
Fixed income (dur 5.5)	**4.5%**	**4.6%**	**5.5%**	**3.6%**	**3.8%**	**5.6%**	**3.5%**	**3.7%**	**5.6%**
Fixed income (dur 5.9)	4.6%	4.7%	5.9%	3.7%	3.9%	5.9%	3.6%	3.8%	5.9%
US Core Bonds (dur 5.9)	4.5%	4.7%	6.1%	3.7%	3.9%	6.1%	3.6%	3.8%	6.0%
US Securitized (dur 5.7)	4.6%	4.8%	6.8%	3.8%	4.1%	6.9%	3.8%	4.0%	6.9%
US Treasuries (dur 5.9)	4.1%	4.3%	5.7%	3.2%	3.3%	5.7%	3.1%	3.2%	5.7%
US Corporates (dur 6.3)	5.2%	5.5%	9.1%	4.3%	4.7%	9.2%	4.2%	4.6%	9.1%
US Govt Related (dur 5.2)	4.6%	4.8%	6.3%	3.9%	4.1%	6.4%	3.8%	4.0%	6.4%
US TIPS (dur 7.3)	4.1%	4.2%	5.3%	3.2%	3.3%	5.3%	3.0%	3.2%	5.3%
Non Core Bonds (dur 5.0)	5.0%	5.8%	13.6%	4.2%	5.1%	13.6%	4.1%	5.0%	13.6%
Global Investment Grade (dur 6.0)	4.8%	5.1%	8.4%	4.1%	4.4%	8.5%	4.0%	4.3%	8.5%
Global High Yield (dur 4.2)	4.9%	5.5%	11.7%	4.5%	5.2%	11.9%	4.5%	5.2%	12.0%
Global Inflation-Linked Bonds (dur 10.6)	3.9%	4.1%	7.3%	3.2%	3.5%	7.2%	3.1%	3.4%	7.2%
EMD Local Currency (dur 5.0)	5.0%	5.8%	13.6%	4.2%	5.1%	13.7%	4.1%	5.0%	13.7%
Cash & Equivalents	2.8%	2.8%	1.6%	2.2%	2.3%	1.9%	2.2%	2.2%	2.0%
Inflation									
US Price	2.2%	2.2%	2.2%	2.2%	2.2%	2.3%	2.1%	2.2%	2.3%
US Wage	2.4%	2.4%	2.6%	2.3%	2.3%	2.7%	2.3%	2.3%	2.7%

4.2.2. Positive scenario: Strong growth

Risk and return statistics Dec22 Positive (USD, net of fees)	Year 1-10 Geometric return	Year 1-10 Arithmetic return	Year 1-10 Volatility	Year 1-20 Geometric return	Year 1-20 Arithmetic return	Year 1-20 Volatility	Year 1-30 Geometric return	Year 1-30 Arithmetic return	Year 1-30 Volatility
Total assets	**6.6%**	**7.2%**	**11.8%**	**6.3%**	**7.0%**	**11.9%**	**6.2%**	**6.9%**	**12.0%**
Equity and Private Assets	**7.1%**	**8.3%**	**16.6%**	**6.9%**	**8.2%**	**16.7%**	**6.9%**	**8.2%**	**16.8%**
Global Public Equities	6.8%	8.3%	18.2%	6.6%	8.2%	18.2%	6.6%	8.1%	18.3%
Developed Markets Equity	6.5%	7.9%	18.2%	6.3%	7.8%	18.2%	6.2%	7.8%	18.2%
Emerging Markets Equity	8.1%	11.2%	26.5%	7.6%	10.8%	26.6%	7.5%	10.7%	26.6%
Frontier Markets Equity	8.7%	12.5%	30.9%	8.0%	12.0%	31.0%	7.6%	11.8%	31.1%
Private Equity	7.7%	10.0%	23.2%	7.0%	9.4%	23.6%	6.7%	9.2%	23.7%
Real Assets	5.9%	7.0%	15.7%	6.3%	7.4%	15.8%	6.4%	7.6%	15.9%
Real Estate	5.8%	7.0%	16.4%	6.2%	7.4%	16.6%	6.3%	7.6%	16.7%
Absolute Return Strategies	3.9%	4.2%	8.5%	3.9%	4.3%	8.4%	3.9%	4.3%	8.4%
Infrastructure	6.0%	7.2%	16.1%	6.2%	7.3%	16.1%	6.4%	7.5%	16.1%
Timberland and Farmland	5.6%	6.2%	13.8%	5.5%	6.2%	13.9%	5.5%	6.2%	14.0%
Gold	1.1%	3.1%	21.9%	1.5%	3.7%	22.5%	1.7%	3.9%	22.8%
Commodities	2.2%	3.5%	17.3%	2.4%	3.7%	17.6%	2.6%	4.1%	17.7%
Private Debt	4.6%	4.9%	7.9%	4.3%	4.6%	7.9%	4.1%	4.4%	8.0%
Real Estate Debt	4.2%	4.3%	3.9%	3.9%	3.9%	4.1%	3.7%	3.8%	4.2%
Fixed income (dur 5.5)	**4.7%**	**4.8%**	**5.7%**	**4.0%**	**4.2%**	**5.6%**	**3.9%**	**4.1%**	**5.6%**
Fixed income (dur 5.9)	4.8%	5.0%	6.1%	4.1%	4.3%	6.0%	4.0%	4.2%	5.9%
US Core Bonds (dur 5.9)	4.8%	4.9%	6.2%	4.1%	4.2%	6.1%	4.0%	4.1%	6.1%
US Securitized (dur 5.7)	5.1%	5.3%	7.0%	4.5%	4.7%	6.9%	4.4%	4.6%	6.9%
US Treasuries (dur 5.9)	4.0%	4.2%	6.0%	3.2%	3.4%	5.8%	3.1%	3.3%	5.7%
US Corporates (dur 6.3)	5.6%	6.0%	9.1%	5.0%	5.4%	9.2%	5.0%	5.3%	9.2%
US Govt Related (dur 5.2)	5.1%	5.3%	6.4%	4.5%	4.7%	6.4%	4.4%	4.6%	6.4%
US TIPS (dur 7.3)	4.0%	4.1%	5.9%	3.3%	3.5%	5.6%	3.2%	3.4%	5.5%
Non Core Bonds (dur 5.0)	5.5%	6.3%	13.7%	4.8%	5.6%	13.7%	4.7%	5.6%	13.7%
Global Investment Grade (dur 6.0)	5.1%	5.5%	8.4%	4.8%	5.1%	8.5%	4.7%	5.1%	8.5%
Global High Yield (dur 4.2)	5.4%	6.1%	11.8%	5.4%	6.1%	12.0%	5.5%	6.1%	12.1%
Global Inflation-Linked Bonds (dur 10.6)	3.7%	4.0%	7.9%	3.5%	3.8%	7.5%	3.5%	3.8%	7.4%
EMD Local Currency (dur 5.0)	5.5%	6.3%	13.7%	4.8%	5.6%	13.8%	4.7%	5.6%	13.8%
Cash & Equivalents	2.8%	2.9%	1.5%	2.3%	2.3%	1.8%	2.2%	2.2%	2.0%
Inflation									
US Price	2.3%	2.3%	2.2%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%
US Wage	2.8%	2.9%	2.7%	2.8%	2.9%	2.7%	2.9%	2.9%	2.8%

4.2.3. Negative scenario: Net Zero Financial Crisis

Risk and return statistics Dec22 NZFC (USD, net of fees)	Year 1-10 Geometric return	Year 1-10 Arithmetic return	Year 1-10 Volatility	Year 1-20 Geometric return	Year 1-20 Arithmetic return	Year 1-20 Volatility	Year 1-30 Geometric return	Year 1-30 Arithmetic return	Year 1-30 Volatility
Total assets	**4.4%**	**5.2%**	**12.7%**	**4.7%**	**5.4%**	**12.3%**	**4.9%**	**5.6%**	**12.2%**
Equity and Private Assets	**4.0%**	**5.4%**	**17.9%**	**4.7%**	**6.1%**	**17.2%**	**5.0%**	**6.4%**	**17.1%**
Global Public Equities	3.4%	5.1%	19.5%	4.3%	6.0%	18.7%	4.6%	6.3%	18.5%
Developed Markets Equity	2.9%	4.7%	19.5%	4.0%	5.6%	18.7%	4.3%	6.0%	18.5%
Emerging Markets Equity	5.2%	8.4%	26.9%	5.1%	8.4%	26.6%	5.4%	8.7%	26.5%
Frontier Markets Equity	4.3%	8.3%	30.7%	4.8%	8.9%	30.6%	5.2%	9.4%	30.6%
Private Equity	4.8%	7.4%	24.9%	5.5%	8.1%	24.6%	5.7%	8.4%	24.5%
Real Assets	4.5%	5.6%	15.7%	4.6%	5.7%	15.6%	4.6%	5.8%	15.7%
Real Estate	4.4%	5.6%	16.5%	4.5%	5.7%	16.4%	4.6%	5.9%	16.4%
Absolute Return Strategies	2.4%	2.7%	8.9%	2.6%	3.0%	8.6%	2.7%	3.1%	8.5%
Infrastructure	4.4%	5.5%	16.0%	4.1%	5.2%	15.9%	3.9%	5.0%	15.8%
Timberland and Farmland	4.2%	4.8%	13.7%	4.0%	4.7%	13.7%	4.0%	4.7%	13.8%
Gold	1.8%	3.8%	22.1%	1.9%	4.1%	22.6%	1.9%	4.1%	22.8%
Commodities	2.7%	4.0%	17.3%	2.3%	3.7%	17.5%	2.2%	3.6%	17.7%
Private Debt	4.3%	4.6%	8.3%	3.9%	4.2%	8.2%	3.7%	4.0%	8.1%
Real Estate Debt	3.7%	3.8%	4.0%	3.3%	3.3%	4.1%	3.1%	3.2%	4.2%
Fixed income (dur 5.5)	**4.4%**	**4.6%**	**5.7%**	**3.7%**	**3.9%**	**5.6%**	**3.6%**	**3.7%**	**5.6%**
Fixed income (dur 5.9)	4.5%	4.7%	6.1%	3.8%	4.0%	6.0%	3.6%	3.8%	6.0%
US Core Bonds (dur 5.9)	4.5%	4.7%	6.2%	3.8%	4.0%	6.1%	3.6%	3.8%	6.1%
US Securitized (dur 5.7)	4.5%	4.8%	7.2%	3.9%	4.1%	7.1%	3.7%	4.0%	7.0%
US Treasuries (dur 5.9)	4.0%	4.2%	5.8%	3.3%	3.4%	5.7%	3.1%	3.2%	5.7%
US Corporates (dur 6.3)	5.1%	5.6%	9.9%	4.4%	4.9%	9.6%	4.3%	4.7%	9.5%
US Govt Related (dur 5.2)	4.6%	4.8%	6.7%	3.9%	4.1%	6.6%	3.8%	4.0%	6.5%
US TIPS (dur 7.3)	4.5%	4.6%	5.3%	3.4%	3.6%	5.4%	3.2%	3.3%	5.3%
Non Core Bonds (dur 5.0)	4.3%	5.1%	13.6%	4.3%	5.2%	13.7%	4.2%	5.1%	13.7%
Global Investment Grade (dur 6.0)	4.8%	5.2%	9.0%	4.2%	4.6%	8.8%	4.1%	4.4%	8.7%
Global High Yield (dur 4.2)	4.9%	5.7%	12.9%	4.6%	5.3%	12.5%	4.5%	5.2%	12.4%
Global Inflation-Linked Bonds (dur 10.6)	4.3%	4.5%	7.3%	3.5%	3.7%	7.2%	3.3%	3.6%	7.2%
EMD Local Currency (dur 5.0)	4.3%	5.1%	13.7%	4.3%	5.2%	13.7%	4.2%	5.1%	13.7%
Cash & Equivalents	2.9%	2.9%	1.6%	2.3%	2.3%	1.9%	2.1%	2.1%	2.0%
Inflation									
US Price	2.7%	2.7%	2.2%	2.4%	2.4%	2.3%	2.3%	2.3%	2.4%
US Wage	2.7%	2.7%	2.6%	2.2%	2.3%	2.7%	2.1%	2.2%	2.7%

4.2.4. CMA comparison

Risk and return statistics December 2022 Arithmetic return (USD, net of fees)	Year 1-10				
	OFS	NZFC	POS	NZFC -/- OFS	POS -/- OFS
Total assets	**6.3%**	**5.2%**	**7.2%**	**-1.1%**	**0.9%**
Equity and Private Assets	**7.0%**	**5.4%**	**8.3%**	-1.6%	1.3%
Global Public Equities	6.9%	5.1%	8.3%	-1.8%	1.4%
Developed Markets Equity	6.6%	4.7%	7.9%	-1.9%	1.3%
Emerging Markets Equity	9.6%	8.4%	11.2%	-1.2%	1.6%
Frontier Markets Equity	10.3%	8.3%	12.5%	-2.0%	2.2%
Private Equity	9.0%	7.4%	10.0%	-1.6%	0.9%
Real Assets	6.1%	5.6%	7.0%	-0.5%	0.9%
Real Estate	6.1%	5.6%	7.0%	-0.5%	0.9%
Absolute Return Strategies	3.1%	2.7%	4.2%	-0.4%	1.1%
Infrastructure	6.3%	5.5%	7.2%	-0.8%	0.8%
Timberland and Farmland	5.2%	4.8%	6.2%	-0.4%	1.0%
Gold	3.0%	3.8%	3.1%	0.8%	0.1%
Commodities	3.4%	4.0%	3.5%	0.6%	0.1%
Private Debt	4.4%	4.6%	4.9%	0.1%	0.5%
Real Estate Debt	3.7%	3.8%	4.3%	0.1%	0.6%
Fixed income (dur 5.5)	**4.6%**	**4.6%**	**4.8%**	0.0%	0.2%
Fixed income (dur 5.9)	4.7%	4.7%	5.0%	-0.1%	0.2%
US Core Bonds (dur 5.9)	4.7%	4.7%	4.9%	0.0%	0.2%
US Securitized (dur 5.7)	4.8%	4.8%	5.3%	0.0%	0.5%
US Treasuries (dur 5.9)	4.3%	4.2%	4.2%	-0.1%	-0.1%
US Corporates (dur 6.3)	5.5%	5.6%	6.0%	0.0%	0.5%
US Govt Related (dur 5.2)	4.8%	4.8%	5.3%	0.0%	0.5%
US TIPS (dur 7.3)	4.2%	4.6%	4.1%	0.4%	-0.1%
Non Core Bonds (dur 5.0)	5.8%	5.1%	6.3%	-0.6%	0.5%
Global Investment Grade (dur 6.0)	5.1%	5.2%	5.5%	0.1%	0.4%
Global High Yield (dur 4.2)	5.5%	5.7%	6.1%	0.1%	0.5%
Global Inflation-Linked Bonds (dur 10.6)	4.1%	4.5%	4.0%	0.4%	-0.1%
EMD Local Currency (dur 5.0)	5.8%	5.1%	6.3%	-0.6%	0.5%
Cash & Equivalents	2.8%	2.9%	2.9%	0.0%	0.0%
Inflation					
US Price	2.2%	2.7%	2.3%	0.4%	0.1%
US Wage	2.4%	2.7%	2.9%	0.3%	0.5%

4.2.5. Climate risk

Risk and return statistics December 2022 Year 1-30 (USD, net of fees)	Net-Zero Geometric return	Net-Zero Financial Crisis Geometric return	Limited Action Geometric return	High Warming Geometric return
Total assets	**5.2%**	**4.9%**	**4.6%**	**4.0%**
Equity and Private Assets	**5.5%**	**5.0%**	**4.7%**	**3.8%**
Global Public Equities	5.1%	4.6%	4.3%	3.4%
Developed Markets Equity	4.8%	4.3%	4.0%	3.2%
Emerging Markets Equity	5.9%	5.4%	4.8%	3.5%
Frontier Markets Equity	5.7%	5.2%	4.7%	3.6%
Private Equity	6.1%	5.7%	5.1%	4.0%
Real Assets	5.1%	4.6%	4.5%	3.8%
Real Estate	4.8%	4.6%	4.3%	3.7%
Absolute Return Strategies	2.8%	2.7%	2.6%	2.4%
Infrastructure	6.3%	3.9%	5.9%	3.4%
Timberland and Farmland	4.0%	4.0%	3.3%	2.4%
Gold	1.8%	1.9%	1.9%	1.9%
Commodities	2.3%	2.2%	2.3%	2.4%
Private Debt	3.7%	3.7%	3.7%	3.7%
Real Estate Debt	3.1%	3.1%	3.0%	3.1%
Fixed Income and Cash (dur 5.5)	**3.6%**	**3.6%**	**3.5%**	**3.5%**
Fixed income (dur 5.9)	3.7%	3.6%	3.6%	3.6%
US Core Bonds (dur 5.9)	3.6%	3.6%	3.5%	3.5%
US Securitized (dur 5.7)	3.7%	3.7%	3.7%	3.7%
US Treasuries (dur 5.9)	3.1%	3.1%	3.0%	3.0%
US Corporates (dur 6.3)	4.2%	4.3%	4.2%	4.2%
US Govt Related (dur 5.2)	3.8%	3.8%	3.7%	3.7%
US TIPS (dur 7.3)	3.2%	3.2%	3.1%	3.1%
Non Core Bonds (dur 5.0)	4.4%	4.2%	4.0%	4.0%
Global Investment Grade (dur 6.0)	4.1%	4.1%	4.0%	4.0%
Global High Yield (dur 4.2)	4.5%	4.5%	4.4%	4.4%
Global Inflation-Linked Bonds (dur 10.6)	3.3%	3.3%	3.2%	3.2%
EMD Local Currency (dur 5.0)	4.4%	4.2%	4.0%	4.0%
Cash & Equivalents	2.1%	2.1%	2.1%	2.0%
Inflation				
US Price	2.3%	2.3%	2.2%	2.2%
US Wage	2.1%	2.1%	2.0%	1.9%

A description of the scenarios can be found under 4.1.3.

4.2.6. Economic stress scenarios

Risk and return statistics December 2022 Year 1-10 (USD, net of fees)	Stagflation Geometric return	Secular Stagnation Geometric return	Deflation Geometric return
Total assets	**4.5%**	**3.6%**	**0.4%**
Equity and Private Assets	**4.1%**	**2.8%**	**-2.0%**
Global Public Equities	3.1%	2.2%	-3.0%
Developed Markets Equity	2.7%	1.7%	-3.7%
Emerging Markets Equity	4.8%	4.7%	0.4%
Frontier Markets Equity	3.3%	3.4%	-1.1%
Private Equity	4.7%	4.1%	-0.5%
Real Assets	7.3%	2.9%	0.4%
Real Estate	7.1%	2.7%	0.3%
Absolute Return Strategies	2.1%	2.1%	0.9%
Infrastructure	7.6%	3.1%	-0.4%
Timberland and Farmland	11.6%	0.0%	-6.9%
Gold	4.5%	0.5%	0.4%
Commodities	3.8%	0.8%	-1.3%
Private Debt	4.6%	3.5%	3.4%
Real Estate Debt	4.1%	3.3%	2.6%
Fixed Income and Cash (dur 5.5)	**4.4%**	**4.5%**	**4.3%**
Fixed income (dur 5.9)	4.5%	4.6%	4.4%
US Core Bonds (dur 5.9)	4.5%	4.6%	4.4%
US Securitized (dur 5.7)	4.6%	4.7%	4.4%
US Treasuries (dur 5.9)	4.1%	4.2%	4.0%
US Corporates (dur 6.3)	5.1%	5.3%	5.1%
US Govt Related (dur 5.2)	4.7%	4.7%	4.5%
US TIPS (dur 7.3)	6.7%	2.9%	1.3%
Non Core Bonds (dur 5.0)	3.8%	4.3%	3.0%
Global Investment Grade (dur 6.0)	5.0%	4.7%	4.3%
Global High Yield (dur 4.2)	5.5%	4.7%	4.2%
Global Inflation-Linked Bonds (dur 10.6)	6.5%	2.7%	1.5%
EMD Local Currency (dur 5.0)	3.8%	4.3%	3.0%
Cash & Equivalents	3.2%	2.5%	1.9%
Inflation			
US Price	4.7%	1.0%	-0.4%
US Wage	4.8%	1.2%	-0.1%

A description of the scenarios can be found under 4.1.4.

4.3. Economic comparison to the 2019 ALM study

Compared to the previous ALM study carried out in 2019, there are significant differences in the economic climate. These differences shape the current situation as well as the projections, which in turn affect our observations and recommendations.

The 2019 economic environment was characterized by historically low interest rates. The world was influenced by trade tensions and political uncertainty. Economic uncertainty was high. On the one hand you had risks of moving into a prolonged period of low interest rates, low growth, and low inflation (secular stagnation). On the other hand, there was upward pressure on (wage) inflation and rates driven by long-term demographic changes.

Since 2019, the extraordinary events experienced over the past four years drastically changed the investment landscape, which had previously been characterized by a prolonged period of low interest rates. The aftermath of extraordinary pandemic-related policy stimulus combined with negative supply shocks (driven by Covid-19 pandemic, Russia-Ukraine war) led to inflation hitting a 40-year high in developed economies. This triggered the quickest pace of monetary tightening since the 1980's. Fixed income investments became much more appealing, while equities lost some of their attractiveness.

Long-term expected total nominal portfolio return is about 1% lower now than it was in 2019. This will impact investment strategy decisions and the development of the UNJSPF Required Contribution Rate.

5. Results

5.1. Current status evaluation

5.1.1. Current situation

The plan's annual contribution rate is 23.70% of the annual pensionable earnings; a rate that has been in place since 1990. At the time of the latest official actuarial valuation (at 31 December 2021), 21.40% of the net present value of future annual pensionable remuneration was required to fully fund the pension plan. This rate is known as the Required Contribution Rate (RCR). A RCR greater than 23.70% relates to a deficit, while an RCR below 23.70% points to a surplus.

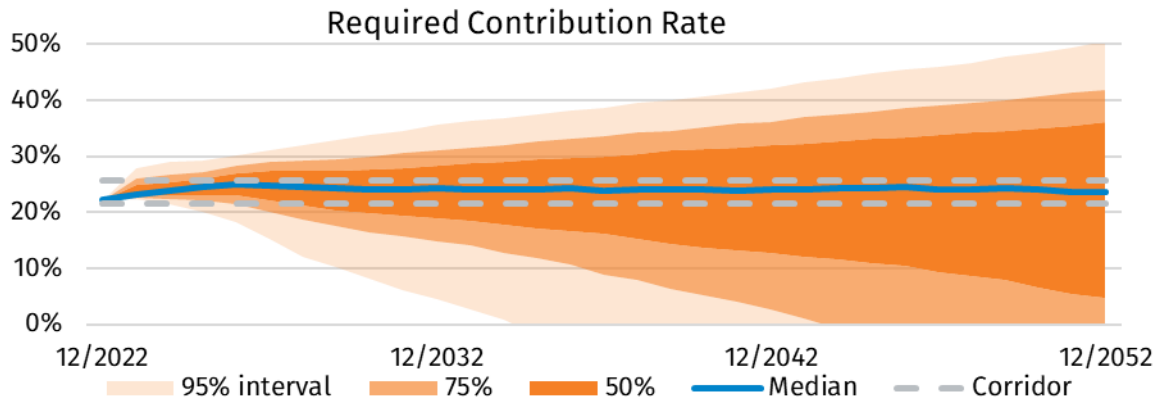
Projecting from the position of the fund at 31 December 2021, the UNSJPF was estimated to be in surplus at the end of 2022. The estimated present value of all future benefits payable is $177.5 billion, while the estimated value of plan assets plus present value of future expected contributions is $183.6 billion, with an estimated RCR of around 22.22%. This indicates a surplus of $6.1 bn, or 1.48% below the current contribution rate of 23.70%.

This is an improvement compared to the estimate of 23.7% for the end of 2018, in the 2019 ALM study, driven by strong investment performance. Note that in both cases (2018 and 2022) these numbers are estimates derived as part of the ALM study, as no official valuation was carried out for these specific years.

5.1.2. Expectation

In the 2019 ALM study, the median RCR was expected to decrease in the long-term, as the projected investment returns (on average) exceeded the discount rate. Now, the median RCR is broadly flat when projected over time, with the baseline OFS staying within the required contribution corridor of +/-2% around 23.70% (based on current SAA).

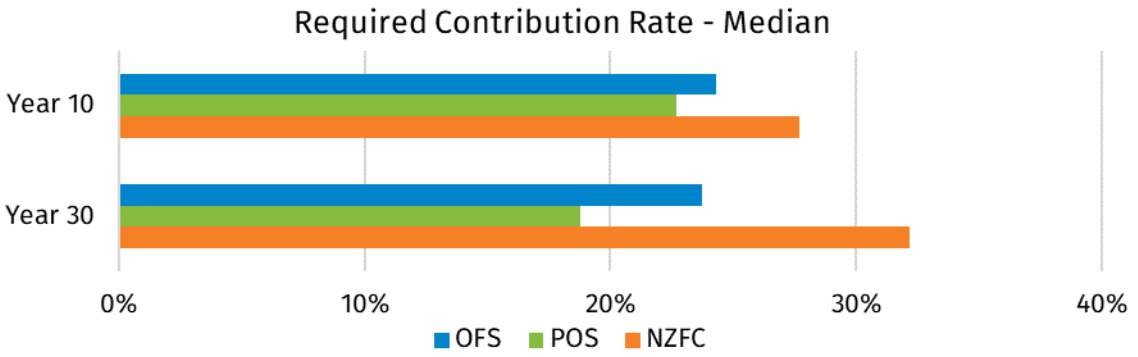
While the median stays in the corridor, the great majority of the scenarios will break out of it (up or down). This uncertainty is driven by inflation (benefit liabilities) and investment volatility. Note that the UNJSPF has no predefined "automatic" steering policies. Thus, this projection assumes that all policies will remain the same for the next 30 years. In reality, the Board will adjust policies to adapt to the ever-changing environment. Therefore, in the analyses we focus mostly on the 10-year horizon and use the 20-year and 30-year horizon as secondaries.



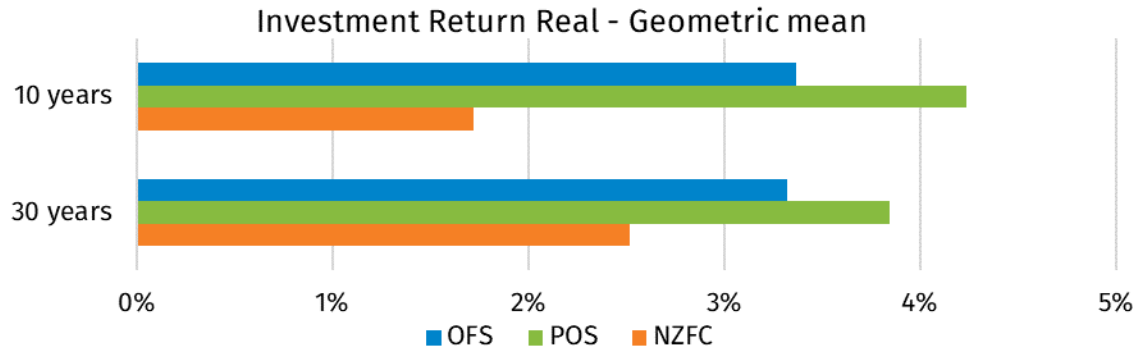
Note that all results shown in this report are based on the current (2021) SAA and Ortec Finance Scenarios (OFS) unless stated otherwise.

5.1.3. Comparing scenarios

We simulated and compared the RCR on different horizons under the three world views: baseline Ortec Finance Scenarios (OFS), a positive strong growth scenario (POS), and a (financially) negative Net Zero Financial Crisis scenario (NZFC).



The differences in RCR are caused by differences in expected returns and inflation. The latter affects both sides of the balance sheet, albeit not entirely symmetrically.



On a 10-year horizon, it may be possible to achieve a real return of 3.5% on the OFS baseline scenario but with a lower probability compared to the 2019 ALM study. On a 30-year horizon, achieving a 3.5% real return may be more challenging in the OFS and POS scenarios. With the NZFC scenario it is unlikely that an expected return of 3.5% could be achieved, regardless of the asset mix.

5.1.4. Numerical ALM results

	OFS			POS			NZFC		
ALM Results (*end of period) - SAA	**10 years**	**20 years**	**30 years**	**10 years**	**20 years**	**30 years**	**10 years**	**20 years**	**30 years**
Portfolio Nominal Return									
Geometric Mean	5.7%	5.5%	5.5%	6.6%	6.3%	6.2%	4.4%	4.7%	4.9%
Volatility	11.8%	11.8%	11.8%	11.8%	11.8%	11.9%	12.7%	12.3%	12.1%
10% CVaR	-15.3%	-15.6%	-15.6%	-14.2%	-14.8%	-15.0%	-17.9%	-17.1%	-16.7%
Portfolio Real Return									
Geometric Mean	3.4%	3.3%	3.3%	4.2%	4.0%	3.8%	1.7%	2.3%	2.5%
Volatility	11.7%	11.8%	11.8%	11.7%	11.8%	11.8%	12.5%	12.2%	12.1%
10% CVaR	-17.5%	-17.7%	-17.7%	-16.3%	-16.9%	-17.2%	-20.2%	-19.2%	-18.9%
Required Contribution Rate (RCR)									
Median*	24.3%	24.2%	23.7%	22.7%	20.7%	18.8%	27.7%	29.8%	32.2%
80% VaR*	29.3%	33.3%	38.4%	28.0%	30.5%	34.2%	32.2%	37.6%	44.2%

The table shows the numerical results for the current SAA under the three primary stochastic scenarios: Ortec Finance Scenarios (OFS), Positive growth scenario (POS) and the Net Zero Financial Crisis scenario (NZFC).

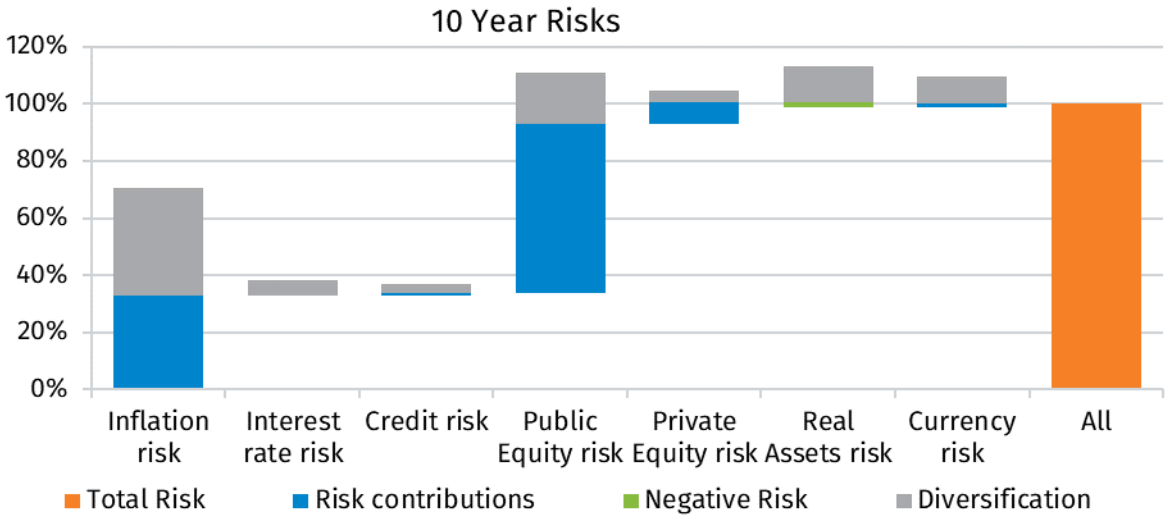
5.1.5. Risk factor decomposition

To quantify risk factors, we analyzed “surplus” in the worst-case scenarios after 10 years. Worst-case is defined here as the 5% conditional value at risk (CVaR).

The graph below shows the current SAA’s total risk (orange) and the individual risk factors that contributed to it in these 5% scenarios (blue). The gross risk of individual factors may be larger in a different subset of scenarios (blue + gray), when other risks, and thus total risk, is smaller. The difference between the “gross” risk of an individual risk factor versus the net risk in the total balance sheet worst-case scenarios is shown as diversification (gray). Some asset classes may actually appreciate in the worst-case scenarios. This leads to a negative contribution (green).

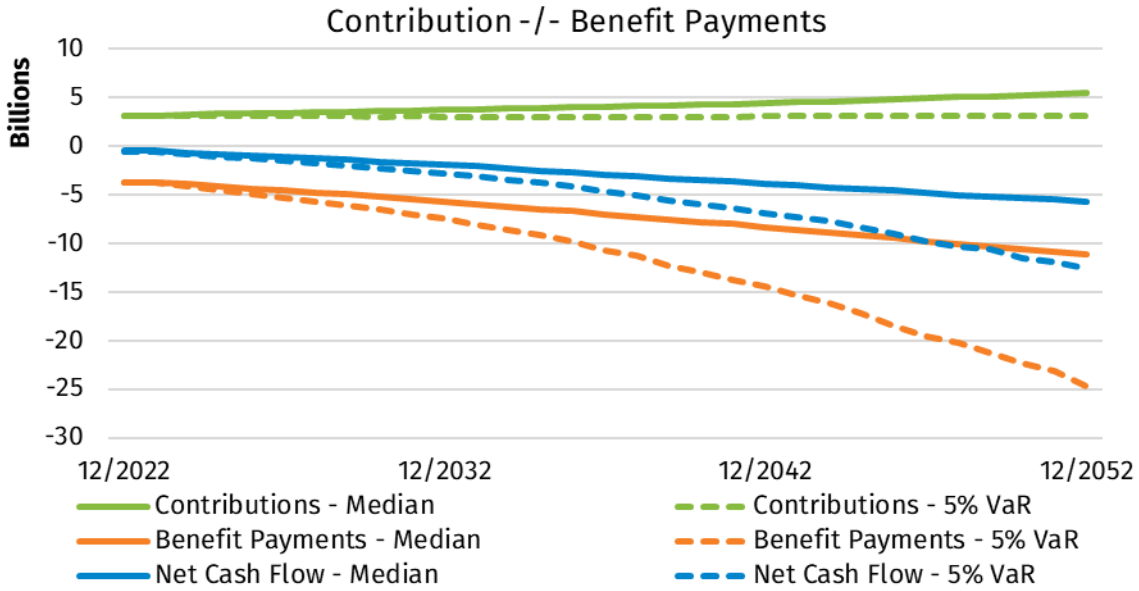
Over a 10-year period with the current SAA, the UNJSPF surplus decreased by around $80 billion in the worst-case scenario. For context, in year 10 the assets side of the balance sheet (actuarial value of assets + expected contribution) was roughly $244 billion in the median scenario. In these scenarios, the losses are primarily explained by public equity risk (59% of total risk) and inflation risk (33% of total risk). In these scenarios, real assets show a ‘negative

contribution', meaning in the scenarios where the total portfolio depreciates the most, real assets are expected to (slightly) appreciate. This is not to say real assets have no risk: in other scenarios, the situation may be reversed (albeit at a lower total risk). Overall, the fund may benefit from greater diversification to reduce total balance sheet risk.



5.1.6. Liability cash flows

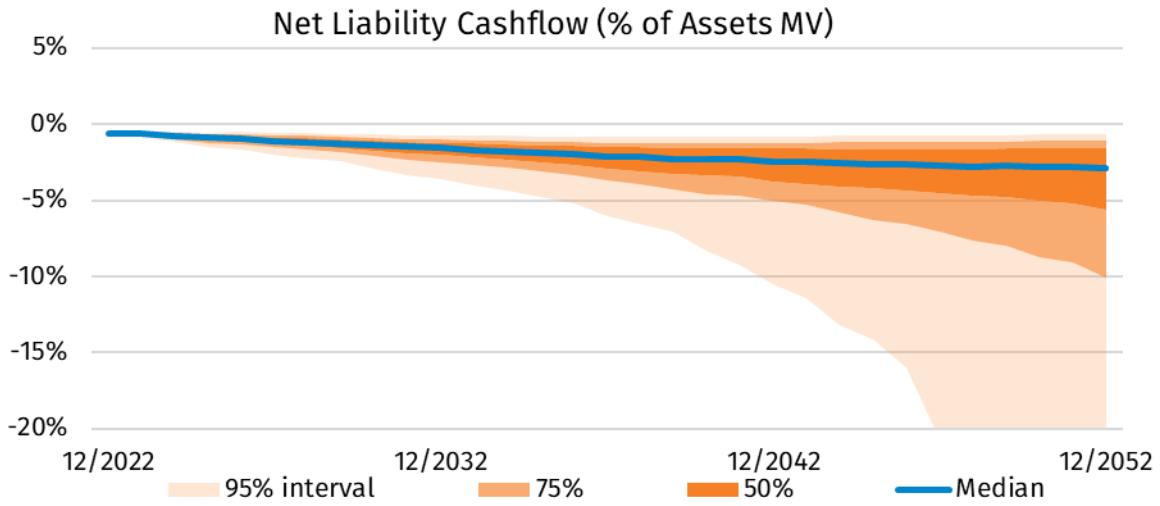
The modelled benefit payments of and contributions for 2022 were relatively close. As time passes, the fund becomes increasingly cash flow negative as the benefit payments grow at a faster rate than contributions, which means the fund is maturing. The number of retirees grows faster than the number of active participants.



The chart above shows the progress of the contributions, benefit payments and net cashflows over a period of 30 years. The solid lines show the median of the simulated scenarios, while the dotted lines show the 5% VaR (5% worst-case scenario). The uncertainty of the projection is driven by inflation and exchange rates, particularly for benefit payments.

At the start of the simulation the net cashflow is almost 0, but over the next few decades, it becomes increasingly negative. After 30 years, the median scenario shows a net cashflow of -$5 billion. Contributions increase to approximately $5 billion, while benefit payments increase to approximately -$10 billion. The benefit payments are represented as negative numbers because they indicate a cash outflow.

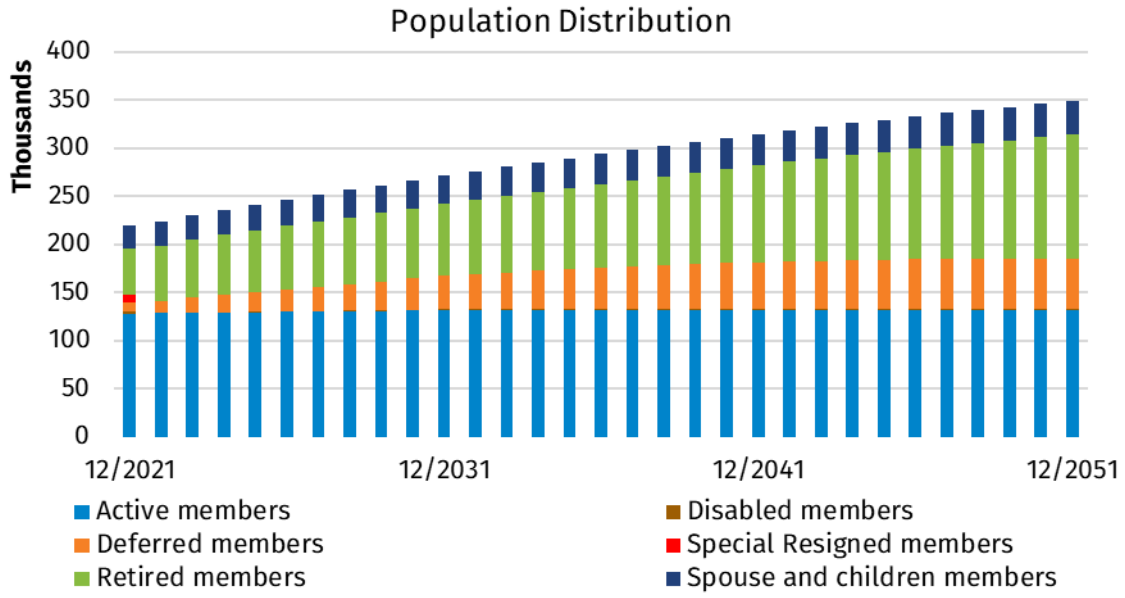
In the worst-case scenarios, the levels of the benefit payments increase drastically, compared to the contributions. This results in a net cashflow that is more than twice as large as in the median scenario (-$12 billon vs -$5 billion). Do note that contributions and benefit payments have opposite relationships with inflation, therefore, it is unlikely for both to experience a 5% VaR simultaneously.



As a percentage of the assets, the net liability cashflow decreases very slightly from 0% to –3% over the next 30 years in the median scenario. Note that the distribution is extremely skewed to the downside. In a limited number of scenarios, the level of the assets decreases rapidly over the coming decades, while the net cashflow increases due to inflation. This is based on the assumption that policies will remain unchanged indefinitely. However, in reality, policies will inevitably be expected to be modified over time to address any issue and maintain a stable outlook.

5.1.7. Demographic developments

The liability cash flows are dependent on the projection of the individual members. In the chart below, the first stacked column shows the member distribution as loaded into the liability model. This is the situation before the start of the simulation. In red, we specify a group of "Special Resigned" members. These are members who are part of the actives group, but currently do not accrue any benefits. We assume that these members go through the separation process: they resign, may leave with a lumpsum, or may take a deferred benefit before ultimately retiring to receive a pension.



Each simulation year, new members enter the fund, as employees resign or retire. In line with the 2021 actuarial valuation assumptions, it is assumed that the active member group of Professional staff has a small population growth of 0.5% per year for the first 10 years, after which growth is assumed to be zero.

As the fund matures, the Deferred member (orange) and Retired member (green) groups grow significantly. After 30 years, the number of members has increased from around 220,000 to almost 350,000.

5.2. Two-Track analyses

Two-Track is an option for UNJSPF beneficiaries residing in certain countries outside the USA to have their periodic benefit adapt to the local cost-of-living changes, rather than US CPI. The effects of the Two-Track feature on the UNJSPF are driven by developments in exchange rates and inflation levels in countries where the Two-Track is available. These effects are

both direct and indirect: direct by impacting the cost of benefit payments to members on the Two-Track and indirect by influencing peoples' choices with respect to opting into the Two-Track. In essence, there are four effects that will increase the cost (in USD) of Two-Track payments:

- A weaker Dollar.
- Higher inflation in non-USD regions.
- A positive difference between the 36-month average local currency/USD exchange rate and the current exchange rate.
- Substantial and sustained differences in the cost of living between other countries and the USD, leading to cost-of-living-differential (COLD) factor adjustments.

The basic actuarial valuation of benefits of the UNJSPF is based on the USD benefits, with an explicit loading added to the final RCR to reflect the estimated cost of the Two-Track. This loading is based on the long-term view of the cost of the Two-Track, taking into account the recent emerging cost (calculated by the Consulting Actuary). As a result, short-term changes in exchange rates and country inflation may not have an immediate effect on the solvency of the fund when considered in the context of the Two-Track. However, the underlying drivers of the cost of the Two-Track and the actual benefits payable can impact both sides of the balance sheet and therefore the RCR.

While an assumption for the cost of the Two-Track is utilized in the actuarial valuation, the real cost of the Two-Track may be higher or lower. This poses a risk, both from a solvency and liquidity perspective.

5.2.1. Two-Track rules

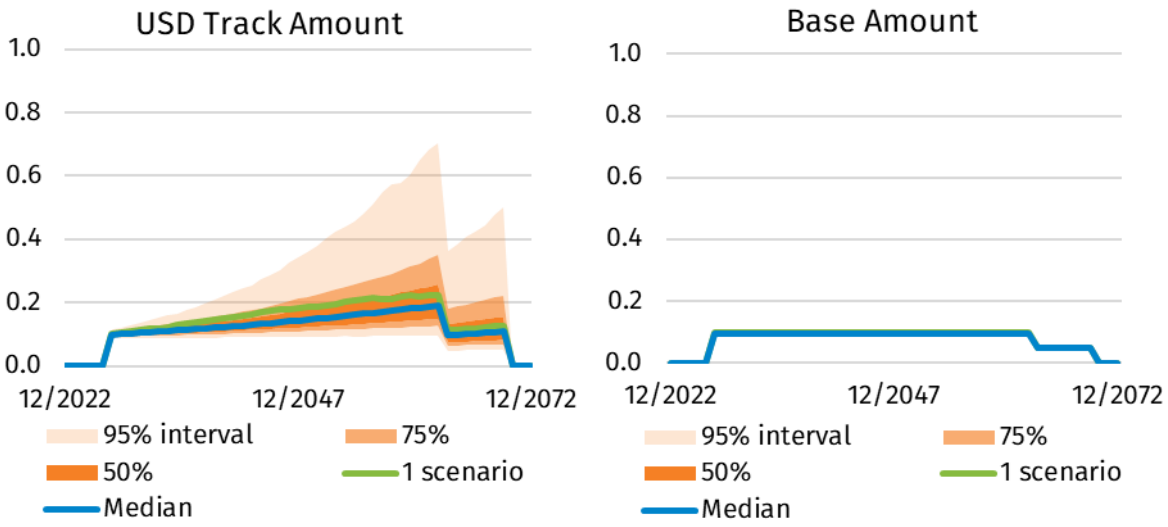
A beneficiary residing outside the USA has the option to stay on the single-track system (USD benefits linked to USD inflation) or elect to the Two-Track system, which seeks to preserve the local purchasing power of the benefit by following local inflation and maintaining a stable payment in the local currency. Once opted in, the beneficiary cannot revert to the single track. Beneficiaries may opt into Two Track at retirement or at a later date, with the calculation based on the original date of separation rather than any later opt-in date.

The local track benefit is determined based on a 36-month average exchange rate at the date of separation. The benefit may also be increased with a one-off cost of living adjustment – COLD factor – if the beneficiary resides in a location with a significantly higher cost of living compared to New York. Furthermore, a base amount (in USD) is determined which will

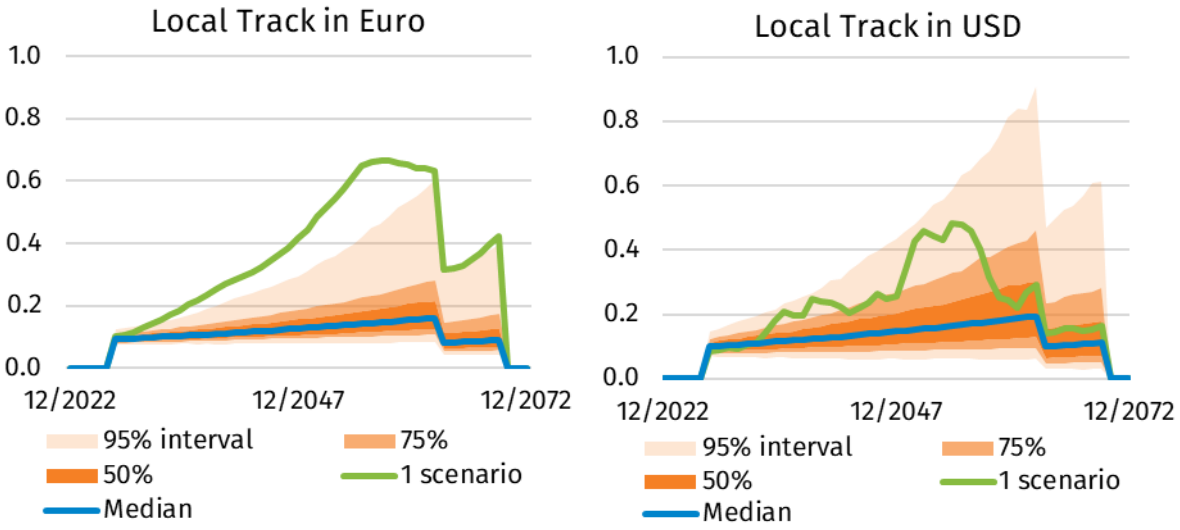
continue unindexed in the future. After this, the local track and USD base amount will be increased according to the local country CPI and US CPI respectively.

Two-Track model approach – example

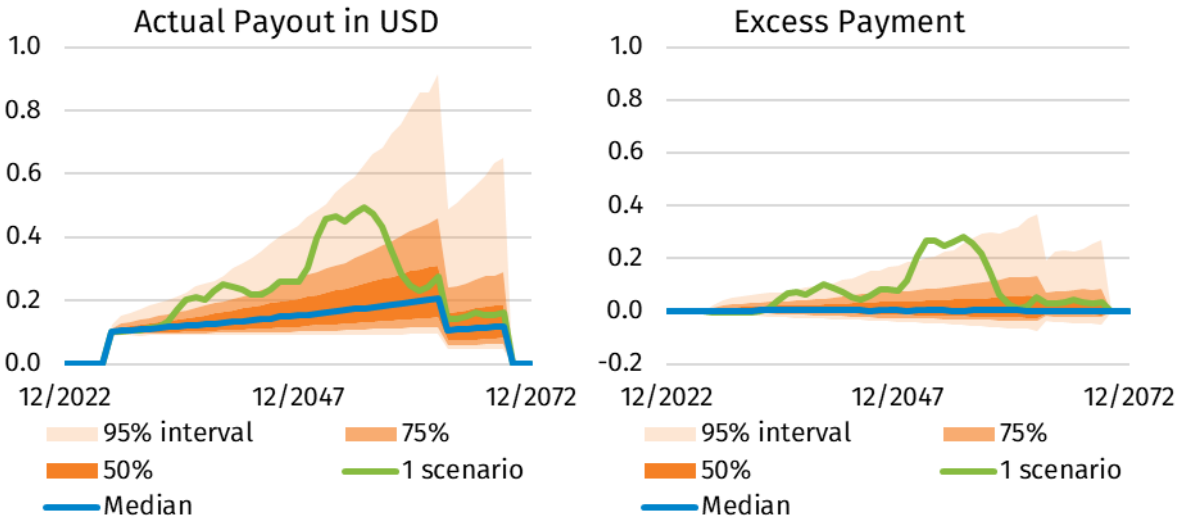
In the charts below we show the development of the different components of the Two-Track system (base amount, local track, USD track, actual pay out and excess payment; all in millions) for a current active member who enters the Two-Track in 2027 (retirement year) in a Eurozone country. This member dies in 2063, after which his spouse will receive benefits for another 7 years.



The first chart on the left shows the development of this members USD track benefit over time. In 2063 there is a dip in the benefit as the member dies and a spouse pension of 50% of the original amount is paid out. The range of possible outcomes in this development is linked to CPI US. The chart to the right shows the development of the Base amount. This amount is determined for the first time at separation (2027 when the member retires). At this moment, the base amount is equal to the benefit the member has earned, which is payroll dependent. Since the payroll is stochastic (wage inflation) up to the separation moment, the base amount also displays (limited) variability of outcome, although it is hard to discern due to the scale of the graph.



These charts show the Local Track benefit in local currency (left) and the same amount expressed in USD (right). This Local Track benefit is initially determined by the USD Track benefit, which is converted based on the 36-month average exchange rate and multiplied by the COLD factor. Once the Local Track benefit is calculated, it grows stochastically with local CPI. The chart on the right shows the same Local Track benefit, but now converted to USD using the spot exchange rates. As can be seen by the highlighted sample scenario (green), in USD terms the Local Track is a lot more volatile.



The first chart on the left shows the actual amount paid out to this member (in USD), which is determined using the Two-Track rules described earlier. On the right is the excess payment, which is the difference between the actual pay-out and the USD track benefit. In the chart, the effect of the 80% floor is visible in the limited downside risk. On the other hand, the upward potential is theoretically unlimited.

In summary, the excess payment is determined by the exchange rate, cumulative inflation delta, COLD factor at separation and the 36-month average exchange rate versus the spot exchange rate at separation. Furthermore, the excess payment (in USD terms) is highly volatile and skewed. This volatility is driven by currency returns and inflation differences.

5.2.2. Two-Track cost

The figures below show the excess payments per currency zone in million USD for current non-actives. The initial average excess payments are -9 (Euro zone), 13 (CH zone), -1 (UK zone) and -2 (JPY zone) million USD.

Discounting the excess payments leads to a gross price for the Two-Track system. In the table below the costs are shown as a percentage of NPV of total payroll ($393 billion at the end of 2021).

The cost of Two-Track as a % of the NPV of total payroll per region						
	EUR	CH	UK	CAN	JPN	Total
Current Non-Actives	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%
Current Actives	0.4%	0.3%	0.0%	0.0%	0.0%	0.7%
Future Actives	0.4%	0.3%	0.0%	0.0%	0.0%	0.8%
Total	0.8%	0.7%	0.0%	0.0%	0.0%	1.6%

The Euro and CHF area are the most expensive. Compared with 4 years ago, the cost for non-actives has decreased due to the strong USD. For actives it increased slightly.

When considering the cost of the Two-Track for the actuarial valuation, the UNJSPF has, through insight from its Consulting Actuary, considered this from two perspectives:

- The emerging cost of the Two-Track based on recent experience – this is considered biennially as part of the experience study that is used to develop the assumptions for the next actuarial valuation. The table presented above is comparable with this approach, with the Consulting Actuary calculating the most recent cost to be around 1.5%.
- The long-term cost of the Two-Track – this analysis has been carried out less frequently and was previously undertaken by the Consulting Actuary in 2015 around the time of the 2015 ALM study. This analysis was also completed by Ortec Finance with its 2019 ALM study.

In assessing the long-term cost of the Two-Track in 2015, the Consulting Actuary applied additional loadings to reflect the higher level of uncertainty over a longer horizon. The key areas where this differed to the short-term view based on recent experience included:

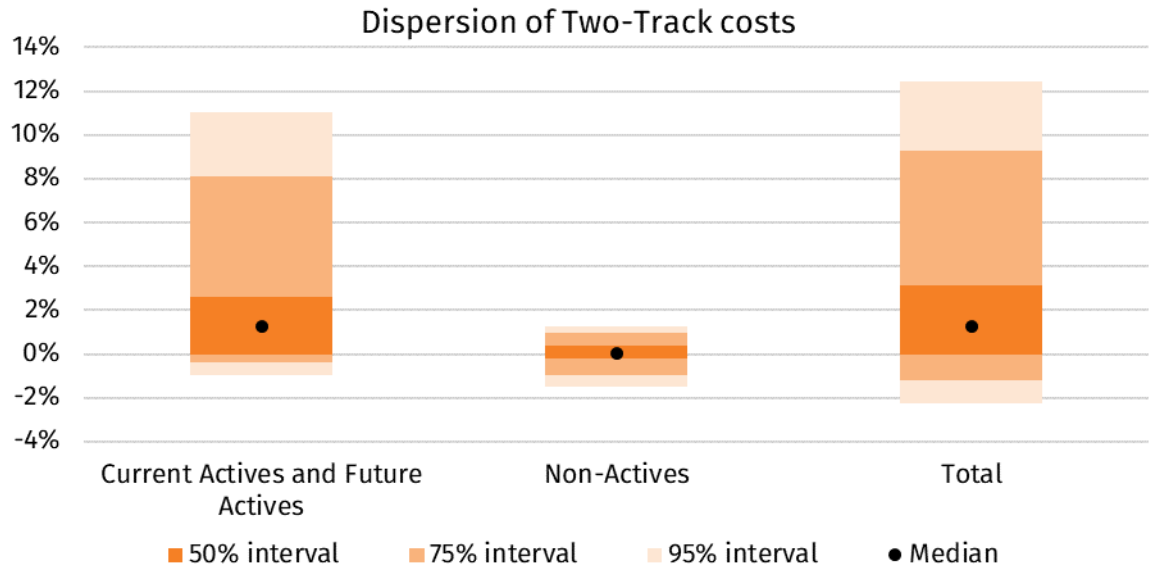
- Assuming 50% of the benefits are on the two track instead of the 40% assumed.
- A loading of 8% to capture the effect of soft currencies which, in general, have a higher expected cost.
- A 20% loading for sample bias, model bias and error and a margin for conservatism.

The final assumption that is then used in the actuarial valuation has been a blend of the shorter-term emerging cost and the longer-term view.

For the 2023 ALM study, Ortec Finance applied the same loadings for the long-term cost of the Two-Track and derived an expected cost equal to 2.3% of the NPV of total payroll. This is comparable to the 2.24% long term cost calculated by the Consulting Actuary in 2015 and the 2.2% cost determined by Ortec Finance in 2019.

In the ALM model we calculated the cost of Two-Track on a scenario-by-scenario basis. Hence, it is possible to evaluate the distribution of potential outcomes. The chart below shows the long-term costs expressed in present value of the total payroll. This also includes the

loadings outlined above. The distribution is skewed to the upside which implies potential high cost. Some of the scenarios show a negative cost of the Two-Track. Negative cost is limited by the floor of 80% of the USD Track.



By nature of an option, the realization will (generally) not be the average of potential outcomes.

5.2.3. Two-Track feature sensitivity analysis

The Two-Track feature has many parameters which determine the outcome of the option. To obtain insights in the sensitivity of Two-Track costs to these parameters, we consecutively performed the following:

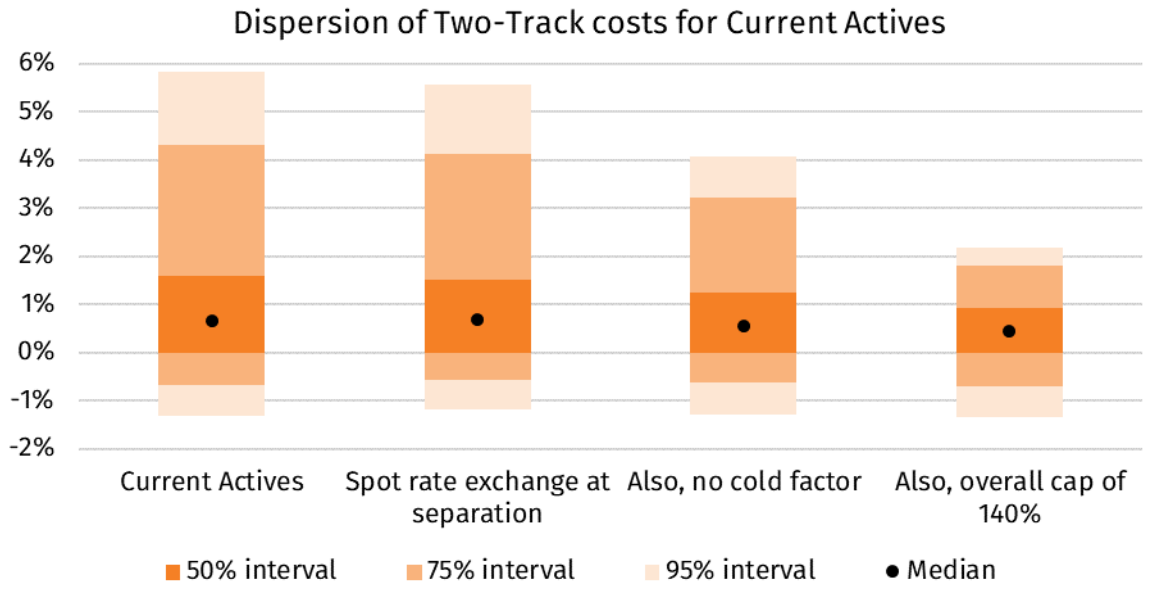
1. Removed the 36-month average exchange rate: at separation, the Local track benefit is determined based on a 36-month average exchange rate. This leads to an immediate excess (positive and negative) for the member.
2. Removed the COLD factor application for professional staff. This COLD factor corrects for the cost-of-living differential and can only be positive.
3. Applied an overall cap of 140%: consequently, the Local track cannot be higher than 140% of the USD track.

In this sensitivity analysis we focus on the current actives only, to have a closed-end simulation (which is not possible with future actives). Furthermore, non-actives are not sensitive to parameters 1 and 2.

The cost of Two-Track as a % of the NPV of the total payroll	
Current Actives	
Base case	0.7%
1. Remove 36-month currency averaging	0.7%
2. Also remove COLD factor	0.5%
3. Also apply 140% overall cap	0.3%

Removing the 36-month averaging does not impact the value of the Two-Track a lot (under our scenario assumptions). It is important to bear in mind that this sensitivity analysis assumes that all eligible members opt-in. Behavioral aspects might have a substantially larger impact – for example, less people might opt-in if they don't see an initial benefit improvement. The COLD factor surcharge has an asymmetrical impact. Therefore, removing the COLD factor has somewhat more impact on the cost. Finally, we observe a significant cost reduction when applying the 140% overall cap, especially limiting (extreme) risks.

The option value of Two-Track is mainly influenced by the stochasticity after the opting-in through the exchange rate and CPI differential.



In the chart above the dispersion of the Two-Track costs are presented for the consecutive adjustments as a percentage of the present value of the future payroll. The asymmetrical adjustments have asymmetrical effects on the outcome. Taking the spot exchange rate at separation instead of the 36-month average has a small impact on the dispersion. Removing the COLD factor and applying an absolute cap of 140% have a more significant impact at the upper side of the cost distribution.

5.2.1. Two-Track member behavior sensitivity analysis

In the simulation we assume a 100% probability of opting in for Two-Track at separation for all eligible members. Currency distribution is assumed constant (32% Non-USD). Therefore, effectively we assume 32% of all members will choose the Two-Track at separation. In real life, the plan has observed higher and lower participation over time based on the fluctuation of the US dollar, which correlates to the Two-Track excess outcome being positive or negative at first payment date.

To analyze the sensitivity to member choices, we compare a couple behaviors:

- **Current base assumption. A fixed percentage (100%) opts-in. This is unconditional to economic conditions.**
- **Members opt in at moment of separation, dependent on if the first payment delivers a positive excess outcome.**
- **Members opt in anytime the Two-Track delivers an excess payment for them.**

We assume that the current Non-Actives already made their choice. We will only focus on the current Actives as this will lead to a closed simulation. Taking future Actives into account would result in a never-ending simulation.

In the table below the cost for the current active members is shown for the different opt-in behaviors. No surcharges are applied.

The cost of Two-Track as a % of the NPV of the total payroll	
Current Actives	
All opt in (Base case)	0.7%
Smart opt in at separation only	0.6%
Opt in whenver positive outcome	0.8%

It should be noted that the comparison is not entirely fair. The base case assumes full participation while the others have a lower than 100% participation grade. Nonetheless, we can conclude that smart opting-in adds value for the members, even years after separation. This is mainly caused by exchange rate movements over time which add a lot of value to the members.

5.2.1. Two-Track analyses summary

With respect to the cost of Two-Track, we conclude:

- **The expected cost of Two-Track, as percentage of present value of total payroll is:**

    - 1.6% for the shorter-term view, based on recent experience and the emerging cost.
    - 2.3% for the longer-term view, with additional loadings applied to reflect the future uncertainty over the longer term.
- Costs are primarily driven by the opt-in and future inflation in the Eurozone countries and the strength of the EUR compared to the US dollar, and secondarily by the opt-in and future inflation in Switzerland and the strength of the CHF compared to the US dollar. Other currencies play a much smaller role.
- Two-Track costs are highly uncertain: it is an option with no cap. Risk is (theoretically) unlimited.

Based on sensitivity analyses we conclude:

- The 36-month average exchange rate does not have significant impact on the Two-Track cost (under OF exchange rate assumptions and assuming no behavior aspects).
- Removal of the COLD factor would reduce cost.
- Applying a cap of 140% would greatly reduce risk and hence also cost.
- Members can derive value from opting in at the right time – this further increases the cost of Two-Track.

The potential to hedge currency risk is assessed in ALM context in a separate chapter.

5.3. Required Contribution Rate corridor and risk metric

5.3.1. Required contribution risk metric

The UNJSPF targets a Required Contribution Rate corridor (RCR) of 21.70% to 25.70% (i.e., +/-2% around 23.70%). The +/-2% corridor is a suitable risk metric to assess whether the Required Contribution Rate is still within acceptable limits now, or in the short-term (for the next 2 years, until the next actuarial valuation). Ideally the UNJSPF would specify a risk tolerance: what is an acceptable probability of the Required Contribution Rate breaking out of the corridor in 2 years' time, at the next actuarial valuation? This could help to monitor risk and enable an early warning system.

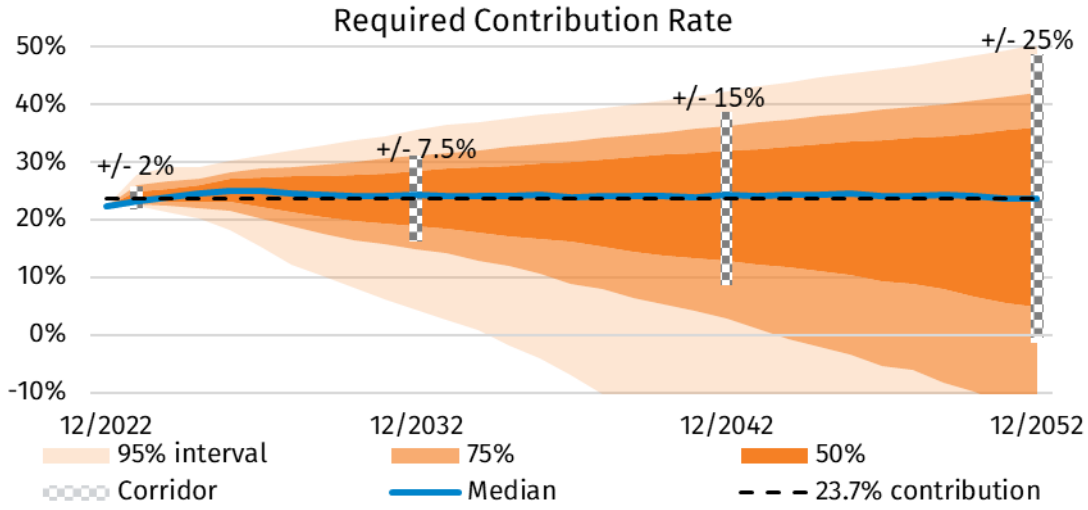
For longer horizons, as used in this study, the corridor is too narrow to be used as risk metric. Given the simulations assume current policies remain in effect indefinitely, the distribution of scenarios widens. As a result, the majority scenarios will fall out of the corridor after a 10-, 20-, or 30-year period. In reality, policies change over time, adjusting to changing circumstances. As these discretionary decisions are unknown, they are not considered in the simulation. Hence the need for alternative risk metrics for the purpose of ALM.

We have analyzed a number of alternative risk metrics that could be suitable for the purpose of evaluating different strategies in ALM context. We have studied:

- A horizon dependent corridor
- A corridor versus an upper threshold
- Value at risk (VaR) metrics

We would aim for the risk metric to capture around 75%-80% of the scenarios. This should be high enough to measure risk (opposed to be driven purely by the central expectation, a return metric), but also sufficiently far off from the tails which are heavily dependent on policy decisions (and the absence thereof in the model).

For the corridor, a horizon dependent definition would be needed to capture sufficient scenarios at different points in time given the increasing dispersion of the scenarios. On a 10, 20, and 30-year horizon a corridor of respectively +/-7.5%, +/-15%, +/-25% would be fitting.

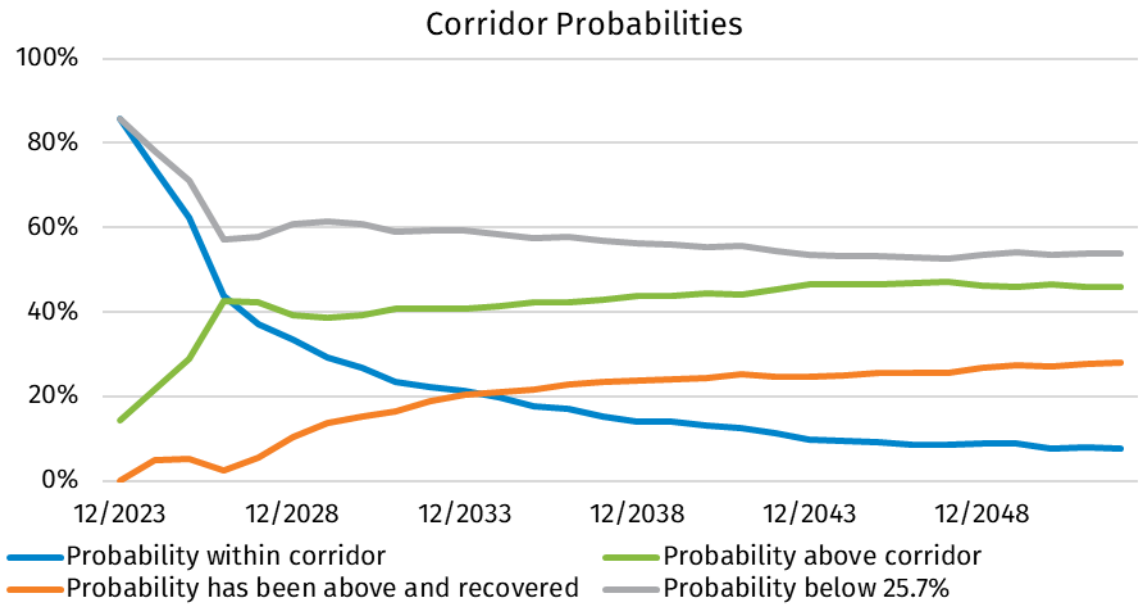


While a horizon dependent corridor may work reasonably well to compare strategies, the non-normal distribution of the scenarios may make interpretation of results less intuitive. The upper threshold solves this concern, but the threshold level would still need to be horizon dependent.

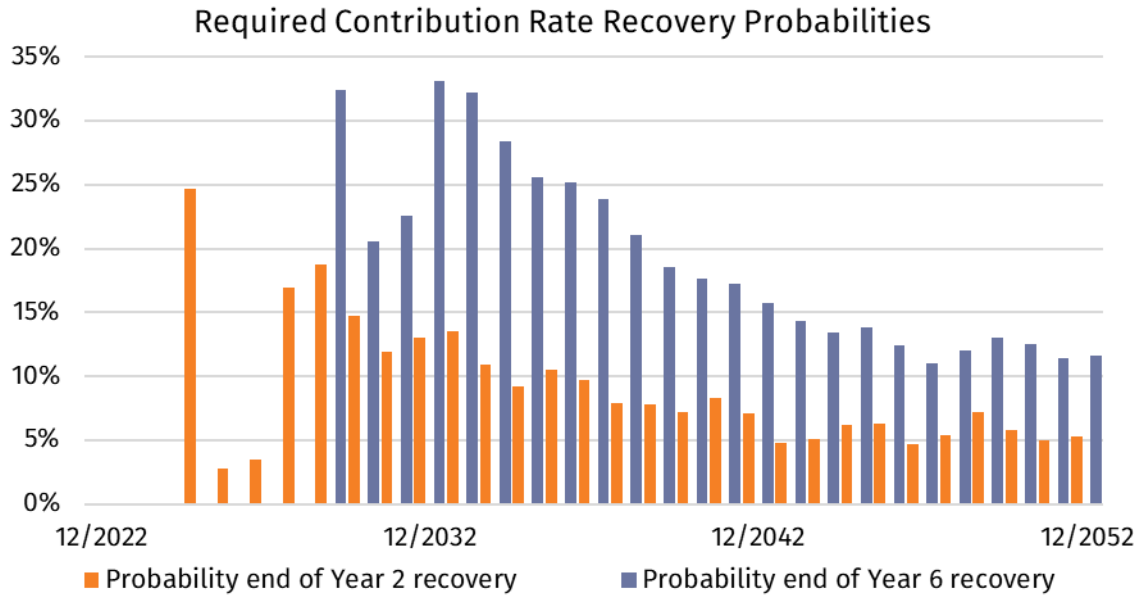
For comparing policies in ALM context we prefer using an 80% Value at Risk metric. This enables us to use a single definition for all horizons. 80% VaR captures a reasonable amount of risk, without overly focusing on tail risks - which are unlikely to materialize as policy changes will be implemented before they can be reached. Comparisons will be relative: no absolute risk tolerance has been specified by the UNJSPF.

5.3.2. Corridor probabilities

The UNJSPF has a Required Contribution Rate corridor (RCR) of 21.7% to 25.7% (i.e., +/-2% around 23.7%). We analyzed the probabilities of the RCR reaching levels above or below the corridor, as well as probabilities of recovery to within the corridor.



In the first three years, the probability of the RCR staying within the corridor decreases as uncertainty of the projection increases over time. The probability that the Required Contribution Rate was above the corridor but has recovered increases steadily after year 3 as more scenarios that have exceeded the corridor have had time to recover. The probability that the RCR stays below 25.7% is around 54% in year 30, while the probability that it will stay within the corridor is 8%. This is assuming all current policies remain in place.



The chart shows the probability of recovering at the time of valuation after it had fallen outside the corridor.

The probability of bouncing back into the corridor after the Required Contribution Rate had fallen outside, significantly decreases in the first years to around 5% and 20% for 2-years cycle and 6-years cycle, respectively, after which it should up again in 2028 respectively 2032. The ups-and downs in the probabilities are driven by the overall upwards movement of the entire distribution of contribution scenarios in the first years.

In the long-term, probabilities of recovery decrease as the distribution of scenarios widens, driven by inflation and investment volatility.

5.4. Liquidity risk

The UNJSPF is a maturing fund. As such, liquidity will become an increasingly important topic over the long term. With this analysis we assess the liquidity needs and risks of the fund.

We identify the following (primary) liquidity needs:

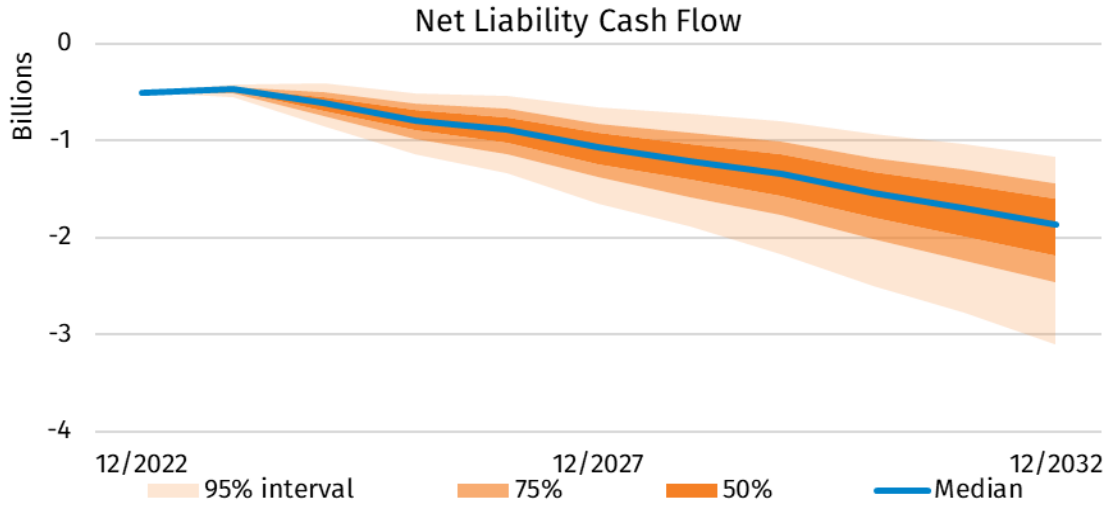
- Benefit payments
- Private assets
- Rebalancing
- Costs

Sources of liquidity:

- Contributions
- Coupons, dividends, distributions

- Selling liquid assets
- Selling illiquid assets (at a discount)

This analysis focuses on a 10-year horizon, as there is ample time to make significant policy changes if required beyond that point.

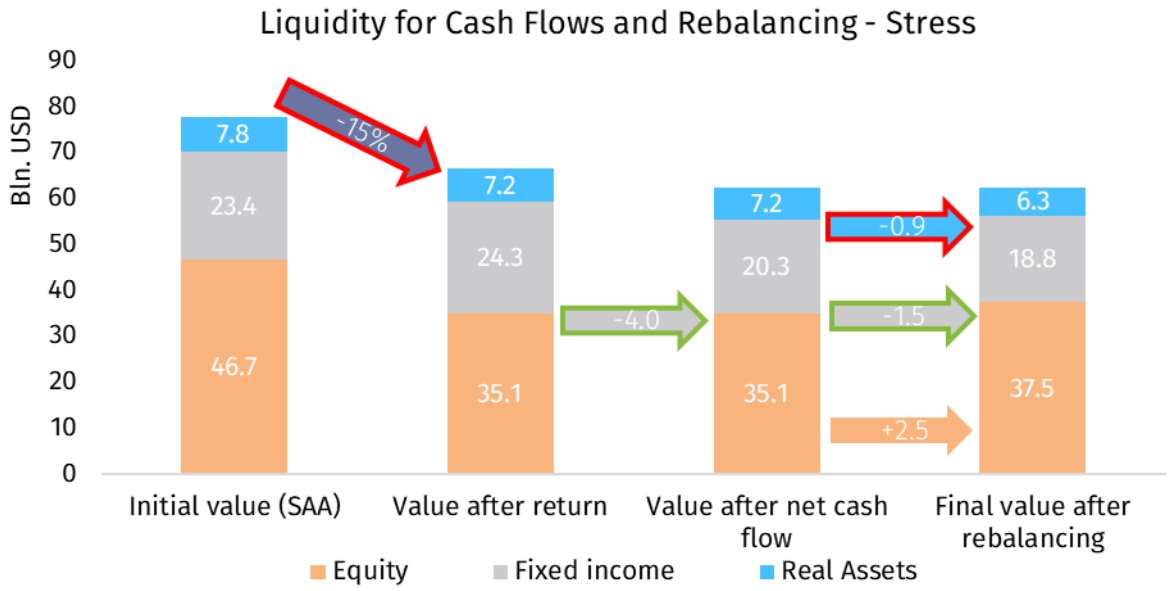


In the median of the scenarios, the net liability cashflow is approximately $2 billion in year 10, while the 5% CVaR is roughly $3 billion. Private assets too, may pose a liquidity risk. The net cashflow has been around -$400 million per year for the past decade. This cashflow could increase if the allocations to private assets are higher. Therefore, over the next decade, roughly $2.5-$3.5 billion of liquidity is needed from the Assets in normal circumstances. This should be of no concern given the amount of liquid assets of the UNSJPF.

To assess liquidity needs under adverse situations, we ran two stress scenarios.

Stress Scenario 1: Investment losses and a contribution stop

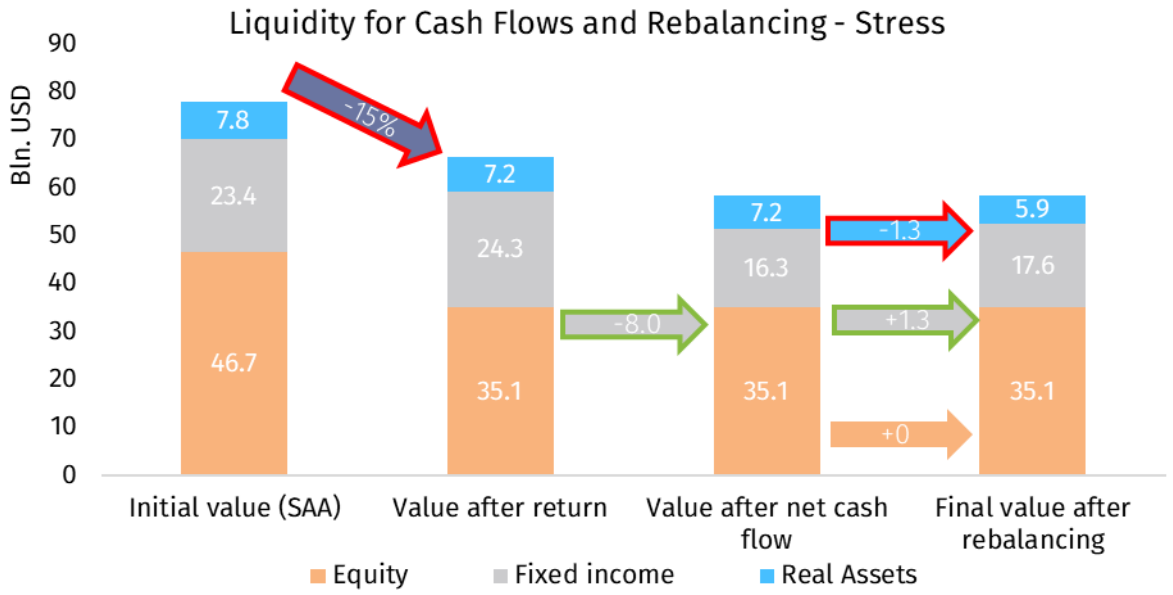
In this scenario, we assessed the impact of a -15% total portfolio return along with a halt in contribution payments. In these scenarios, we see the negative return explained by losses on equity and real assets while the value of fixed income increases.



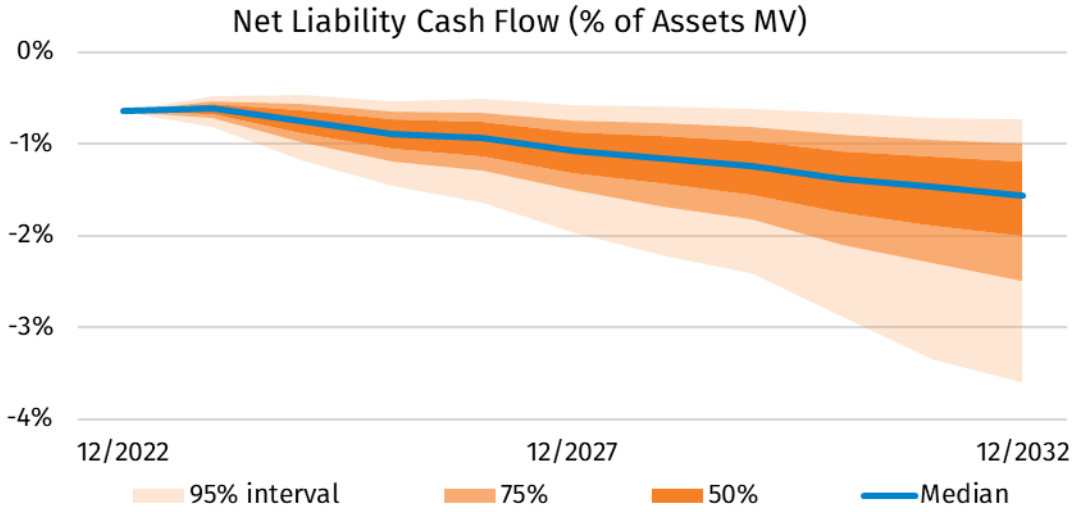
Step 1 represents the asset value after a -15% investment return shock on the SAA. Step 2 represents the asset value after a net cashflow payment of $4 billion assuming that no contributions are received. This does not lead to any liquidity problems as the UNJSPF can obtain the required cash from Public Fixed Income to make the benefit payments (-$4 billion). Finally, step 3 shows the asset value after rebalancing to the SAA. To fully rebalance back to the SAA, the Equity portfolio needs a $0.9 billion investment, which can be funded by selling Real Assets. Due to the low liquidity of Real Assets this could lead to potential rebalancing problems.

Stress Scenario 2: Investment return shock of –15% *and* Two-Track troubles

This scenario is similar to stress scenario 1, but with a larger net liability cash outflow. This is due to adverse Two-Track scenarios that lead to higher costs.



In the example above, Step 1 shows the value of assets after a -15% investment return shock on the SAA. Moving to step 2, we assumed a larger net cashflow payment of $8 billion, which includes additional Two-Track payments. While a greater portion of assets must be sold off to attain the required liquidity, the Public Fixed Income portfolio can be partially liquidated. In step 3, after rebalancing to the SAA, $1.3 billion must be withdrawn from the Real Assets portfolio and invested in the Equity portfolio. However, the low liquidity of the Real Assets portfolio poses a potential rebalancing problem for the UNJSPF.



The negative net liability cash flow remains relatively a small percentage of assets. It can increase to around –3% in worst-case scenarios. However, the previous analysis has demonstrated that the need for liquidity can significantly increase in stress situations.

Based on the results of this analysis we advise allocating at least 10% to *very liquid assets*, defined as Treasuries and Cash, to ensure sufficient liquidity during severe stress events.

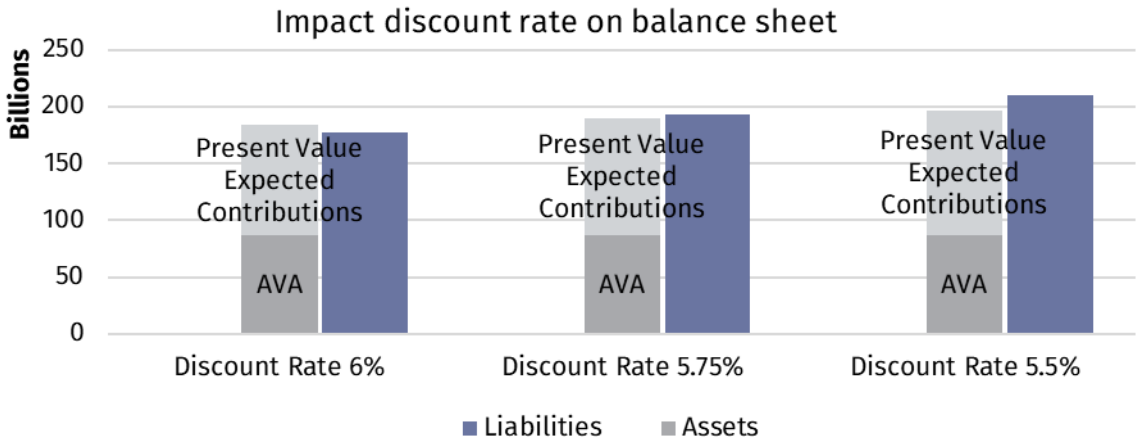
5.5. Discount rate sensitivity

Currently, the UNJSPF has a fixed discount rate of 6%. This consists of a 2.5% expected inflation rate and a 3.5% expected real return assumption on an arithmetic basis. With the Ortec baseline and Positive scenarios used in this study, achieving a 3.5% real return may be possible, although with a lower probability than in past ALM studies. However, this seems impossible for the Net Zero Financial Crisis (NZFC) scenario, regardless of the asset mix. Were such a scenario to unfold, a discount rate cut might become appropriate, immediately reflecting the need for higher funding.

In this section, we show the impact of a discount rate cut on:

- The current Open Group valuation
- The development of the Required Contribution Rate (RCR) under the NZFC scenario

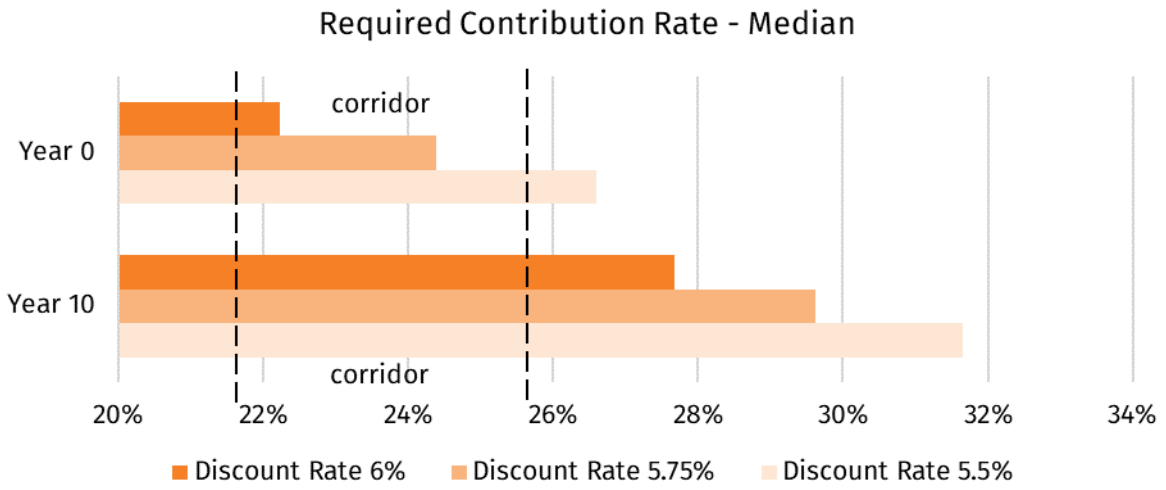
We assumed decreases to 5.75% and 5.5%, with benefit inflation remaining at 2.5%. While this does not fully reflect the achievable return in the NZFC scenario, it is a meaningful step in such an uncertain environment. All other parameters are assumed to remain unchanged.



This chart shows the level of assets (including expected contributions) and total liabilities for the three different discount rates: 6% (current), 5.75%, and 5.5%. These results are for the Open Group valuation estimated at 31 December 2022 and assume the contribution rate remains 23.70%.

As the discount rate decreases, both expected contributions and liabilities increase. The increase is more substantial for the latter due to duration effects and the fact that both

current *and* future liabilities are affected. In contrast, *only* the expected contributions are affected on the assets side. As a result, the current surplus turns into a deficit.

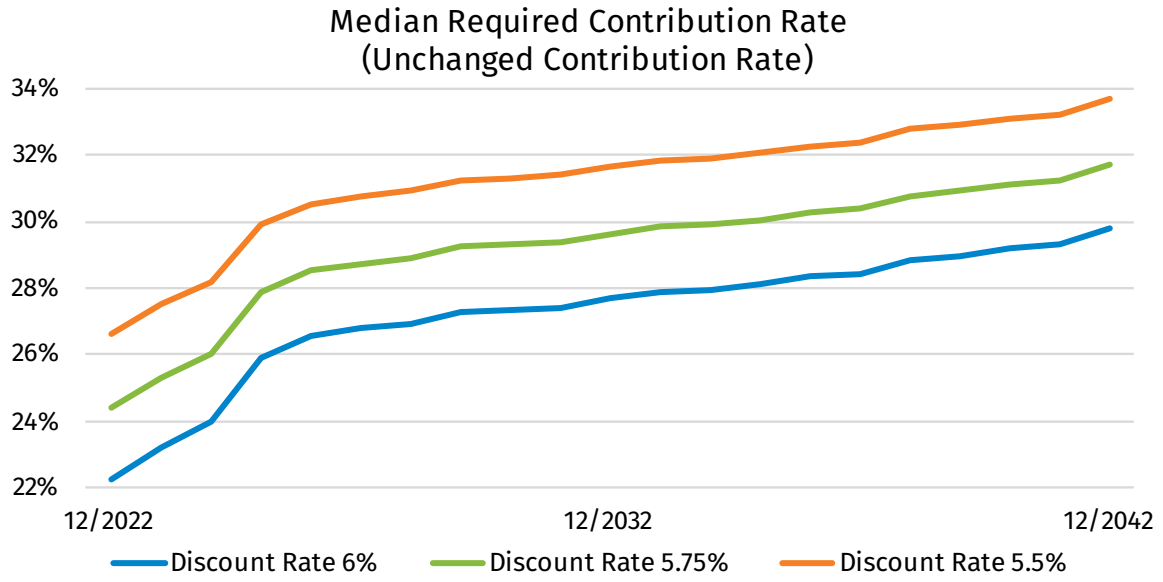


Shown above is the development of the median RCR under the NZFC scenario – the world view under which a rate cut might be appropriate.

With a 50bps discount rate reduction, the RCR increases by around 4%. This relative increase is steady over time. Regardless of the discount rate cut, after 10 years the median RCR is projected to be outside the +/- 2% corridor.

Actuaries are required to use a discount rate that best reflects expected future investment returns in order to provide the plan sponsor with the appropriate expectation of future funding requirements. If the NZFC becomes the dominant scenario, the discount rate would be changed when the CMA and ALM study results reflect the expected lowered future investment return. If the resulting funding position is unsustainable, the effects of a lowered discount rate can be offset by decreasing pension benefits or increasing the contribution rate, or both.

To provide more insight into the dynamics of the RCR, we show the development over time. Again, we keep the actual contribution rate at 23.70%, regardless of the discount rate.



A lower discount rate results in a higher increase in liabilities than in the assets, and thus a lower surplus. This then translates into a higher RCR. Given the actual contribution rate stays fixed (23.70%), the funding position is negatively impacted.

There is a steep increase in the RCR in the first years of the projection. This is caused by historical returns (via the Actuarial Value of Assets) and primarily by financial shocks in the economic scenario.

The Pay-out/Pay-in ratio (*expected liabilities/expected contribution*) under different discount rates results is:

- 6.00% discount rate: 92%
- 5.75% discount rate: 98%
- 5.50% discount rate: 105%

If one wanted to offset the change pay-out/pay-in ratio this can be achieved by increasing the contribution rate or decreasing the pension benefits. We calibrated the contribution rate to consider the higher cost of pension accrual under the lower discount rates. We arrived at the following contribution rates as percentage of total payroll:

- 6.00% discount rate: 23.7%
- 5.75% discount rate: 24.9%
- 5.50% discount rate: 26.6%

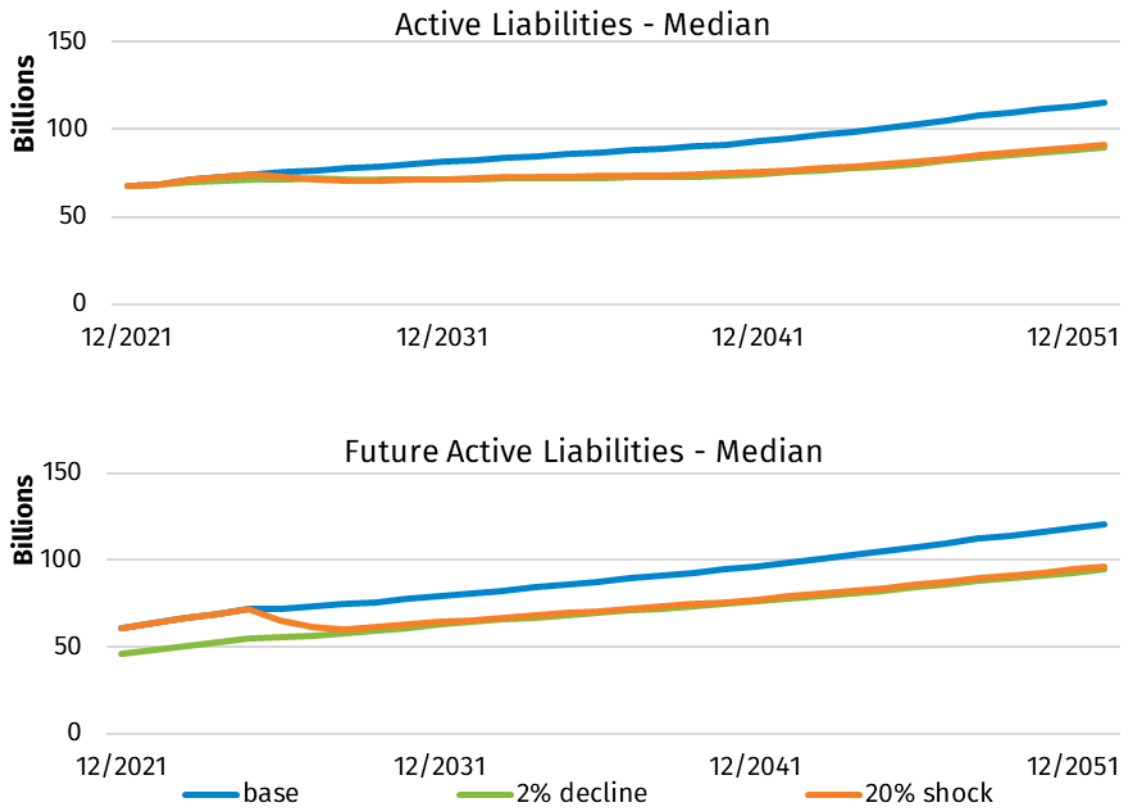
Noteworthy, under the Ortec baseline or Positive scenarios we do not see a strong need for discount rate adjustments.

5.6. Population growth sensitivity

Participant growth assumptions impact the projection of the current and future active member liabilities, as well as the expected contributions from current active members. In the ALM study, and in line with the most recent actuarial valuation assumptions, it is assumed that the Actives population grows by 0.5% per year for 10 years (only Professional staff), after which growth is assumed to be zero.

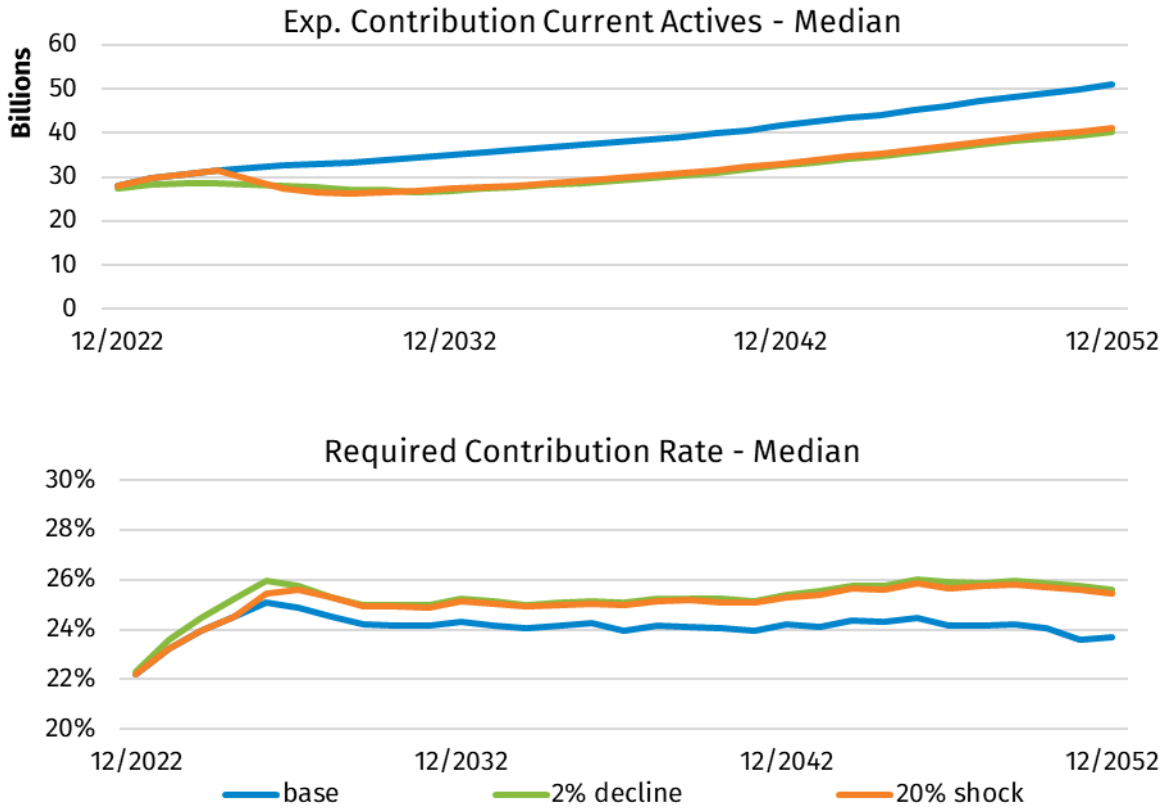
In this section, we analyzed the impact of two alternate growth assumptions on the liability projections:

- 2% decline per year for 10 years
- 0.5% growth per year for 10 years, with a -20% population shock in year 5



At the start of the simulation, all current active member liabilities start at the same value. The case with the 2% decline (in green) starts to decrease immediately. On the other hand, for the case with the -20% shock (in orange), the liabilities develop the same as the base case for the first 5 years, after which they also decline. In the long-run, both alternatives perform similarly, with a liability reduction of 21% for the –20% shock case and 22% for the 2% decline case.

With the future members, the 2% decline case immediately starts off lower than the other cases. This is because the 2% decline is expected and is thus factored into the liability of the future members. Like the development of the current active liabilities, the base case and 20% shock follow the same development until year 5, after which the future member liabilities also decline. In the long run, the impact is 20% for the -20% shock case and 21.5% for the steady 2% decline case.



Overall, the development of the expected contributions is similar to that of the current active member liabilities. With fewer members entering the Fund, there is an impact on the payroll and thus, on the expected contribution as well. In the long-run, the expected contributions decrease by roughly 20% for the –20% shock case and 21% for the 2% decline case.

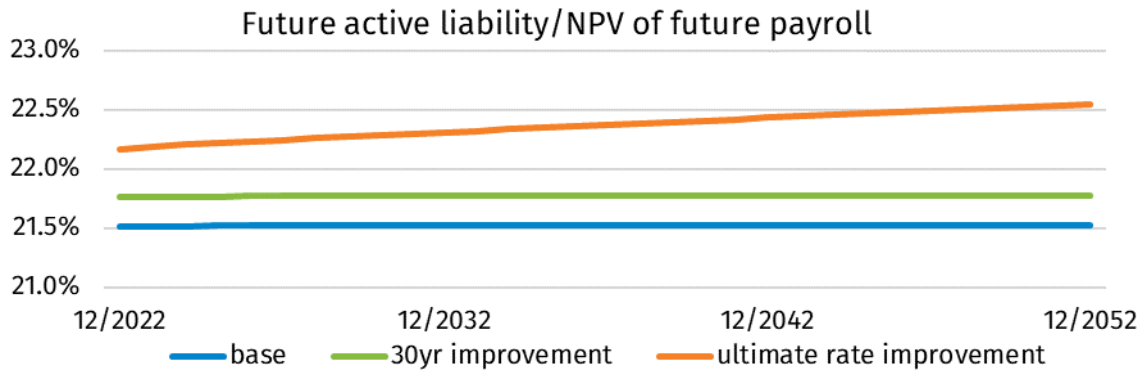
In the 2% decline case we see the RCR start to increase immediately and almost reach 26%, before reducing and stabilizing. With the 20% shock case, the RCR follows a similar path to the base case, until the shock in year 5, after which it also increases. After 30 years, the median RCR has increased by 1.7% and 1.9% for the 20% shock and 2% decline cases respectively.

5.7. Mortality risk

Mortality rates are an important factor in a liability valuation and have an impact on the cost of the pension scheme. Currently it is assumed that mortality rates improve for 20 years (both male and female) and remain constant afterwards.

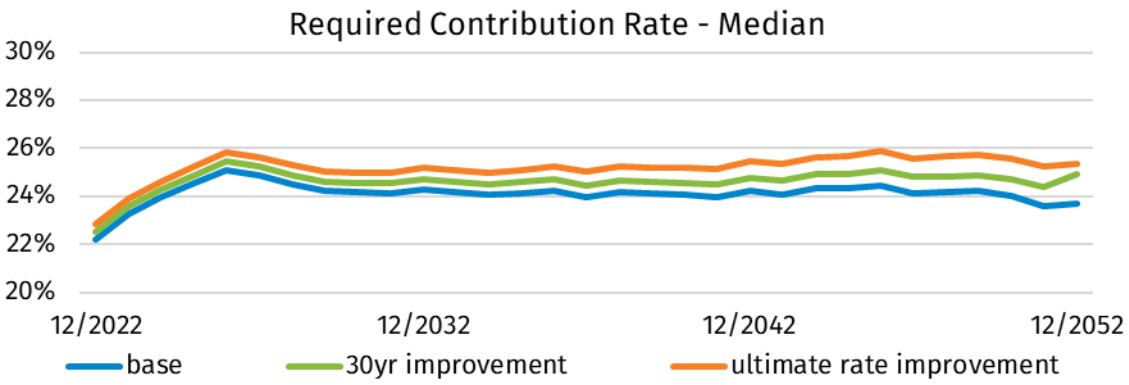
In this section we analyzed the impact of two alternate mortality rate assumptions on the cost of the pension scheme as well as the Required Contribution Rate:

- Mortality rate improvements for 30 years, and constant afterwards
- Mortality rates improve forever



The chart above shows the development of the future member liability as a percentage of the future expected payroll for the three different mortality rate assumptions. This metric gives an idea of the cost of the pension scheme.

With the base case (in blue) and 30-year improvement (in green), the cost is constant at roughly 21.5% and 21.75% respectively. This implies that with an extra 10 years of mortality rate improvements, the costs go up by approximately 0.25% of the payroll. On the other hand, for the ultimate rate improvement (in orange) the cost keeps on increasing over time as mortality rates improve and people live longer.



The RCR increases from the base case to the two alternative mortality improvement scenarios. As mortality rates improve and the pension fund consequently faces higher costs, the RCR must increase to fund these future payments.

5.8. Benefit improvements

In the 1980's UNJSPF had to implement a number of substantial changes to its plan design to preserve the long-term sustainability of the Fund. Several of those changes related to how the cost-of-living adjustment (COLA) was applied. At the time, this was implemented on the understanding that these adjustments might be reversed in better times. Over the years, the original changes have been incrementally reversed and the UNJSPF now just has a couple remaining that have been approved for implementing, subject to the Fund having sufficient actuarial surplus. We analyzed the impact of the two adjustments: an initial cost of living adjustment and the deferred period for the cost-of-living adjustments for deferred benefits.

Initial cost of living adjustment

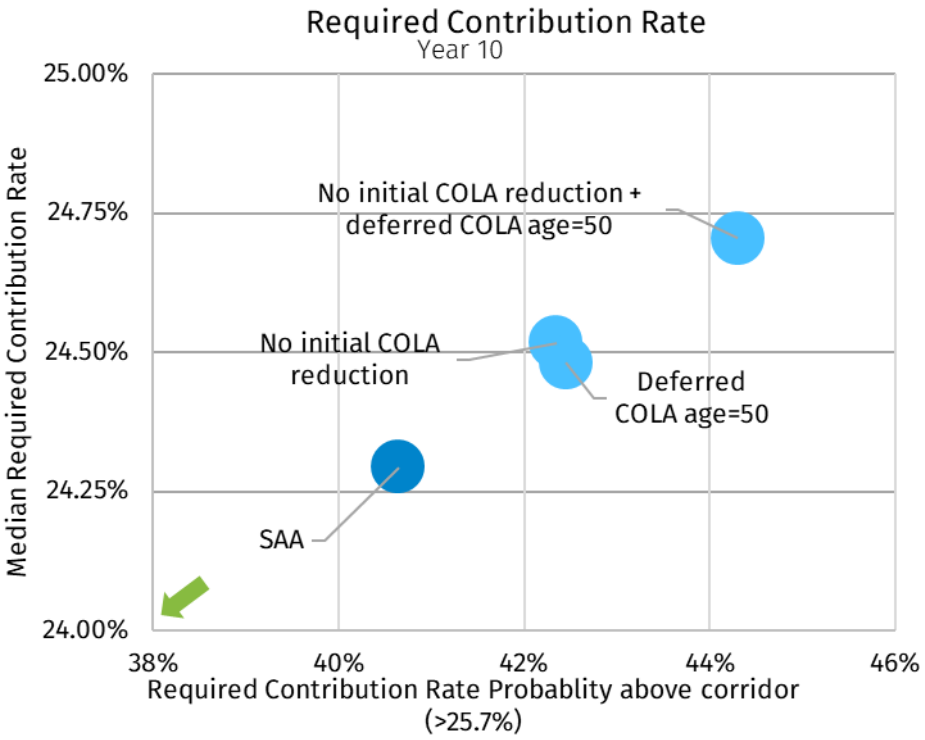
Currently, there is an initial reduction of 0.5% in the first COLA after someone starts to draw their benefit. The change that has been approved is removing that reduction to all new retirees *and* applying a one-off increase of 0.5% to all existing beneficiaries who would have been subject to the original reduction (which will be the majority of beneficiaries now).

Cost of living to deferred benefits in deferred period

Currently, COLA to deferred benefits not yet in payment is applied from age 55. A change has been approved to have this applied from age 50 instead.

Impact

In the chart below we analyze the impact of both measures on the Required Contribution Rate over 10-year horizon.



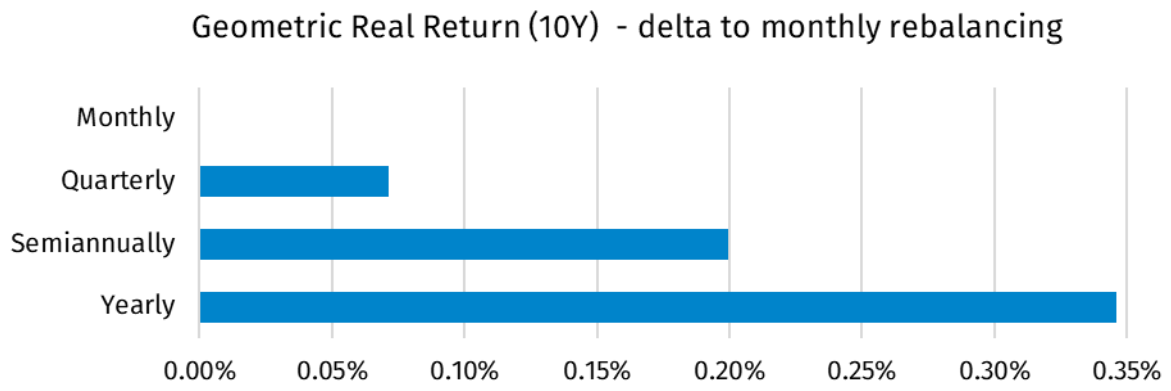
The removal of the initial cost of living adjustment and the adjustment of the COLA age for deferred members to 50 (instead of 55) increase the RCR by about +0.2% each after 10-years. The combination of the two measures adds up to a RCR increase of around 0.4%. Probabilities of breaching the Corridor deteriorate in alignment with the impact of the plan design changes. Given the width of the RCR distribution, the impact on the probability measure is limited.

5.9. Allocation bandwidths and rebalancing

A rebalancing strategy includes strategic allocations, upper and lower limits, frequency of rebalancing and the level to which to rebalance. These parameters affect the expected return, risk, and liquidity risk. Furthermore, it is important to note that rebalancing policies may differ for the benchmark and the portfolio. For instance, when a fund employs portfolio bandwidths, benchmark rebalancing does not necessarily have to be matched by portfolio rebalancing.

Frequency

We assessed the impact of the frequency of rebalancing. Note this is a simplified analysis that assumes no rebalancing cost and assumes that all assets are highly liquid. Results are directional only.



The frequency of rebalancing significantly impacts on both the expected return and risk. A lower rebalancing frequency has a positive impact on investment returns. Under the yearly rebalancing strategy, the geometric return is significantly higher than the alternate strategies. With a lower rebalancing frequency, asset allocation can naturally drift towards better-performing assets, leading to better overall returns. Additionally, with more frequent rebalancing, transaction costs will be higher, and returns will be reduced further (not considered in this analysis).

Do note that low-frequency rebalancing, as well as rebalancing to a bandwidth implies (on average) a higher allocation to risky assets, which may increase risk exposure for the total portfolio.

Bandwidths and partial rebalancing

When the portfolio does not completely follow benchmark rebalancing, the resulting drift can further improve results. This is the case when a bandwidth applies (i.e., less frequent portfolio rebalancing) and/or the portfolio is not rebalanced to the benchmark weight.

A wide bandwidth is necessary to make effective tactical asset allocation decisions. This will result in greater allocation effects in performance measurement but will also require more elaborate attribution and detailed explanation to stakeholders. In case tactical decisions are irrelevant, it is better to opt for a smaller bandwidth to reduce portfolio risk in comparison to the strategic benchmark. The following are typical varieties of portfolio rebalancing:

- Full rebalancing to the strategic benchmark
  - Generally, has the largest transactions and market timing risks
- Partial rebalancing to the nearest limit (edge)
  - Can lead to very frequent portfolio rebalancing in a trending market after a limit is exceeded
- Halfway between the strategic benchmark and nearest limit

- The in-between option

Currently, the UNJSPF rebalances its benchmarks at a monthly frequency, with OIM taking market views into consideration when making decisions about portfolio rebalancing each month. This approach ensures that portfolio deviations from the strategic benchmark are limited. However, a less frequent rebalancing schedule, such as quarterly or annually, or a partial portfolio rebalancing approach can result in increased portfolio drift and higher expected return and risk.

If tactical allocation decisions are made, a wider bandwidth is required to achieve significant impact. Conversely, a smaller bandwidth is more appropriate when limiting relative portfolio risk. We advise UNSJPF to use a wider bandwidth if tactical allocation decisions remain relevant.

Bandwidths for equity, real assets and fixed income are not in proportion to each other: the large bandwidth for equity is not matched by the much smaller bandwidths of the other asset classes. We advise bringing this into better proportion.

The increase of the bandwidths for fixed income is justified in view of the current levels of spreads and interest rates. We advise increasing the bandwidth for fixed income.

Based on the following assumptions:

- Risk management and attribution versus the strategic allocation is important
- Bandwidths should allow both for drift and tactical allocation decisions
- Portfolio rebalancing should be efficient with an average risk contribution

We would suggest the following:

- Keep the monthly OIM meeting, but by default rebalance the benchmark less frequently than monthly
- Set bandwidths of 5-10% for equity and fixed income
- Rebalance the portfolio to halfway between the strategic allocation and nearest limit
- Opportunity for OIM to make discretionary decisions

By implementing these suggestions, the portfolio can naturally drift towards better-performing assets, resulting in an improved expected return and risk. At the same time, the OIM can still exercise discretionary decision-making when it comes to tactical asset allocation changes.

Our suggested bandwidths are summarized in the table below.

ALM 2023	2021 SAA	Proposal A			Proposal B			Delta bandwidths	
	100.0%	Minimum	100.0%	Maximum	Minimum	100.0%	Maximum	Minimum	Maximum
Equity and Private Assets	**69.0%**	**52.0%**	**60.0%**	**68.0%**	**58.0%**	**66.0%**	**74.0%**	8%	8%
Global Public Equities	53.0%	35.0%	43.0%	51.0%	38.0%	46.0%	54.0%	8%	8%
Developed Markets Equity	46.9%	27.0%	35.0%	43.0%	30.0%	38.0%	46.0%	8%	8%
Emerging Markets Equity	6.1%	4.0%	8.0%	12.0%	4.0%	8.0%	12.0%	4%	4%
Private Equity	7.0%	3.0%	7.0%	11.0%	5.0%	9.0%	13.0%	4%	4%
Real Assets	9.0%	5.0%	10.0%	15.0%	6.0%	11.0%	16.0%	5%	5%
Real Estate	8.0%	4.5%	8.5%	12.5%	4.0%	8.0%	12.0%	4%	4%
Infrastructure	1.0%	0.0%	1.5%	3.5%	0.0%	2.0%	4.0%	2.0%	2%
Timberland and Farmland	0.0%	0.0%	0.0%	2.0%	0.0%	1.0%	3.0%	1%	2%
Private Debt	0.0%	0.0%	0.0%	2.0%	0.0%	0.0%	2.0%	0%	2%
Fixed Income and Cash	**31.0%**	**32.0%**	**40.0%**	**48.0%**	**26.0%**	**34.0%**	**42.0%**	8%	8%
Fixed income	29.0%	31.0%	39.0%	47.0%	25.0%	33.0%	41.0%	8%	8%
US Core Bonds	28.0%	27.0%	35.0%	43.0%	20.5%	28.5%	36.5%	8%	8%
US Securitized	8.3%	7.0%	10.0%	13.0%	5.5%	8.5%	11.5%	3%	3%
US Treasuries	13.0%	11.0%	14.0%	17.0%	10.3%	13.3%	16.3%	3%	3%
US Corporates	5.9%	7.0%	10.0%	13.0%	3.0%	6.0%	9.0%	3%	3%
US Govt Related	0.8%	0.0%	1.0%	3.0%	0.0%	0.8%	2.8%	1%	2%
Non Core Bonds	1.0%	1.0%	4.0%	7.0%	1.5%	4.5%	7.5%	3%	3%
US High Yield	0.0%	0.0%	2.0%	4.0%	0.5%	2.5%	4.5%	2%	2%
EMD Local Currency	1.0%	0.0%	2.0%	4.0%	0.0%	2.0%	4.0%	2%	2%
Cash & Equivalents	2.0%	0.5%	1.0%	3.0%	0.5%	1.0%	3.0%	0.5%	2%

5.10. Currency risk and hedging

5.10.1. Currency exposure

Currency exposure and risk play a central role for the UNJSPF. Unlike many pension plans, the Fund has currency exposure not only to its assets, but on the liability side as well.

Assets

As of December 2022, the UNJSPF assets amounted to $77.9 billion. About 75% of these investments are in USD, while the remaining 25% are invested globally. The Euro has the highest exposure among these investments, followed by the Japanese Yen.

Asset Exposure - December 2022	USD	EUR	JPY	GBP	HKD	CAD	CNY	AUD	OT	Total
$ billions	60.6	4.3	2.7	1.5	1.5	1.5	1.0	1.0	3.9	77.9
% of Total Assets	77.7%	5.5%	3.4%	1.9%	1.9%	1.9%	1.3%	1.2%	5.1%	100.0%

Liabilities and Two-Track

On the UNJSPF balance sheet, no liability currency risk is visible as the actuarial valuation is carried out on the USD-track of the members. However, for beneficiaries who have opted into the Two-Track system, benefit levels are determined with reference to the exchange rate between their local currency and the USD at the time of their separation. As a result, the currency exposure from the liabilities relates to the uptake patterns of the Two-Track.

The average cost of the Two-Track is considered by applying a (static) loading in the actuarial valuation (however in realization these costs can vary). The plan will only experience the currency exposure by means of the actual payments made. Therefore, on the short-term the liability currency risk is not noticed in the RCR amount, but on the long-term it will be.

When simulating the Two-Track benefit payments, we can split the amounts paid with foreign currency exposure and those without exposure. Taking the foreign exposure payments (in USD terms) and discounting them with the Fund's discount rate gives a value for the currency exposure.

Average currency exposure: $ billions	EUR	CH	UK	CAN	JPN
Current Non-Actives	3.4	2.2	0.2	0.1	0.1
Current Actives	9.1	5.6	0.6	0.4	0.3
Future Actives	6.1	3.8	0.4	0.2	0.2
Total	18.6	11.6	1.2	0.7	0.5

Based on the average, the implicit future exposure to foreign currencies is USD 33 billion. The realization of currency exposures will be heavily dependent on exchange rates and inflation in individual countries. Therefore, in the table below we show the distribution of outcomes (split in percentiles) for the sum of the regional currency exposures per member group.

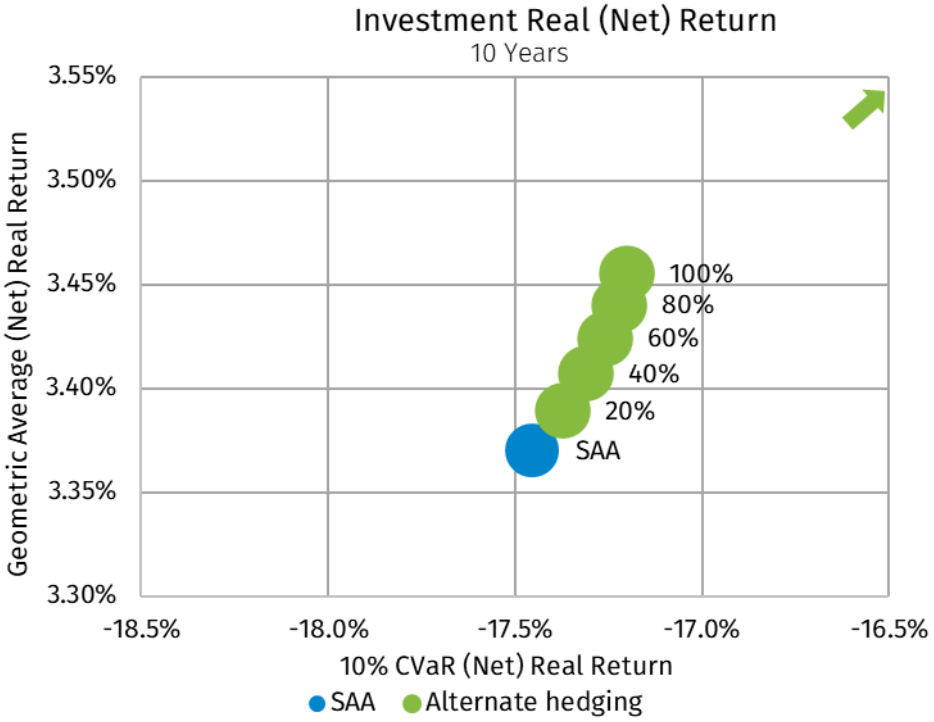
Dispersion of aggregated currency exposure (EUR, CHF, GBP, CAD & JPY zone): $ billions				
Percentiles	Current Non-Actives	Current Actives	Future Actives	Total
1%	2.1	3.2	2.1	7.4
10%	3.6	6.8	3.5	14.0
20%	4.2	8.8	4.4	17.3
30%	4.6	10.5	5.2	20.2
40%	5.0	12.1	6.2	23.3
50%	5.4	13.9	7.3	26.6
60%	6.0	15.8	8.3	30.2
70%	6.7	18.1	10.0	34.9
80%	7.6	21.3	12.7	41.6
90%	8.8	27.4	19.0	55.3
99%	13.1	57.6	64.6	135.2

Depending on the scenario, the currency exposure differs. The dispersion of the currency exposure scenarios is large. Depending on the development of US CPI, local CPI and the respective exchange rates, a member may receive a spot rate converted benefit payment or a local track benefit payment. This introduces currency risk to the plan as exposures can increase greatly when the USD weakens. As a result of this property of the Two-Track system, it is difficult to hedge this exposure in practice. Additionally, the current definition of the

balance sheet will not reward you directly for hedging this risk as the actuarial valuation does not explicitly consider the currency aspect in the Two-Track.

5.10.2. Currency hedging

We analyzed the effects of a currency hedge on the assets, ranging from 0% to 100% hedge on all modelled developed markets non-USD currencies.



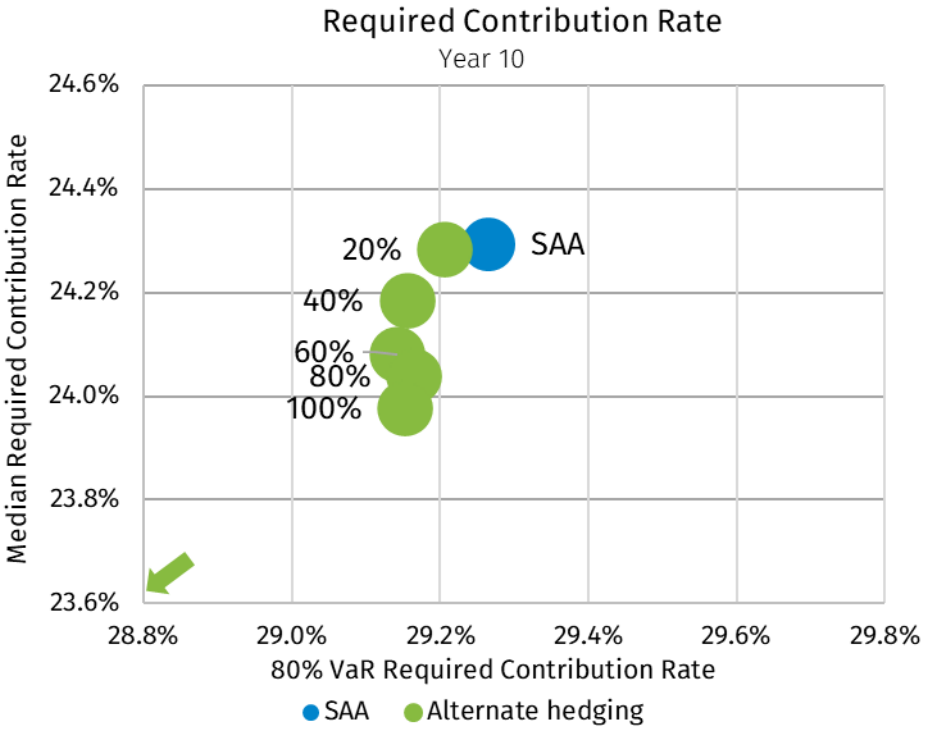
Reducing currency risk by hedging to USD not only lowers risk, but also boosts expected return by approximately 10 bps per year. Additionally, it can potentially enhance the RCR. The increase in return is due to the interest rate differential between the different regions and the US.

The forward FX rate is approximately equal to the current exchange rate multiplied by (1 + interest rate of country A) / (1 + interest rate of country B). Therefore, in the long run, fully (100%) hedged currency returns are roughly equal to the local currency returns minus the interest rate differential between the two countries. However, at shorter horizons, hedged currency returns may be influenced by cross-currency basis due to supply and demand driven deviations from the exchange rate implied by the interest rates.

Currently, and based on average in the simulation, the US has higher yields than Europe and Japan. This results in positive hedging returns for investors based in the US.

Importantly, this analysis does not include the implementation and management costs associated with hedging, which could potentially offset any gains.

Two-Track also plays an important role, as this also impacts the currency exposure on the liability side. This can become visible in the RCR results.



The RCR results show a slightly different pattern than the return results. While the median rate reduces, risk reduction is marginal and non-linear. This is due to correlations of the assets with the liabilities, especially through the Two-Track. Overall, we do see a positive effect from currency hedging.

Based on our quantitative analyses, it is worthwhile considering setting up the implementation capabilities to hedge developed markets currency exposures. However, further analysis is necessary before making a decision. The OIM should weigh the potential benefits (approx. 10 bps on the total portfolio) against the implementation costs and risks before making any recommendation. Furthermore, it is important to monitor the economic circumstances related to the (negative) cost of hedging vs. risks of open currency exposure, especially if the decision is made to hedge. If the interest rate differential between countries changes, so does the cost of hedging.

5.10.3. Emerging market debt

The hedging analysis above focused on developed market currencies. The UNJSPF also has exposure to emerging market debt local currency (EMD LC). One of the key risk drivers of EMD is political risk. This risk can materialize both in defaults as well as currency risk. In that way, the currency risk of EMD is, in our opinion, different from, e.g., USD/CHF uncertainty. With the interest rate differential between emerging markets and developed markets, it is still favorable to keep the currency risk open. Practical (implementation-related) reasons form another argument not to hedge EMD LC.

5.11. Qualitative assessment of asset classes

In this section we will provide a qualitative overview of the different asset classes analyzed in this study. We included asset classes that the UNJSPF was interested in or new ones that we proposed for new portfolios. For each asset class, we will provide a short description including its key characteristics, pros, and cons of investing in it.

Equity Frontier Markets

A frontier market benchmark refers to more developed countries than the Least Developed Countries (LDCs) but less established than Emerging markets in terms of the size of stock markets and currency markets. Although there is no consensus about the definition, these markets tend to be in the Middle East, North Africa, and Latin America. These markets can be invested in through REITS, ETFs or directly.

Pros	Cons
Provides diversification	Higher risk, especially tail risk
Potential for higher returns	Concentration risk, esp. geographically
Potential ESG impact through supporting frontier economics	Customization might be required to fit investment criteria
	Higher reputation risk due to weaker transparency and political risk

Timberland

Timberland investment involves the investment in land that produces timber and timber production. Timberland shows direct links with cyclical trends in the economy, especially that

of real estate development. At the same time, it shows a low correlation with listed equity and debt markets. It is usually centered in Australia, North America, and specific countries in Latin America and is capital-intensive with long investment horizons.

Pros	Cons
High ESG impact as it is a carbon solution	Illiquid asset class
Low overall correlation, thus providing potential for diversification	Requires large initial investments
Correlation with inflation	Poses a reputational risk related to (indirect) land ownership
Community and biodiversity benefits	Requires specific expertise

Farmland

Farmland investment involves the investment in land, farms, and crops. It consists of a spectrum of products like short-term crops (potato, wheat) or long-term crops (apples, pears). Generally centered in the USA, Europe, Brazil, and a few other countries, farmland investing is also capital-intensive with long investment horizons. There are a few different operational models for farmland investing: cash lease (fixed $ amount per acre), share lease (investor and tenant share the crops/revenue), custom farming (3rd party operator) and direct farming (investor is the operator).

Pros	Cons
High ESG potential	Illiquid asset class
Low overall correlation, thus providing potential for diversification	Requires large initial investments
Correlation with inflation	Poses a reputational risk related to (indirect) land ownership
Community and biodiversity benefits	Requires specific expertise

Infrastructure Equity

Infrastructure is an investment in the equity of infrastructure companies. These companies invest in and operate the assets and systems that facilitate the functioning of society. In general, there are two key sectors of infrastructure: economic (utilities, transport, etc.) and social (schools, hospitals), with two types of projects: Greenfield (new/yet to be constructed) and Brownfield (an existing project with a history of operations). Just like timberland and farmland, infrastructure investments are capital-intensive with long investment horizons.

Pros	Cons
Provides diversification	Implementation risk in the form of unsuitable investments and long lead times
Potential for inflation protection	Illiquid (average project maturity of 10+ years)
Low correlation with other asset classes	Complex asset class to invest in
Predictable cashflows	Relatively high management and performance fees
Provides an illiquidity premium or selection alpha	

Gold

Gold is part of the commodities asset class and is seen as a 'safe haven' during times of extreme economic crises such as hyperinflation, currency/banking crises or political and social crises. It can be invested in via physical investments (gold bars), physically backed investment funds, derivatives such as futures and swaps and indirectly through gold mines. Gold exhibits a weak correlation with inflation and historically has a low correlation with other asset classes.

Pros	Cons
Provides diversification between other asset classes and within the different commodity sectors	No expected risk premia and low Sharpe ratio

High Yield

A high-yield bond is a bond issued by a company with a credit rating below investment grade. Alternative names include “Non-Investment Grade”, “Speculative Grade”, or “Junk” bonds. Approximately 75% of the high-yield bonds are denominated in USD, and approximately 50% by US issuers. In terms of credit rating, roughly 50% is rated BB and 33% B, with an average maturity of 5 years (although some are as long as 20-30 years). These bonds have historically provided a substantial risk premium over government bonds but are also more volatile.

Pros	Cons
Provides diversification	Higher risk than Investment Grade credits
Potentially higher returns	Lower ESG ratings and coverage than IG
Potential ESG impacts	Potentially higher reputation risk in case of bankruptcies

Private Debt

Private debt is debt investments which are not financed by banks and are not issued or traded in a public market. This broad asset class consists of several sub-classes such as senior secured loans, private placements, real estate debt, infrastructure debt and distressed debt. Due to this broad range, the characteristics of the investment depend on the specific sub-class. However, all these classes are generally illiquid and thus provide an illiquidity premium and selection alpha.

Pros	Cons
Provides an illiquidity premium	Illiquid asset class
Diversifies the credit portfolio	Active management skills are crucial, with the manager selection process being more important and complex than for liquid asset classes
Ability to tailor terms and conditions to the investors' specific requirements	
Higher recovery rates	
Can be ESG attractive	

5.12. Impact investing

Impact investing is an investment strategy which focuses on generating beneficial social and environmental effects, as well as delivering financial gains. Currently, the UNJSPF is not involved in impact investing. However, it represents a new potential area for growth and is of specific interest.

We regard Impact Investing not as a separate asset class but rather as an investment style which can be applied to different asset classes. Examples include renewable energy in an infrastructure portfolio, investing in EU social bonds in a government bond portfolio, or having the best-in-class ESG shares in a listed equity portfolio.

Such investments are typically not combined in a separate 'Impact" portfolio but are part of the underlying asset classes. However, if impact investing has a material impact on the characteristics of the asset class, then it is important to consider adapting the investment process to those characteristics.

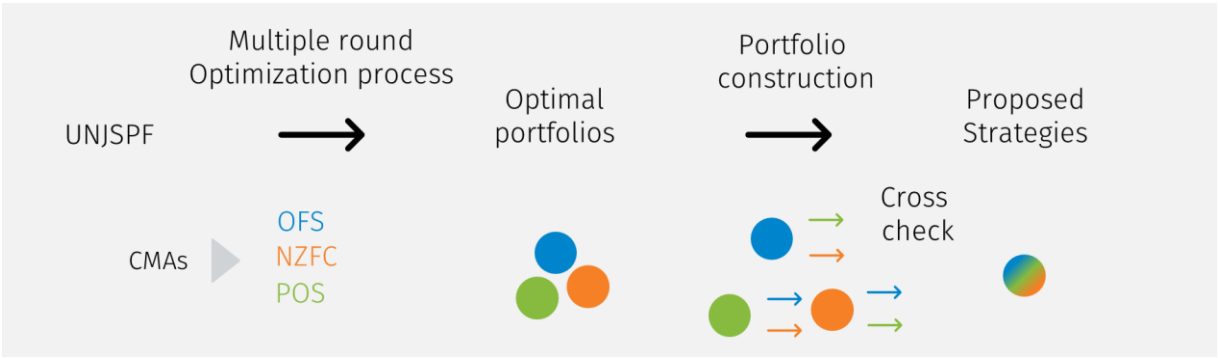
5.13. Asset allocation optimization

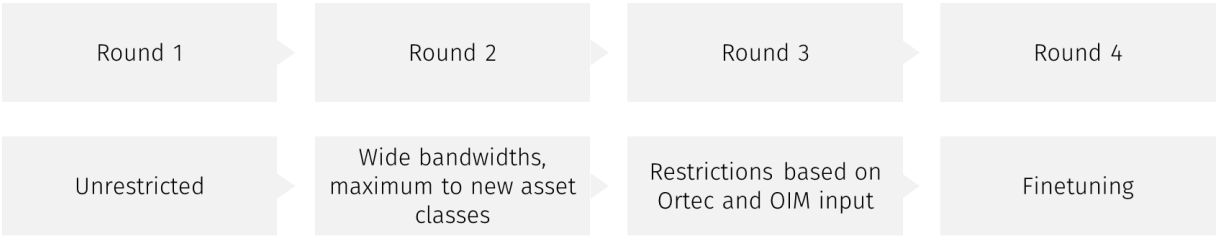
5.13.1. Portfolio optimization process

To obtain insights into the possibilities for improving UNJSPF's strategic asset allocation, we use our optimization model. An optimization model is a useful tool for creating an asset allocation strategy. However, any outcome of an optimization model (and financial models in

general) needs to be interpreted carefully. Therefore, we used the multiple CMAs described in Chapter 3 and applied various sensitivity analyses (longer horizon, optimization target, exclude 1st-year behavior etc.).

For UNJSPF, we analyzed four rounds of increasingly tighter restrictions, each time studying the outcomes and moving closer to investable portfolios. The overall process (top) and the four rounds with restrictions (bottom) are shown in the figures below.





In the following chapters, we will go into more detail about each of the different rounds of optimizations and the learning outcomes we gained during the process.

5.13.2. Optimization conditions

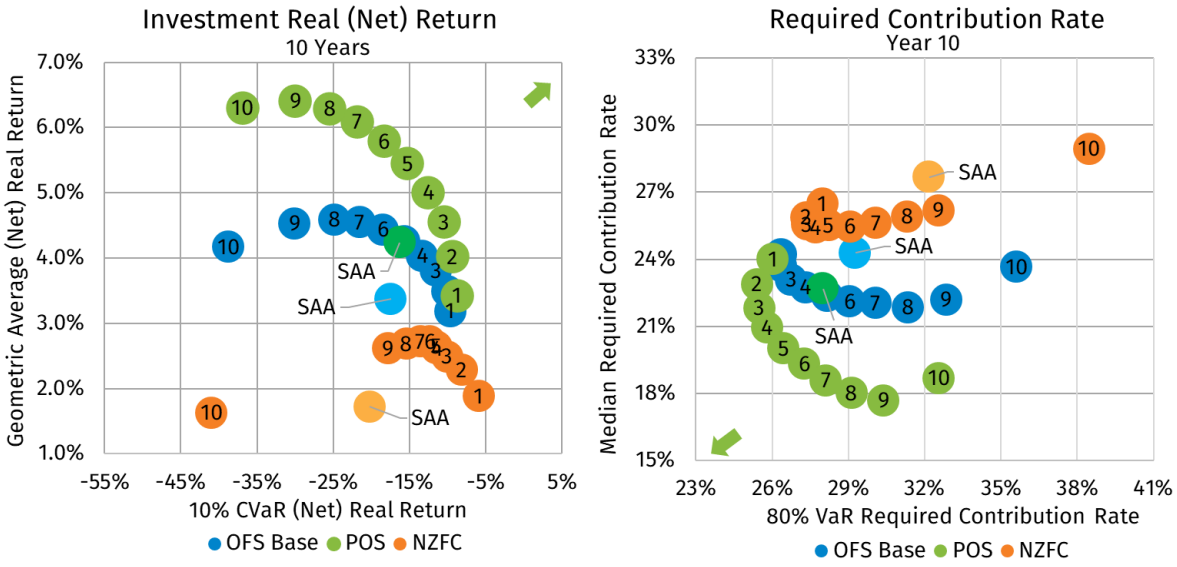
Besides the round-specific asset allocation constraints, the optimization process is subject to a set of generic conditions. This set of conditions is as follows:

- **To improve the funding ratio outlook, we optimize the funding ratio return while minimizing annual risk.**
- **Risk is defined as the 10% conditional value at risk (10% CVaR).**
- **The optimization horizon is 10 years.**

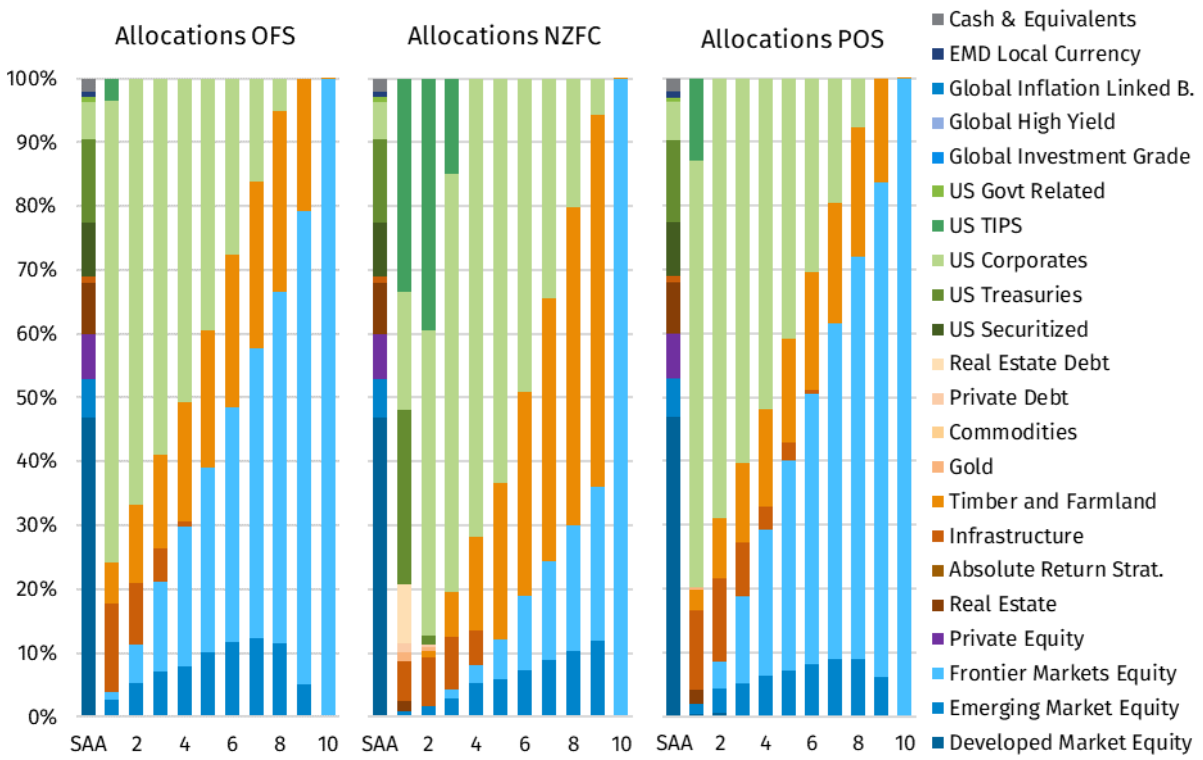
As previously mentioned, various tests have been run to check the results for sensitivity to these assumptions. While not shown in this report, these results were considered and further informed our decisions on the recommended portfolios.

5.13.3. Round 1 – Unconstrained optimization

In this section, we show the results for unconstrained optimization. For three different scenarios (OFS Base, POS and NZFC), the graphs below illustrate the performance of 10 optimal portfolios resulting from the unconstrained optimization. We focus on the real investment return and the RCR. Obviously, the SAA can be improved on both measures if we do not set limitations to asset class allocations. In an unconstrained world, we can conclude that the real investment return target of 3.5% over a 10-year horizon can be achieved for the OFS and POS economies but not for the NZFC economy.



Next, we show the asset allocations for the 10 optimal portfolios resulting from the unconstrained optimization for the three different economies.



From the left to the right, optimal portfolios generate a higher arithmetic return but get riskier as well. For the OFS, we can see that the proportion of fixed income decreases at the expense of public equities as portfolios get more aggressive. Noteworthy is the presence of real assets (timber- and farmland, and infrastructure) in nearly all portfolios.

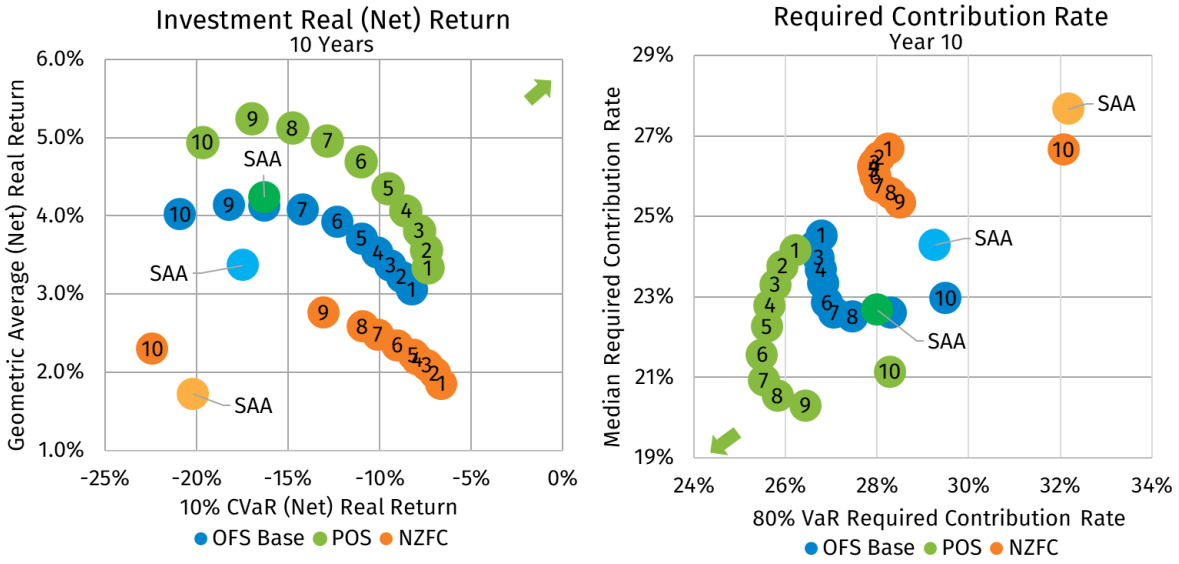
The distribution of allocations across the optimal portfolios for the NZFC economy shows clear differences with the OFS. Relative to the OFS, the NZFC economy is mainly characterized by lower returns and higher inflation levels. For more aggressive portfolios, the optimizer has a stronger preference for real assets and puts less emphasis on public equities compared to the OFS optimization.

On the contrary, when we look at the unconstrained optimal portfolio allocations for the POS economy, we see a roughly similar distribution of asset allocations across portfolios compared to the allocations in the OFS.

Overall, real assets are consistently present in the optimal allocations across the three economies. Furthermore, more aggressive portfolios tend to replace fixed-income products with public equities.

5.13.4. Round 2 – Wide bandwidths

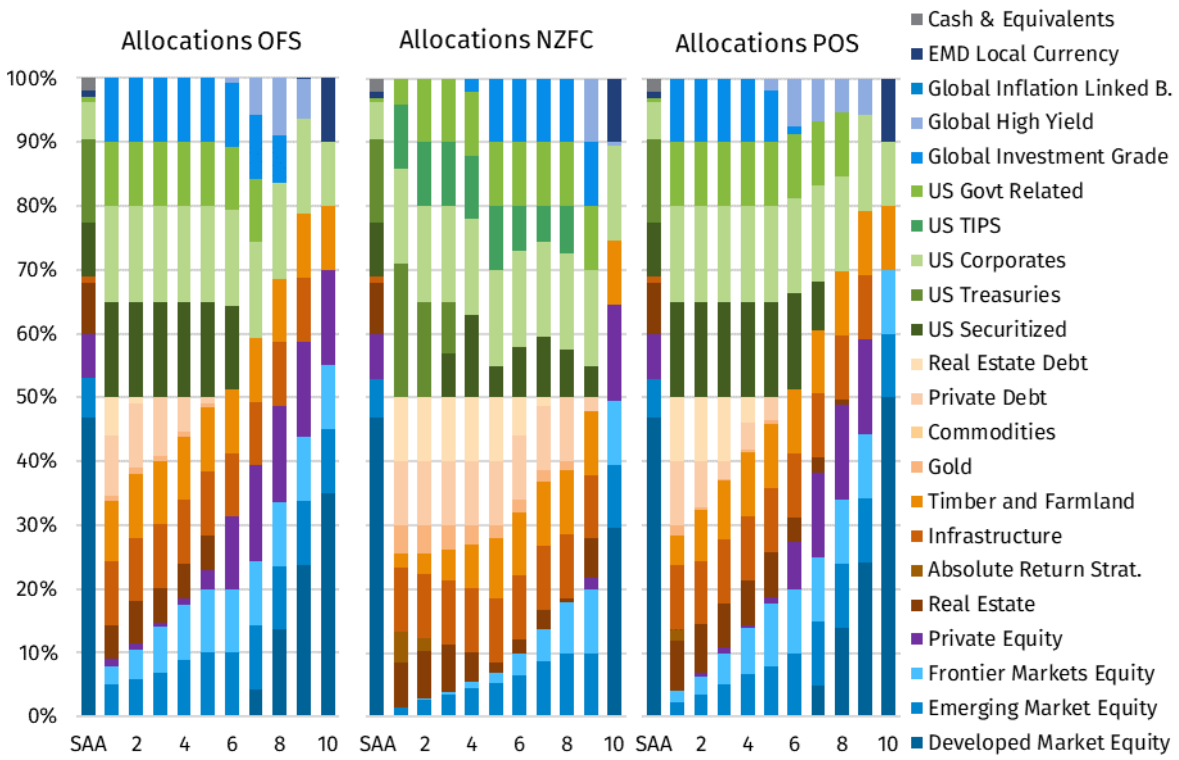
The figure below shows the results for the optimization using wide bandwidths as asset allocation constraints over a 10-year horizon. We observe that there is still substantial room for improving the SAA. As expected, introducing a set of (albeit wide) constraints decreases the room for improvement compared to the first round. It may still be possible to achieve a real investment return of 3.5% in the OFS and POS economy over the next 10 years, whereas it remains out of reach in the NZFC economy.



Considering the OFS allocations in the figure below, imposing wide constraints on the optimization results in more real assets for all portfolios. The optimizer includes a wider range of real assets compared to the previous round by adding, for example, gold. Furthermore, one observes that private equity performs well for more aggressive portfolios. Noteworthy is the low allocation to public equities relative to the SAA.

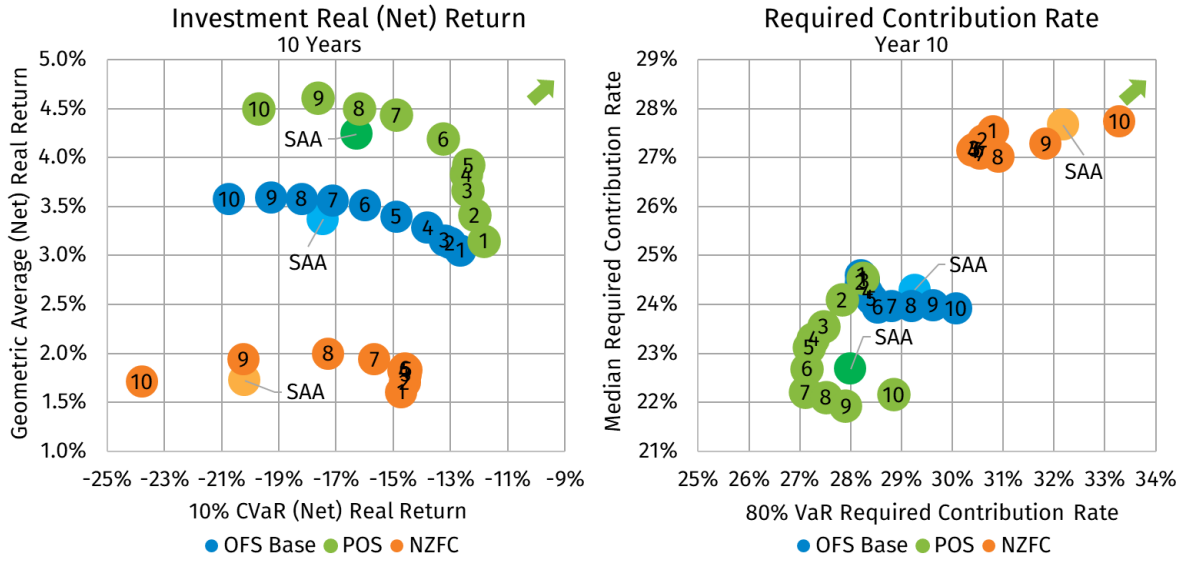
Again, the NZFC economy is associated with different distribution of asset classes relative to the OFS and POS economies. Nearly all portfolios allocate substantially to fixed-income products, making this asset class reach its maximum constraint. Likewise, real assets are also preferred by the optimizer in both defensive and aggressive portfolios. The allocation to public equities is remarkably small, further confirming the idea from Round 1 that this asset class is less favored in the NZFC economy.

The optimal allocations in the POS economy are again roughly similar to those in the OFS. There are some slight differences: for example, private equity performs better in the OFS than the POS economy.



5.13.5. Round 3 – Realistic constraints

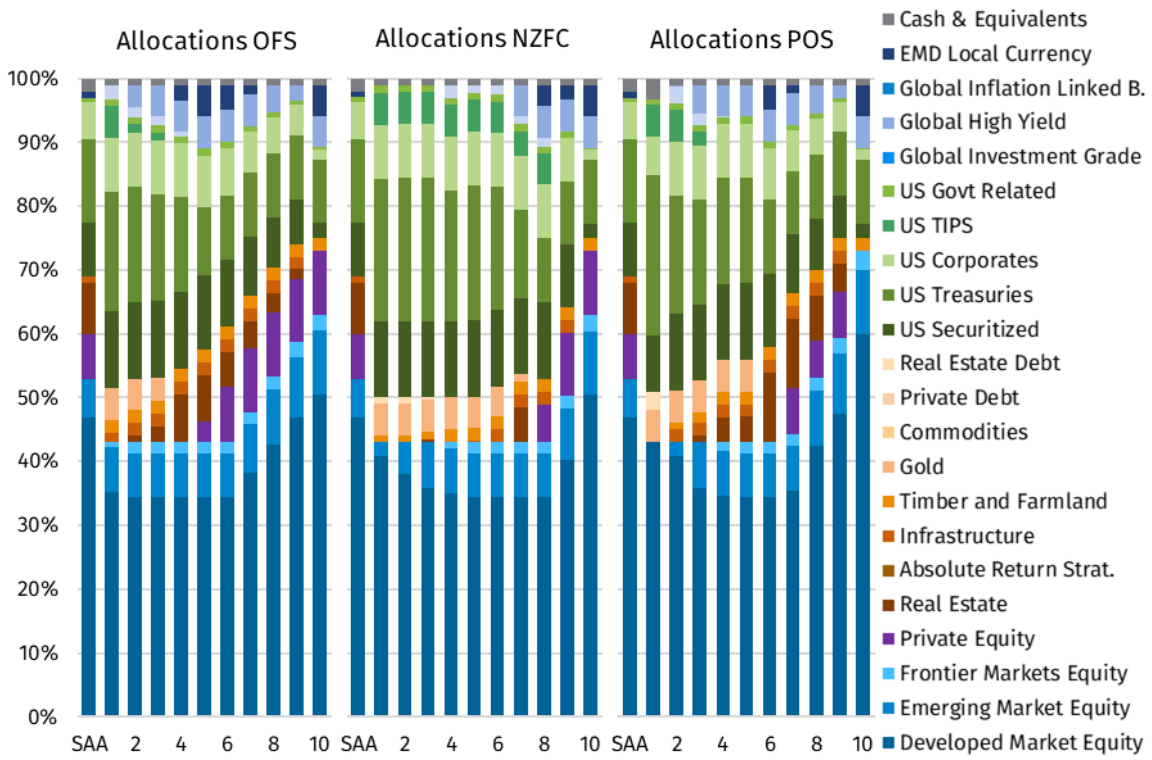
After two rounds of gaining insights into which asset classes are preferred by the optimizer in different economies, we will now focus on optimization results subject to a realistic set of asset allocation constraints that was constructed based on input from both Ortec Finance and the OIM. The figure below shows that the room for improvement of the SAA is mainly directed at the risk side of both the real investment return and the RCR. For example, optimal portfolios 6 and 7 increase (decrease) the expected real investment return (Required Contribution Rate) while reducing the risk in the OFS. Although the room for improvement is small, achieving a real investment return of 3.5% over a 10-year horizon in the OFS and the POS economy may be still possible. The 3.5% target is out of reach in the NZFC economy.



Compared to the SAA, the optimal portfolio allocations for the OFS in the histogram below show a reduction in public equities, an increase in fixed income, and an increase in real assets. Furthermore, we observe that spread-based investments generally perform well. Real estate, infrastructure, and timber- and farmland are preferred real assets in most portfolios. For neutral to aggressive portfolios, private equity performs well. Additionally, EMD local currency shows up for neutral portfolios and the most aggressive portfolio.

Optimal portfolios in the NZFC economy allocate strongly to fixed-income products. Gold performs well for defensive and neutral portfolios. Private equity is favored in more aggressive portfolios.

Similar to previous rounds, optimizing in the POS economy results again in roughly similar allocations relative to the OFS. However, private equity is less preferred in more aggressive portfolios than in the OFS. In the POS economy, most of the aggressive portfolios favor real estate instead of private equity.



5.13.6. Round 4 - Finetuning

No further adjustments have been made to the optimization restrictions. We did, however, assess the impact of two other considerations. These related to high yield and private debt, which were relevant in constructing the recommended portfolios. The considerations are discussed in the next chapter. In this section, we will discuss the impact on results.

We assessed the impact of switching from a global high-yield mandate (as used in the optimizations) to a US-only mandate. We find this change does not materially affect returns (average and CVaR) or ALM results.

We assessed the impact of including private debt in the portfolio at the expense of high yield. We find that private debt has a small but negative effect on ALM results. Furthermore, it diminishes returns of the portfolios of interest to just below the 3.5% real return target.

5.13.7. Optimization sensitivity analyses

The previous four rounds involved varying optimization constraints. To better understand and evaluate the sensitivity to other parameters, additional optimization runs were performed with varying assumptions. The effects on the optimization of the following assumptions have been tested:

- Start date of the optimization: 1 year delay to reduce short-term momentum effects
- End date of the optimization: 30-years instead of 10
- Optimization target: funding ratio return versus real investment return
- Optimization type: Markowitz (volatility) versus Conditional Value at Risk (CVaR)
- Optimization risk levels: 5%, 10%, 20% CVaR
- Optimization observation frequency: annual versus once (cumulative risks and returns)

The results of these runs helped to make fully informed decisions on the SAA recommendation.

5.13.8. Optimization conclusions

The allocations and efficient frontiers shown in this chapter are just a sample of the results obtained. To test for parameter sensitivity and to find robust portfolios, many more optimizations were performed, varying start and end dates of the optimization, risk metrics, constraints, and economic scenarios. Overall, our findings can be summarized as follows:

High level trends – comparing to the current SAA

- Reduction in public equities (OFS, NZFC, POS)
- Increases in fixed income (OFS, NZFC, POS)
- Increases in real assets (OFS, POS); similar or reduction under NZFC

Asset classes

- Spread-based investments generally perform well
- US treasuries performs well in neutral to defensive portfolios
- Infrastructure and timber- & farmland perform well in most portfolios
- Real estate performs well under OFS and POS, less so in NZFC
- Private equity performs well under OFS, somewhat less in POS. In NZFC it is favored in the most aggressive portfolios.

5.14. Recommended asset allocations evaluation

The recommendations on the strategic asset allocations are based on the combined results of this study: optimizations, sensitivity analyses, and qualitative assessments. Leading in our advice is the UNJSPF's goal to preserve long-term sustainability with a minimal amount of risk while considering practical limitations.

Ortec Finance proposed two alternative strategic asset allocations to the UNJSPF. Both portfolios increase expected return and decrease risk. The considerations around the

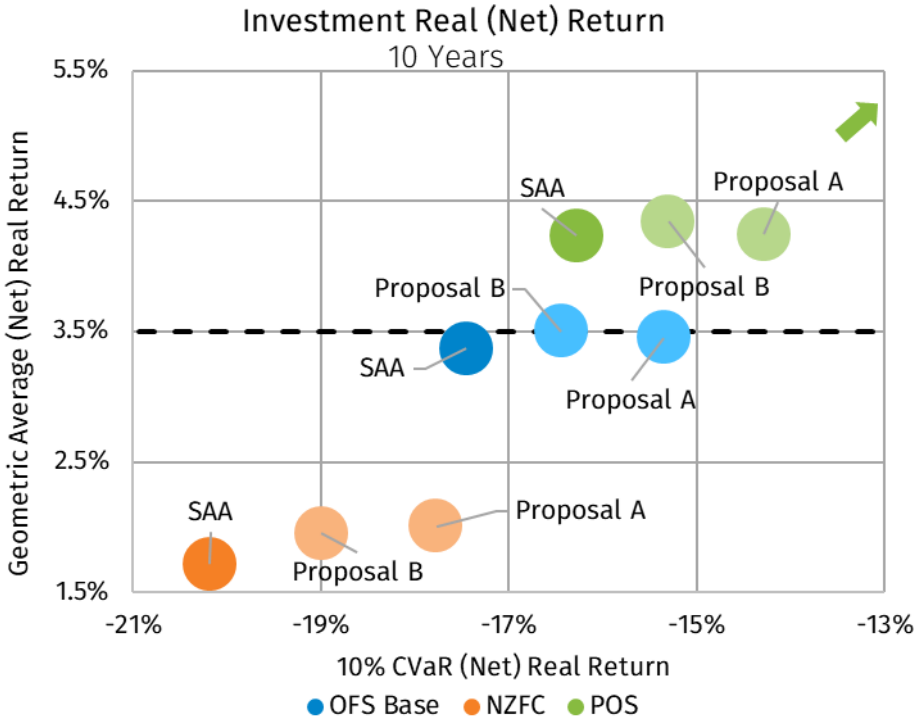
recommended strategic asset allocations (SAA) are discussed in the next section. In this section, we will evaluate the quantitative performance of the recommended strategies.

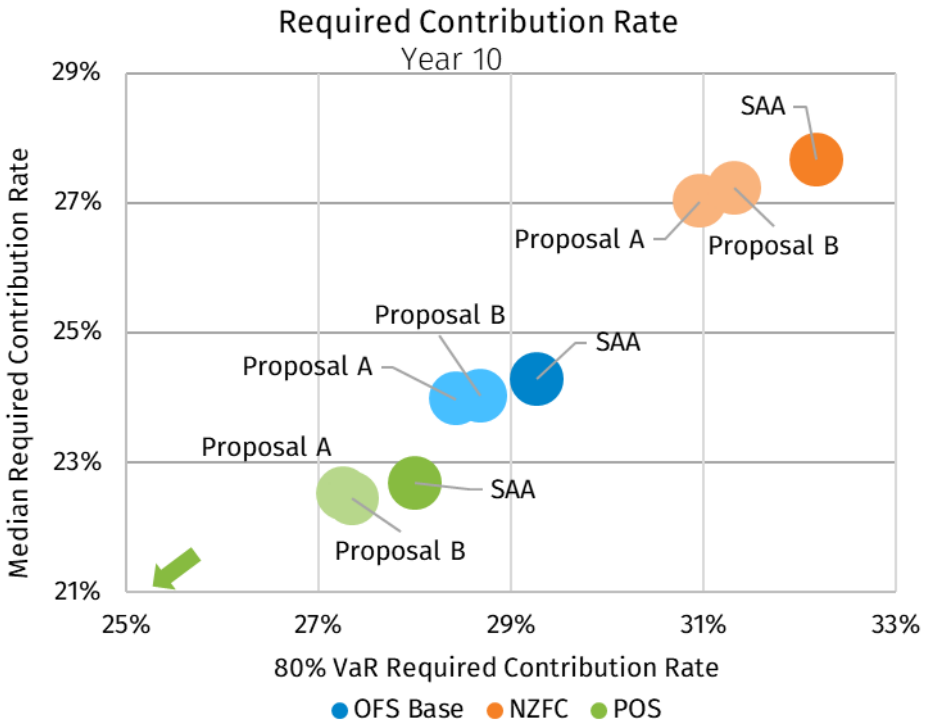
ALM 2023	2021 SAA	2023 Proposal A	2023 Proposal B
Equity and Private Assets	**69.0%**	**60.0%**	**66.0%**
Global Public Equities	53.0%	43.0%	46.0%
Developed Markets Equity	46.9%	35.0%	38.0%
Emerging Markets Equity	6.1%	8.0%	8.0%
Private Equity	7.0%	7.0%	9.0%
Real Assets	9.0%	10.0%	11.0%
Real Estate	8.0%	8.5%	8.0%
Infrastructure	1.0%	1.5%	2.0%
Timberland and Farmland	0.0%	0.0%	1.0%
Private Debt	0.0%	0.0%	0.0%
Fixed Income and Cash	**31.0%**	**40.0%**	**34.0%**
Fixed income	29.0%	39.0%	33.0%
US Core Bonds	28.0%	35.0%	28.5%
US Securitized	8.3%	10.0%	8.5%
US Treasuries	13.0%	14.0%	13.3%
US Corporates	5.9%	10.0%	6.0%
US Govt Related	0.8%	1.0%	0.8%
Non Core Bonds	1.0%	4.0%	4.5%
US High Yield	0.0%	2.0%	2.5%
EMD Local Currency	1.0%	2.0%	2.0%
Cash & Equivalents	2.0%	1.0%	1.0%

The charts below show results for the current 2021 SAA and proposed portfolios A and B under each of the three main economic scenarios: OFS Base, NZFC and POS. Under the OFS (in blue), both proposals A and B, outperform the SAA in terms of risk and return. With both proposals, it is possible to achieve the 3.5% real return target, with proposal A offering more risk reduction relative to proposal B. Consequently, the median Required Contribution Rate and 80% VaR contribution rate are also lower than the SAA.

Under the POS scenario, all portfolios (including the SAA) can achieve the real return target of 3.5%. On the other hand, with the NZFC scenario, none of the portfolios can achieve the target, although the proposed portfolios still outperform the SAA.

Relative differences between the portfolios are maintained across all scenarios.





The following tables provide a comprehensive overview of additional metrics pertaining to all portfolios, covering different time horizons and scenarios. It is important to note that none of the portfolios reach a 3.5% real return over 20 and 30 years under the baseline OFS.

Ortec Finance Scenarios December 2022 (*end of period)	2021 SAA 10Y	Proposal A 10Y	Proposal B 10Y	2021 SAA 20Y	Proposal A 20Y	Proposal B 20Y	2021 SAA 30Y	Proposal A 30Y	Proposal B 30Y
Portfolio Nominal Return									
Geometric Mean	5.7%	5.7%	5.8%	5.5%	5.5%	5.6%	5.5%	5.5%	5.6%
Volatility	11.8%	10.6%	11.3%	11.8%	10.6%	11.4%	11.8%	10.6%	11.4%
10% CVaR	-15.3%	-13.1%	-14.3%	-15.6%	-13.5%	-14.6%	-15.6%	-13.6%	-14.7%
Portfolio Real Return									
Geometric Mean	3.4%	3.5%	3.5%	3.3%	3.3%	3.4%	3.3%	3.3%	3.4%
Volatility	11.7%	10.6%	11.3%	11.8%	10.6%	11.3%	11.8%	10.7%	11.4%
10% CVaR	-17.5%	-15.3%	-16.4%	-17.7%	-15.7%	-16.7%	-17.7%	-15.8%	-16.8%
Required Contribution Rate									
Median*	24.3%	24.0%	24.0%	24.2%	23.9%	23.5%	23.7%	23.3%	22.5%
80% VaR*	29.3%	28.4%	28.7%	33.3%	32.0%	32.2%	38.4%	36.5%	36.6%
Probability above Corridor	34.8%	31.0%	32.3%	39.0%	35.9%	36.4%	41.5%	38.9%	38.9%

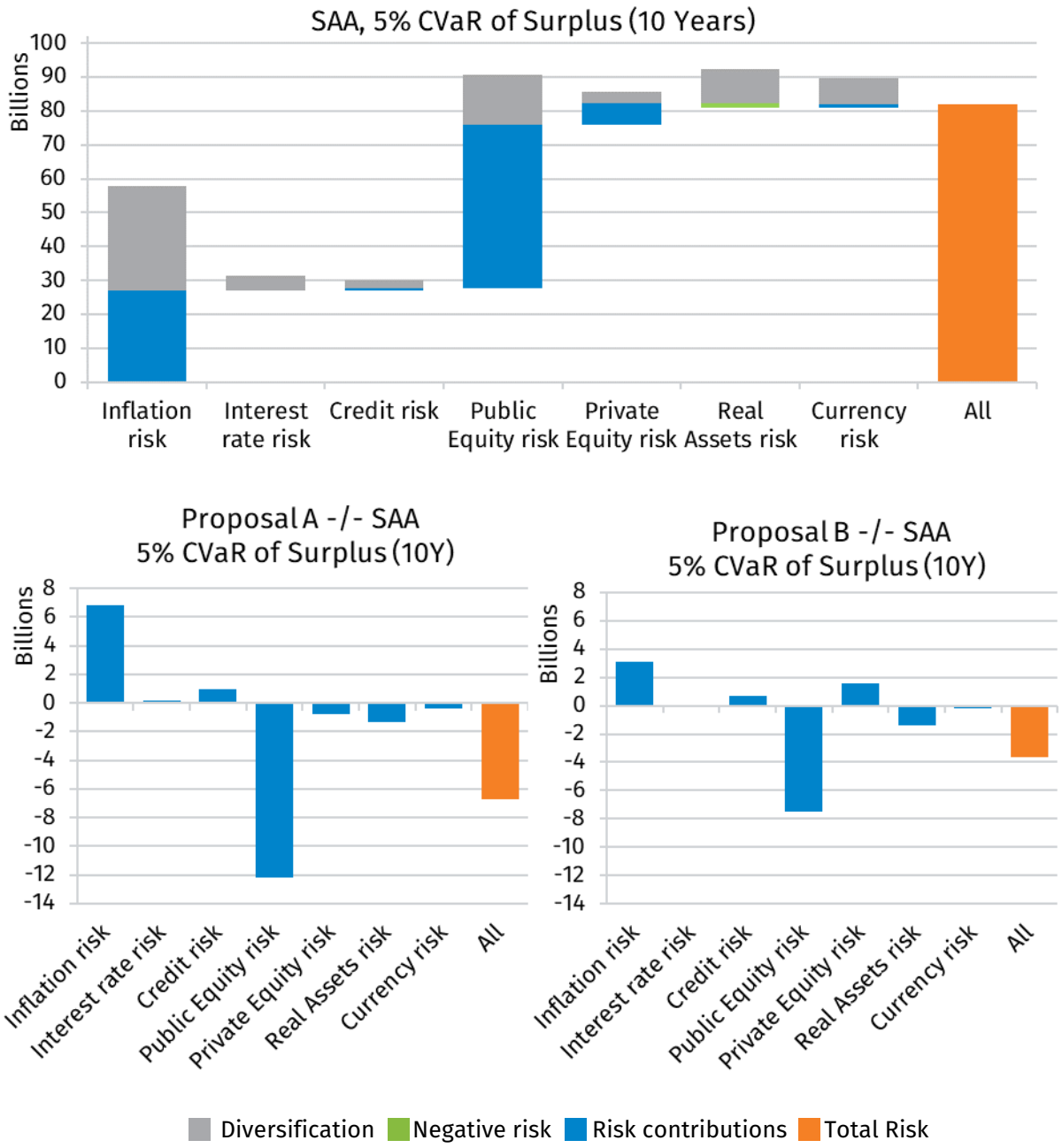
Net Zero Financial Crisis Scenario December 2022 (*end of period)	2021 SAA 10Y	Proposal A 10Y	Proposal B 10Y	2021 SAA 20Y	Proposal A 20Y	Proposal B 20Y	2021 SAA 30Y	Proposal A 30Y	Proposal B 30Y
Portfolio Nominal Return									
Geometric Mean	4.4%	4.7%	4.7%	4.7%	4.9%	4.9%	4.9%	5.0%	5.0%
Volatility	12.7%	11.4%	12.2%	12.3%	11.0%	11.8%	12.1%	10.9%	11.7%
10% CVaR	-17.9%	-15.4%	-16.7%	-17.1%	-14.8%	-16.0%	-16.7%	-14.6%	-15.7%
Portfolio Real Return									
Geometric Mean	1.7%	2.0%	2.0%	2.3%	2.4%	2.5%	2.5%	2.6%	2.7%
Volatility	12.5%	11.3%	12.0%	12.2%	11.0%	11.7%	12.1%	10.9%	11.6%
10% CVaR	-20.2%	-17.8%	-19.0%	-19.2%	-17.1%	-18.2%	-18.9%	-16.8%	-17.9%
Required Contribution Rate									
Median*	27.7%	27.0%	27.2%	29.8%	28.8%	28.9%	32.2%	30.7%	30.8%
80% VaR*	32.2%	31.0%	31.3%	37.6%	36.0%	36.6%	44.2%	41.8%	42.5%
Probability above Corridor	51.9%	48.5%	49.7%	57.0%	54.4%	54.8%	58.6%	56.6%	56.6%

Positive Scenario December 2022 (*end of period)	2021 SAA 10Y	Proposal A 10Y	Proposal B 10Y	2021 SAA 20Y	Proposal A 20Y	Proposal B 20Y	2021 SAA 30Y	Proposal A 30Y	Proposal B 30Y
Portfolio Nominal Return									
Geometric Mean	6.6%	6.6%	6.7%	6.3%	6.3%	6.4%	6.2%	6.2%	6.3%
Volatility	11.8%	10.5%	11.3%	11.8%	10.6%	11.4%	11.9%	10.7%	11.4%
10% CVaR	-14.2%	-12.1%	-13.2%	-14.8%	-12.8%	-13.8%	-15.0%	-13.0%	-14.1%
Portfolio Real Return									
Geometric Mean	4.2%	4.2%	4.3%	4.0%	3.9%	4.0%	3.8%	3.8%	3.9%
Volatility	11.7%	10.5%	11.2%	11.8%	10.6%	11.3%	11.8%	10.7%	11.4%
10% CVaR	-16.3%	-14.3%	-15.3%	-16.9%	-15.0%	-16.0%	-17.2%	-15.3%	-16.3%
Required Contribution Rate									
Median*	22.7%	22.5%	22.4%	20.7%	20.8%	20.2%	18.8%	18.5%	17.6%
80% VaR*	28.0%	27.3%	27.4%	30.5%	29.4%	29.6%	34.2%	32.5%	32.6%
Probability above Corridor	24.7%	21.5%	22.3%	29.1%	26.2%	26.8%	31.5%	28.9%	29.0%

We analyzed the risks involved by measuring the “surplus” in the worst-case scenarios at the end of a 10-year period. The worst-case refers to the 5% conditional value at risk.

In the graph below, the orange bar represents to total risk of the current SAA, while the blue bars show the contribution of individual risk factors in these 5% scenarios. The gross risk of individual factors may be larger in a different subset of scenarios (blue + gray), but the difference is explained by diversification (gray). In some cases, certain asset classes may even

appreciate in the worst-case scenarios, resulting in a negative contribution (green). The bottom two charts depict the deltas between the proposed portfolios and the SAA.



Over a 10-year period, the surplus of the UNJSPF can decrease by about $80 billion in worst-case scenarios with the current SAA. For context, in year 10, the assets side of the balance sheet (actuarial value of assets + expected contribution) is roughly $244 billion in the median scenario.

Overall, both proposed portfolios offer a material risk reduction relative to the SAA. The largest contributor is Public Equity risk since both proposed portfolios have a significantly

lower allocation to Public Equity compared to the SAA. Proposal A offers more of a risk reduction relative to Proposal B. With Proposal A, the absolute risk is reduced (relative to the SAA) by roughly $6-7 billion, while with Proposal B, it is around $4 billion.

It is important to note that the worst-case scenarios are not the same scenarios for all 3 risk factor decompositions. Net inflation risk is different for the 3 portfolios indicating that they are exposed to a different set of worst-case scenarios (as the gross inflation risk, on the liability side, is equal by definition). Since each portfolio has a different exposure to the various risk sources, the worst-case scenarios are also different.

5.15. Climate change stress testing

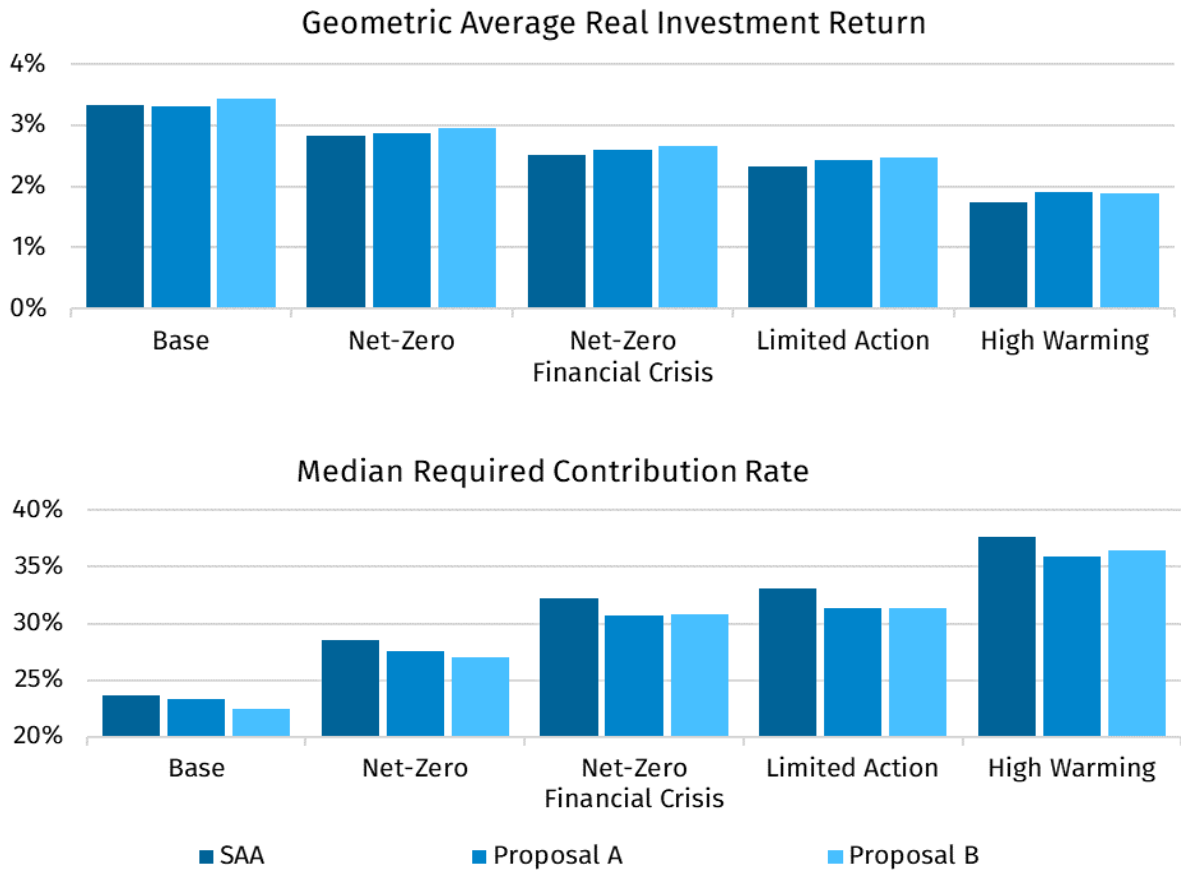
Climate change will have a profound impact on pension plans worldwide. Whether it is through physical risks, technological innovations or governmental policies, climate change impacts the economy and the financial markets, as well as the life expectancy of members. This, in turn, affects the performance and sustainability of the pension plan.

In this analysis, we compare the performance of the two recommended portfolios to the current SAA under various climate scenarios:

- Baseline (OFS)
- Net-Zero
- Net-Zero Financial Crisis
- Limited Action
- High Warming

Although it is impossible to predict which scenario would unfold, these climate narrative-driven stress tests provide valuable information into the risks faced by the UNSJPF and the robustness of the current and proposed strategies under various economic and financial market conditions. The main purpose of this analysis is to assess that the proposed portfolios do not deteriorate results under various potential climate scenarios.

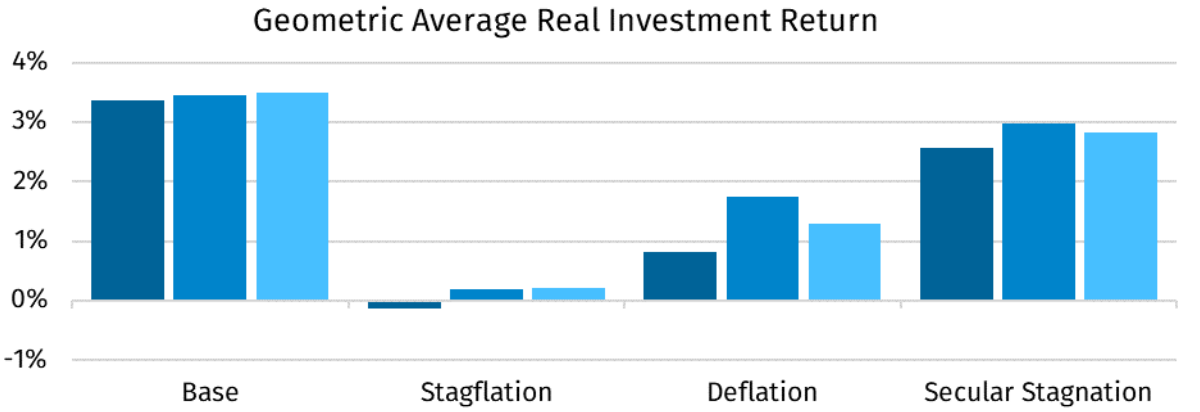
In the charts below, we compare the Real Return and Required Contribution Rate in climate scenarios over a 30Y horizon.

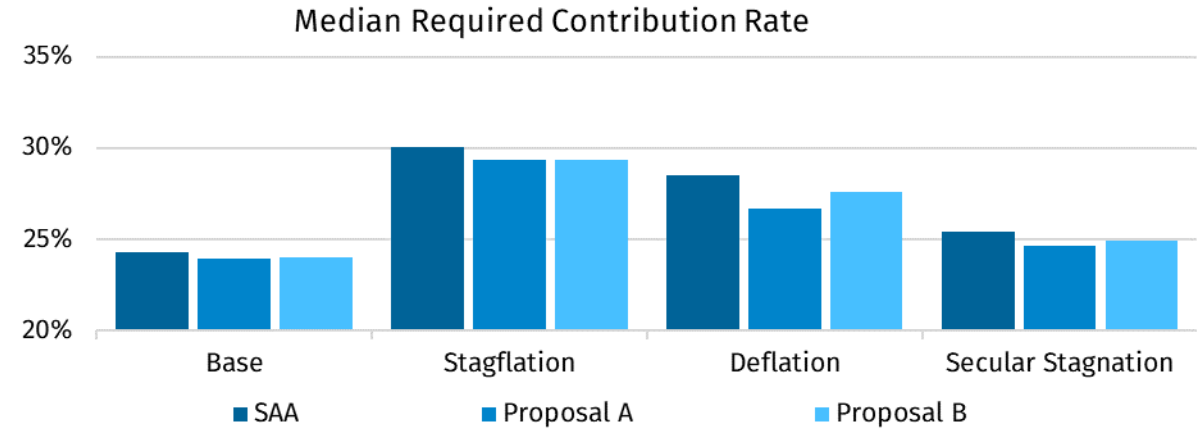


The specific scenarios have a stronger impact on results than the three portfolios tested. We find that both the proposed portfolios outperform the current SAA in all the analyzed climate risk scenarios. In most scenarios, the differences between proposals A and B are small. However, in the High Warming scenario, Proposal A outperforms Proposal B as return-focused assets are expected to be hit harder by the effects of physical risks. In the Net Zero scenario, proposal B outperforms proposal A since return-focused assets stabilize after the repricing period in the first years and converge to their long-term mean just under the baseline levels.

5.16. Economic stress testing

Stress testing is an invaluable resource that provides insights into a plan's sustainability in adverse financial and economic scenarios. These stress tests are meant to replicate plausible real-world economic scenarios which could have an undesired impact on the plan. The goal of this section is to analyze the robustness of the proposed portfolios and check whether their results deteriorate or improve compared to the existing SAA under these adverse conditions.





Please see Section 4.1.4 on page 27 for the stress scenario narratives. In the charts, we compare the Real Return and Required Contribution Rate in three stress scenarios:

- Stagflation
- Deflation
- Secular Stagnation

As is generally the case with stress scenarios, the specific scenarios have a stronger impact on results than which portfolio is selected. Moving from the Base scenario to the Stagflation scenario has a great impact on all portfolios. However, there also are significant differences between the portfolios. Both proposals A and B outperform the SAA in all scenarios. Comparing A to B, proposal A is more resilient under a deflation or secular stagnation scenario.

The outcomes of the stress test show that the proposed portfolios are robust and do not deteriorate results under adverse scenarios.

5.17. Benchmarks

Measuring the investment performance of a pension plan is typically done by comparing the actual returns of the plan with a relevant benchmark. For some assets, this process is relatively straightforward. For example, with listed global equities, the MSCI ACWI benchmark can be used. For private investments, this tends to be more difficult. Private assets are not as liquid, and it is harder to find comparable investments.

In this section, we will first go over the different types of private asset benchmarks and provide recommendations, taking into consideration the benchmarks used by other pension plans around the world.

Types of benchmarks

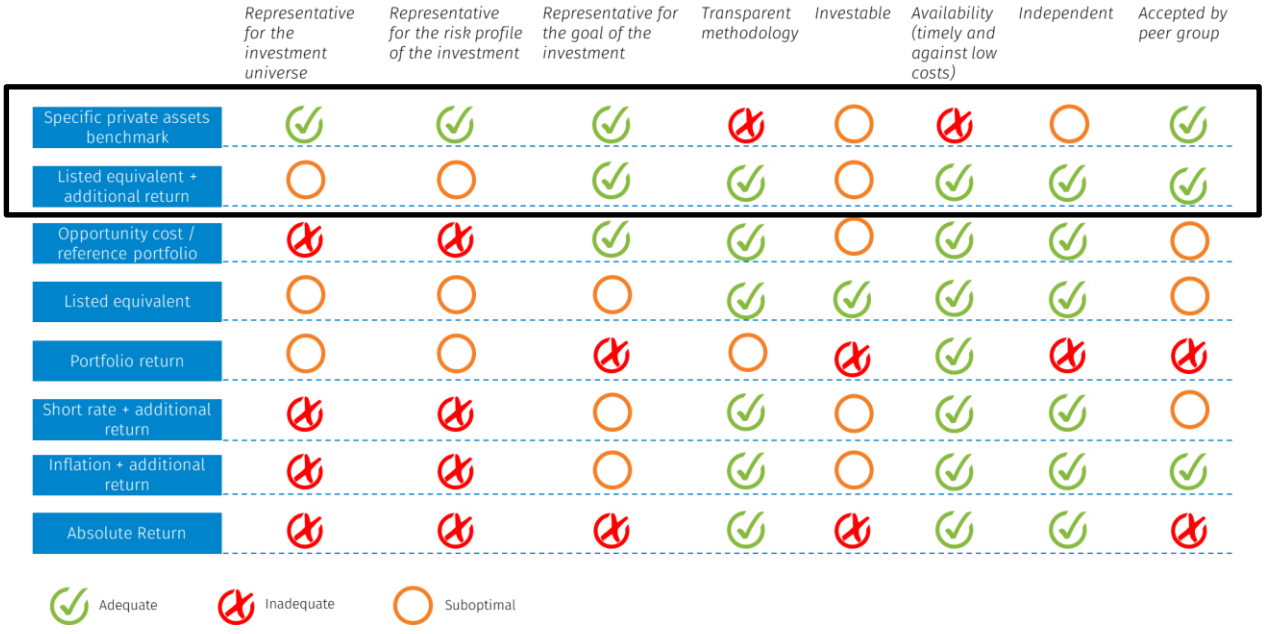
The diagrams below give an overview of the different benchmark types, in which regions they are most widely used, and an example of what it looks like.

	Inflation + additional return	Short-rate+ additional return	Specific private assets benchmark
Definition	Return on real assets should be higher than inflation	There should be a risk premium over the short rate	Reflects returns of comparable investments
Presence	Widely used, mainly in the US, UK, Canada and Australia	Occasionally used, mainly in the Netherlands regulation driven.	Most widely used globally, especially by the largest funds
Example	CPI + 600 bps	EONIA + 500 bps	Preqin or Burgiss Private IQ for PE, Cliffwater direct lending index for private debt, or the NCREIF index for real estate

	Listed equivalent	Listed equivalent + additional return	Opportunity cost / reference portfolio
Definition	In the long run, returns should be comparable to listed equivalents	Returns should be higher than listed alternatives (illiquidity premium)	Returns should be higher than returns of assets sold to buy private assets
Presence	Occasionally used, mainly in the USA, Netherlands	Widely used, mainly in the USA, and the Netherlands	Occasionally used in Europe, mainly in Finland and the UK
Example	Short-term bond index for Private Debt, S&P listed private equity or LPX listed infrastructure	MSCI World + 100 bps	50% equity composite + 50% fixed income composite

	Portfolio return	Peer group benchmark	Absolute Returns
Definition	An asset class that cannot be benchmarked properly should not drive total portfolio out- or underperformance	Compare returns with other pension funds	An asset class without clear benchmark should outperform a specific hurdle rate
Presence	Often used in the Netherlands	Often used by largest pension funds worldwide in addition to other benchmarks	Rarely used, observed in some funds in Sweden
Example	Return of private equity or direct real estate portfolio	CEM benchmarking	Beat a 6% hurdle rate, or return more than 0%

Given this wide range of benchmarks, it is important to find the most suitable, based on a variety of criteria. The chart below shows the different benchmarks with a score on each criterion. Based on these results, the first two benchmark types are preferred.



Recommendations

A comprehensive benchmark analysis was conducted, involving the evaluation of the Fund's existing benchmarks and the identification of potential new benchmarks.

A comparative study was undertaken to gather relevant insights, encompassing the examination of benchmarks used by a selection of pension funds, including the 20 largest pension funds worldwide, alongside internal data sources provided by Ortec Finance.

Given the information provided, the current benchmarks were reviewed, and suggestions were provided on the new asset classes. The table below summarizes this information.

ALM 2023	Benchmarks (Current All ESG, Custom)
Equity and Private Assets	
Global Public Equities	
Developed Markets Equity	MSCI North America/Europe/Pacific IMI All Cap
Emerging Markets Equity	MSCI Emerging Markets All Cap
Private Equity	MSCI ACWI IMI ESG Custom + 2%
Real Assets	
Real Estate	NCREIF Open End Diversified Core Equity (ODCE) (+2% for Non-core)
Infrastructure	US CPI + 4%
Timberland and Farmland	**NCREIF Timberland Index / NCREIF Farmland Index**
Private Debt	**Cliffwater Direct Lending Index (CDLI)**
Fixed Income and Cash	
Fixed income	
US Core Bonds	Bloomberg US Aggregate Bond Index (Proposal B)
US Securitized	Bloomberg US Securitized
US Treasuries	Bloomberg US Treasury
US Corporates	Bloomberg US Corporates
US Govt Related	Bloomberg US Government Related
Non Core Bonds	
US High Yield	**US High Yield: Bloomberg high yield index**
EMD Local Currency	Bloomberg EM local currency government
Cash & Equivalents	Bloomberg 1-3 month US Treasury

With the above criteria in mind and a review of benchmarks used by peers, we recommend keeping the current benchmarks for the existing asset classes and adding the highlighted benchmarks (in **bold**) for the new asset classes.

The current benchmarks the UNJSPF is employing are suitable and commonly used for their respective asset classes, and as such, an update or change is not required. One exception to this case is EMD Local Currency, where we typically see a JP Morgan benchmark employed by peers of the UNJSPF. However, since the rest of the Fixed Income portfolio uses a Bloomberg benchmark, we recommend keeping the same to maintain consistency.

For private equity, a listed equivalent plus additional return is selected. The additional return is justified by the illiquidity premium (short term) and selection alpha potential. Specifically in this category, the first quartile selection of investments will result in outperformance. The current benchmark is, therewith, reasonable and in line with peers.

Indices are also available per asset class and, where relevant, regional. This allows for composite benchmarks at the highest level and no need for MSCI ACWI IMI or Bloomberg US Aggregate indices.

6. Recommendations

This study has covered a broad array of topics ranging from the influence of demographics and the cost of the Two-Track system to the potential impact of climate change on the investment portfolio of the fund. In this section, we will discuss our conclusions and recommendations on strategic asset allocation (SAA), portfolio benchmarks, rebalancing strategy, and currency strategy.

6.1. Overview

Strategic asset allocation, bandwidths, and benchmarks

ALM 2023	2021 SAA	2023 Proposal A	2023 Proposal B	Delta bandwidths Minimum	Delta bandwidths Maximum	Benchmarks (Current All ESG, Custom)
Equity and Private Assets	**69.0%**	**60.0%**	**66.0%**	8%	8%	
Global Public Equities	53.0%	43.0%	46.0%	8%	8%	
Developed Markets Equity	46.9%	35.0%	38.0%	8%	8%	MSCI North America/Europe/Pacific IMI All Cap
Emerging Markets Equity	6.1%	8.0%	8.0%	4%	4%	MSCI Emerging Markets All Cap
Private Equity	7.0%	7.0%	9.0%	4%	4%	MSCI ACWI IMI ESG Custom + 2%
Real Assets	9.0%	10.0%	11.0%	5%	5%	
Real Estate	8.0%	8.5%	8.0%	4%	4%	NCREIF Open End Diversified Core Equity (Non-core +2%)
Infrastructure	1.0%	1.5%	2.0%	2%	2%	US CPI + 4%
Timberland and Farmland	0.0%	0.0%	1.0%	1%	2%	**NCREIF Timberland Index / NCREIF Farmland Index**
Private Debt	0.0%	0.0%	0.0%	0%	2%	**Cliffwater Direct Lending Index (CDLI)**
Fixed Income and Cash	**31.0%**	**40.0%**	**34.0%**	8%	8%	
Fixed income	29.0%	39.0%	33.0%	8%	8%	
US Core Bonds	28.0%	35.0%	28.5%	8%	8%	Bloomberg US Aggregate Bond Index (Proposal B)
US Securitized	8.3%	10.0%	8.5%	3%	3%	Bloomberg US Securitized
US Treasuries	13.0%	14.0%	13.3%	3%	3%	Bloomberg US Treasury
US Corporates	5.9%	10.0%	6.0%	3%	3%	Bloomberg US Corporates
US Govt Related	0.8%	1.0%	0.8%	1%	2%	Bloomberg US Government Related
Non Core Bonds	1.0%	4.0%	4.5%	3%	3%	
US High Yield	0.0%	2.0%	2.5%	2%	2%	**US High Yield: Bloomberg high yield index**
EMD Local Currency	1.0%	2.0%	2.0%	2%	2%	Bloomberg EM local currency government
Cash & Equivalents	2.0%	1.0%	1.0%	0.5%	2%	Bloomberg 1-3 month US Treasury

We recommend keeping the current benchmarks for the existing asset classes and adding the benchmarks highlighted in the table above for the new asset classes (in bold).

Indices are also available per asset class and, where relevant, regional. This allows for composite benchmarks at the highest level and no need for MSCI ACWI IMI or Bloomberg US Aggregate indices.

Rebalancing strategy

Currently, OIM meets with a monthly frequency to discuss portfolio rebalancing. We recommend the UNJSPF to, by default, rebalance less frequently than monthly and to, by default, rebalance to midway the bandwidths. We recommend the ability for OIM to make discretionary rebalancing decisions.

Currency strategy

We find that hedging developed markets' currency risk can be advantageous from a risk and return perspective. Whether or not to implement a hedging strategy is also dependent on

implementation and management cost and risk. We recommend OIM to further analyze and weigh the advantages and disadvantages of currency hedging.

6.2. Strategic Asset Allocation

The recommendations on the strategic asset allocations are based on the combined results of this study: optimizations, sensitivity analyses, and qualitative assessments. Leading in our advice is the UNJSPF's goal to preserve long-term sustainability with a minimal amount of risk while considering practical limitations. Sustainability is measured by the Required Contribution Rate and the real investment return. For the Required Contribution Rate, the fund has defined a target corridor of +/-2% around its actual contribution rate of 23.70%. For investment returns, the UNJSPF's actuarial valuation has, in recent years, assumed a real of return of 3.5%, which was set with reference to what the Fund's Consulting Actuary and Committee of Actuaries believe may be achievable over the long term.

6.2.1. Recommended portfolios

Ortec Finance proposes two asset allocations to the UNJSPF. Both portfolios increase expected return and decrease risk.

ALM 2023	2021 SAA	2023 Proposal A	2023 Proposal B
Equity and Private Assets	**69.0%**	**60.0%**	**66.0%**
Global Public Equities	53.0%	43.0%	46.0%
Developed Markets Equity	46.9%	35.0%	38.0%
Emerging Markets Equity	6.1%	8.0%	8.0%
Private Equity	7.0%	7.0%	9.0%
Real Assets	9.0%	10.0%	11.0%
Real Estate	8.0%	8.5%	8.0%
Infrastructure	1.0%	1.5%	2.0%
Timberland and Farmland	0.0%	0.0%	1.0%
Private Debt	0.0%	0.0%	0.0%
Fixed Income and Cash	**31.0%**	**40.0%**	**34.0%**
Fixed income	29.0%	39.0%	33.0%
US Core Bonds	28.0%	35.0%	28.5%
US Securitized	8.3%	10.0%	8.5%
US Treasuries	13.0%	14.0%	13.3%
US Corporates	5.9%	10.0%	6.0%
US Govt Related	0.8%	1.0%	0.8%
Non Core Bonds	1.0%	4.0%	4.5%
US High Yield	0.0%	2.0%	2.5%
EMD Local Currency	1.0%	2.0%	2.0%
Cash & Equivalents	2.0%	1.0%	1.0%

The allocations show a decrease in Developed Markets Equity, with increases in Fixed Income and Real Assets.

The OIM could consider including Private Debt (at the expense of High Yield).

6.2.2. Considerations

In this sub-section, we discuss the key considerations around the proposed portfolios.

Decrease in public equity

The decrease in public equity is driven by lower risk premia. Long-term, the aging of populations has a negative impact on expected growth, resulting in slightly lower than historic risk premia. The increased rates compared to the 2019 and 2021 analyses result in a relatively less attractive equity outlook.

The equity risk factor remains the dominant risk factor in both proposed portfolios. The sizeable exposure to this factor makes it possible to still harvest the necessary risk premia.

While the exposure to public equities overall decreases, we advise increasing the allocation to emerging markets. This will help to increase the expected public equity return and improve global diversification.

Increase to private assets

The allocation to private assets is increased to boost the expected return of the portfolio and provide diversification against the equity risk factor.

Increase in fixed income

Recent global affairs have brought back fixed income as a relatively attractive asset class in comparison to equities. Fixed income can provide a risk reduction from a total perspective and now also help with the expected return. The increase in fixed income is accompanied by a reduction in cash. This should reduce the cash drag while sufficient liquidity is ensured through the sizable allocation to US treasuries.

High yield

High yield performs well in the optimizations. We recommend specifically investing in US high yield instead of global, as a US-only mandate can be executed more efficiently and provides more liquidity. Our sensitivity analyses show no downside to investing in the US instead of global high yield as the UNSJPF achieves sufficient global diversification via other asset classes.

Private debt

The OIM has expressed interest in exploring the private debt asset class. From a qualitative perspective, we note that the general characteristics of private debt make it worthwhile to consider thisan addition to the portfolio. However, private debt is a labor-intensive asset class (to mandate and monitor). Alpha might be substantial, but it is not a given and has not been a part of the optimization analyses. Within private debt, we see large differences depending on the type of debt.

From a quantitative point of view, we note that the optimizations show private debt is currently less attractive than listed spread products. The asset benchmark is negatively impacted by assets that were introduced in the low-rate environment. Therefore, we do not include private debt in our proposed portfolios.

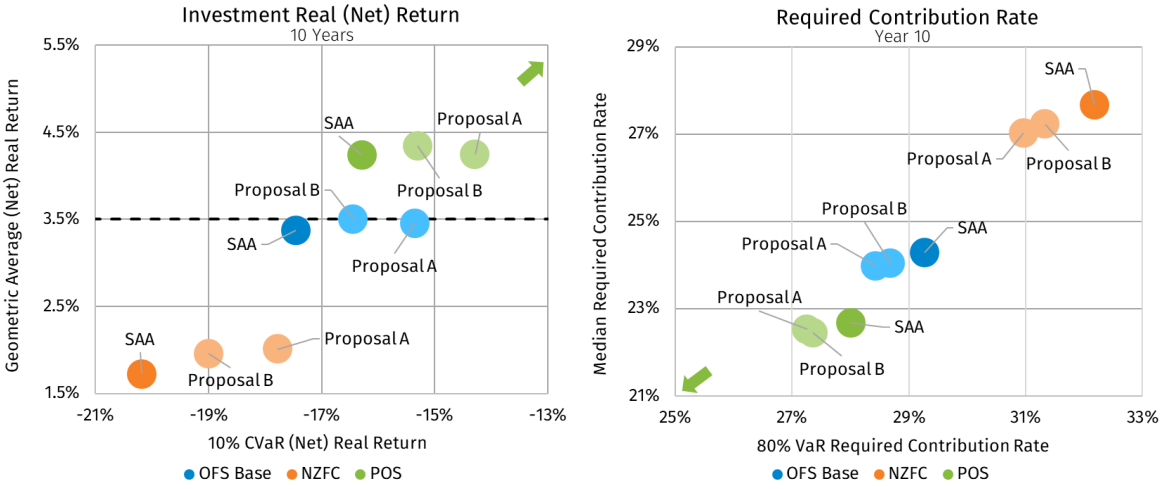
However, with private debt, building experience and a network is important. If the asset does become relatively more attractive in the future (in terms of expected risk/return), it will be easier to implement a higher allocation if the OIM is an experienced private debt investor. Therefore, we do recommend including a bandwidth for Private Debt so that preparations are possible.

Proposal A versus proposal B

Both proposals A and B improve the financial sustainability of the UNJSPF. Proposal A, with a larger exposure to fixed income, works especially well in the current interest rate environment. Long-term, it may be challenging to rely on fixed income returns, depending on interest rate movements. Proposal B, with a more modest increase in fixed income, is more suitable when rates and spreads compress.

6.2.3. Performance

In the graphs and table below, we show the performance of the recommended portfolios A and B for the 3 central scenarios on a 10-year basis. In the results section, results on a 30-year horizon and the performance of proposals A and B under various climate scenarios and economic stress scenarios can be viewed.



Ortec Finance Scenarios December 2022 (*end of period)	2021 SAA 10Y	Proposal A 10Y	Proposal B 10Y	2021 SAA 10Y	Proposal A 10Y	Proposal B 10Y	2021 SAA 10Y	Proposal A 10Y	Proposal B 10Y
Portfolio Nominal Return									
Geometric Mean	5.7%	5.7%	5.8%	4.4%	4.7%	4.7%	6.6%	6.6%	6.7%
Volatility	11.8%	10.6%	11.3%	12.7%	11.4%	12.2%	11.8%	10.5%	11.3%
10% CVaR	-15.3%	-13.1%	-14.3%	-17.9%	-15.4%	-16.7%	-14.2%	-12.1%	-13.2%
Portfolio Real Return									
Geometric Mean	3.4%	3.5%	3.5%	1.7%	2.0%	2.0%	4.2%	4.2%	4.3%
Volatility	11.7%	10.6%	11.3%	12.5%	11.3%	12.0%	11.7%	10.5%	11.2%
10% CVaR	-17.5%	-15.3%	-16.4%	-20.2%	-17.8%	-19.0%	-16.3%	-14.3%	-15.3%
Required Contribution Rate									
Median*	24.3%	24.0%	24.0%	27.7%	27.0%	27.2%	22.7%	22.5%	22.4%
80% VaR*	29.3%	28.4%	28.7%	32.2%	31.0%	31.3%	28.0%	27.3%	27.4%
Probability above Corridor	34.8%	31.0%	32.3%	51.9%	48.5%	49.7%	24.7%	21.5%	22.3%

Both proposals increase return and decrease risk across the three Scenarios used (OFS, NZFC, POS). Analyses on the 30-year horizon show a similar result, with A and B outperforming the current SAA. Sensitivity analyses further confirm that the proposed portfolios are robust under different scenarios.

6.3. Allocation bandwidths and rebalancing

Currently, the UNJSPF rebalances the benchmarks at a monthly frequency. The OIM makes a monthly decision on portfolio rebalancing, taking market views into account.

Monthly benchmark and portfolio rebalancing limit portfolio deviations from the strategic benchmark. A lower frequency of benchmark rebalancing, for instance, annually, or of portfolio rebalancing, for instance, by using bandwidths or partial portfolio rebalancing, will result in portfolio drift and, therewith, higher expected return and risk. We advise UNJSPF to determine what sources of drift are acceptable for the UNJSPF.

If tactical allocation decisions are made, a wider bandwidth is required to have a significant impact. If not, a smaller bandwidth is more applicable to limit relative portfolio risk. We advise UNSJPF to use a wide bandwidth if tactical allocation decisions remain relevant.

Current bandwidths for equity, real assets and fixed income are not in proportion to each other: large bandwidth for equity is not matched by the much smaller bandwidths of the other asset classes. We advise bringing this into better proportion.

The increase of the bandwidths for fixed income is justified in view of the current levels of spreads/interest rates. We advise increasing the bandwidth for fixed income.

Based on the following assumptions:

- Risk management and attribution versus strategic allocation is important
- Bandwidths should allow both for drift and tactical allocation decisions
- Portfolio rebalancing should be efficient with an average risk contribution

We would suggest the following:

- Keep the monthly OIM meeting, but by default, rebalance less frequently than monthly
- Set bandwidths of 5-10% for equity and fixed income
- Rebalance the portfolio to halfway between the strategic allocation and the nearest limit
- Opportunity for OIM to make discretionary decisions

The combination of these suggestions would allow for the portfolio to naturally drift towards better-performing assets and would improve the expected return and risk. At the same time, the OIM can still make discretionary decisions regarding tactical asset allocation changes.

Our suggested bandwidths are summarized in the table below.

ALM 2023	2021 SAA	Proposal A			Proposal B			Delta bandwidths	
	100.0%	Minimum	100.0%	Maximum	Minimum	100.0%	Maximum	Minimum	Maximum
Equity and Private Assets	**69.0%**	**52.0%**	**60.0%**	**68.0%**	**58.0%**	**66.0%**	**74.0%**	8%	8%
Global Public Equities	53.0%	35.0%	43.0%	51.0%	38.0%	46.0%	54.0%	8%	8%
Developed Markets Equity	46.9%	27.0%	35.0%	43.0%	30.0%	38.0%	46.0%	8%	8%
Emerging Markets Equity	6.1%	4.0%	8.0%	12.0%	4.0%	8.0%	12.0%	4%	4%
Private Equity	7.0%	3.0%	7.0%	11.0%	5.0%	9.0%	13.0%	4%	4%
Real Assets	9.0%	5.0%	10.0%	15.0%	6.0%	11.0%	16.0%	5%	5%
Real Estate	8.0%	4.5%	8.5%	12.5%	4.0%	8.0%	12.0%	4%	4%
Infrastructure	1.0%	0.0%	1.5%	3.5%	0.0%	2.0%	4.0%	2.0%	2%
Timberland and Farmland	0.0%	0.0%	0.0%	2.0%	0.0%	1.0%	3.0%	1%	2%
Private Debt	0.0%	0.0%	0.0%	2.0%	0.0%	0.0%	2.0%	0%	2%
Fixed Income and Cash	**31.0%**	**32.0%**	**40.0%**	**48.0%**	**26.0%**	**34.0%**	**42.0%**	8%	8%
Fixed income	29.0%	31.0%	39.0%	47.0%	25.0%	33.0%	41.0%	8%	8%
US Core Bonds	28.0%	27.0%	35.0%	43.0%	20.5%	28.5%	36.5%	8%	8%
US Securitized	8.3%	7.0%	10.0%	13.0%	5.5%	8.5%	11.5%	3%	3%
US Treasuries	13.0%	11.0%	14.0%	17.0%	10.3%	13.3%	16.3%	3%	3%
US Corporates	5.9%	7.0%	10.0%	13.0%	3.0%	6.0%	9.0%	3%	3%
US Govt Related	0.8%	0.0%	1.0%	3.0%	0.0%	0.8%	2.8%	1%	2%
Non Core Bonds	1.0%	1.0%	4.0%	7.0%	1.5%	4.5%	7.5%	3%	3%
US High Yield	0.0%	0.0%	2.0%	4.0%	0.5%	2.5%	4.5%	2%	2%
EMD Local Currency	1.0%	0.0%	2.0%	4.0%	0.0%	2.0%	4.0%	2%	2%
Cash & Equivalents	2.0%	0.5%	1.0%	3.0%	0.5%	1.0%	3.0%	0.5%	2%

6.4. Portfolio benchmarks

Ortec Finance reviewed the current UNJSPF benchmarks and compared these to peers. We also make benchmark suggestions for the new asset classes. We recommend keeping the current benchmarks for the existing asset classes and adding the benchmarks highlighted in the table for the new asset classes (in bold).

ALM 2023	Benchmarks (Current All ESG, Custom)
Equity and Private Assets	
Global Public Equities	
Developed Markets Equity	MSCI North America/Europe/Pacific IMI All Cap
Emerging Markets Equity	MSCI Emerging Markets All Cap
Private Equity	MSCI ACWI IMI ESG Custom + 2%
Real Assets	
Real Estate	NCREIF Open End Diversified Core Equity (ODCE) (+2% for Non-core)
Infrastructure	US CPI + 4%
Timberland and Farmland	**NCREIF Timberland Index / NCREIF Farmland Index**
Private Debt	**Cliffwater Direct Lending Index (CDLI)**
Fixed Income and Cash	
Fixed income	
US Core Bonds	Bloomberg US Aggregate Bond Index (Proposal B)
US Securitized	Bloomberg US Securitized
US Treasuries	Bloomberg US Treasury
US Corporates	Bloomberg US Corporates
US Govt Related	Bloomberg US Government Related
Non Core Bonds	
US High Yield	**US High Yield: Bloomberg high yield index**
EMD Local Currency	Bloomberg EM local currency government
Cash & Equivalents	Bloomberg 1-3 month US Treasury

The current benchmarks the UNJSPF is employing are appropriate for their respective asset classes, and as such, an update or change is not required. One exception to this case is EMD

Local Currency, where we typically see a JP Morgan benchmark employed by peers of the UNJSPF. However, since the rest of the Fixed Income portfolio uses a Bloomberg benchmark, we recommend keeping the same to maintain consistency.

Indices are also available per asset class and, where relevant, regional. This allows for composite benchmarks at the highest level and no need for MSCI ACWI IMI or Bloomberg US Aggregate indices.

6.5. Currency strategy

Based on our quantitative analyses, it is worthwhile considering setting up the implementation capabilities to hedge developed market currency exposures. However, before any decision can be made, further analysis is necessary. The OIM should weigh the potential benefits (approx. 10 bps on the total portfolio) to the implementation costs and risks before making any recommendation to the UNJSPF. Furthermore, it should be considered that if a hedging strategy is implemented, the economic circumstances that dictate the cost of hedging should be actively monitored and weighed against the risks of open currency exposure. If the interest rate differential between countries changes, so does the cost of hedging.

Note that the quantitative analysis incorporated the currency exposure resulting from the Two-Track. Given the complexity of the Two-Track framework, hedging the latent currency exposure of the liabilities itself is difficult.

The UNJSPF also has exposure to emerging market currencies. Considering both the cost of hedging for emerging markets (given the interest rate differential to the US) and practical (implementation-related) hurdles, we would advise against hedging emerging market currency risk.

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