ORTEC FINANCE

Asset & Liability Management Study

United Nations Joint Staff Pension Fund

July 2019

Content

1. Introduction 4
   1.1. Summary of Engagement 4
   1.2. Objectives of ALM Study 4
2. Executive Summary 6
   2.1. Current Situation 6
   2.2. UNJSPF Objectives 6
   2.3. Main Observations and Recommendations 7
3. Approach and Modeling Assumptions 9
   3.1. Scenario Analysis Approach and Process 9
   3.2. Liability Modeling 9
      3.2.1. Projection Individual Participants 10
      3.2.2. Pension Scheme 11
      3.2.3. Two-Track benefit 12
      3.2.4. COLD Factor 13
      3.2.5. Implementation of the Two-Track 13
      3.2.6. Decrement assumptions 15
      3.2.7. Merit scale assumptions 16
      3.2.8. New members 16
      3.2.9. Actuarial valuation of the benefits 17
      3.2.9.1. General assumptions 17
      3.2.9.2. Accrued Liabilities (with and without pension adjustment) 17
      3.2.9.3. IAS 26 valuation (with and without pension adjustment) 17
      3.2.9.4. Open Group valuation 18
      3.2.10. Reconciliation 18
      3.2.11. Contribution 19
      3.2.12. Actuarial Asset Value 19
      3.2.13. Liability Projections 20
   3.3. Asset Modeling 23
      3.3.1. Economic Scenario Generation 23
      3.3.2. Modeling Asset Classes 27
      3.3.3. Economic Assumptions 29
      3.3.4. Current Strategic Asset Allocation (SAA 2015) 31
   3.4. Balance Sheet Modeling 32
      3.4.1. Initial Financial Situation 32
4. Results Asset & Liability Projections 34
   4.1. Scenario Analysis SAA 2015 34
   4.2. Results Projections Two-Track System 37
   4.3. Evaluation Criteria 41
   4.4. Investing more/less in Growth vs Non-growth assets 43

5. Optimized Strategic Asset Allocation 2019 46
5.1. Optimization Asset Allocation 46
5.2. Implementation approach SAA2019 52
6. Sensitivity Analyses 54
6.1. Liquidity analyses 54
6.2. Alternative Economic Assumptions 55
6.3. Alternative Growth Assumptions Active Population 56
6.4. Alternative Mortality Rates 60
6.5. Sequencing 64
6.6. Rebalancing 66
6.7. Currency exposure and Currency hedge 68
6.7.1. Currency exposure at the liability side 68
6.7.2. Currency exposure at the asset side 70
6.7.3. Currency exposure at the total balance sheet level 70
7. Benchmarks for performance measurement 73
7.1. Benchmark introduction 73
7.2. Types of benchmarks 73
7.3. Benchmarks for UNJSPF 75
8. Conclusions and Recommendations 76
8.1. Current and Recommended Strategic Asset Allocation 76
8.2. Liquidity 77
8.3. Two-Track system 77
9. Appendices 78
9.1. Benchmarks per region, asset type and benchmark method 78
9.1.1. Private Debt 78
9.1.2. Infrastructure 79
9.1.3. Real Estate 80
9.1.4. Private Equity 81
9.1.5. Hedge funds 82

1. Introduction

1.1. Summary of Engagement

In November 2018 Ortec Finance was engaged by United Nations to conduct an asset liability management study for the United Nations Joint Staff Pension Fund (UNJSPF).

Ortec Finance is an independent specialist in measuring and managing financial risk. We provide model solutions and consultancy services based on scientific proven technologies for asset liability management, asset allocation, risk management and performance measurement and attribution. Our purpose is to enable people to manage the complexity of investment decisions.

Our globally experienced team consists of technical experts, actuaries and investment specialists.

It is prescribed in the statement of work that an ALM study should be carried out using stochastic projections of UNJSPF's assets and liabilities. The ALM study has to assess the impact of key economic and financial risk factors on the long-term financial condition and provide an analysis of the adequacy of the Fund's contribution rate. In addition the current long-term asset allocation strategies should be reviewed and, if deemed appropriate, alternative strategic asset allocations proposed, including the identification of suitable new asset classes for the UNJSPF investment portfolio in a global context.

We have conducted the ALM study in close cooperation with a UN-ALM working group consisting of people from both the UNJSPF (actuaries) and the Office of Investment Management (OIM). Their assistance in gathering the required data, assumptions, information, etc. and their feedback on preliminary results was of great help for us in conducting this ALM study.

1.2. Objectives of ALM Study

The main objectives of the ALM study are threefold:

- Match the Funds liability projections prepared by Fund's consulting actuary (31/12/2017)
- Conduct a thorough risk analysis of the Fund
- Evaluate current long-term investment strategy and advise on improving the investment strategy

To achieve these objectives we have configured a customized version of our stochastic ALM Software package GLASS. Most of the tailoring was for the benefit of modeling specific liability projections for the Fund based on the individual participants file, applying actuarial assumptions and modeling the specifics of the pension scheme, including the Two-Track system. This enabled us to reconcile the actuarial liability calculations with the official 31/12/2017 valuation by the Fund's actuary.

With the customized version of GLASS we can generate stochastic projections of the liabilities and assets for various time horizons. As part of this ALM study we will conduct a thorough risk analysis of the Fund which will include the following:

- Analysis of current and future states of the plan, including funded status and the required contribution rate
- Take into account major risk factors including market risk, inflation risk, currency risk and demographic risks
- Analysis of liquidity risk based on projected cash flows

- Assess the liability characteristics and projected behavior of the (effective) cost of the Two-Track system
- Sensitivity analysis regarding economic assumptions, mortality assumptions and assumptions with respect to future growth of active population
- Sequencing analysis

Based on the analysis defined above we will evaluate the current long term investment strategy and recommend efficiency improvements of the investment strategy based a risk vs return trade-off in an ALM environment (relative to the liabilities). The expected return should be sufficient to support the desired level of funding and contribution. The level of risk should be appropriate given the risk tolerance level of UNJSPF.

In addition we will analyze potential currency hedging strategies if deemed appropriate to the Fund. We will also identify suitable (sub) asset classes which might further optimize the investment strategy.

2. Executive Summary

2.1. Current Situation

The plan's current annual contribution rate is 23.7% of annual pensionable remuneration. This contribution rate is already in place since the nineties in the previous century. Based on the December 31, 2017 actuarial valuation results, 23,75% of the net present value of future annual pensionable remuneration was required to fully fund the pension plan over the infinite term, based on actuary's assumption of a 6.0% expected return on assets and an expected inflation rate of 2.5%, among other assumptions.

The present value of all future benefits payable by the plan is $146.0 billion. The value of plan assets plus present value of future expected contributions is $145.8 billion, based on assumed annual contribution rate of 23.7% of pensionable remuneration. This represents an expected shortfall of $0.2 billion. The actuary has determined that a 23,75% contribution rate is required to keep the pension fund in balance (i.e. present value of assets plus contributions would be equal to $146.0 billion): the required contribution rate.

The present value of accrued benefits (past benefits only) is $58.8 billion, versus an actuarial value of assets of $60.4 billion. Therefore, on a present value of accrued benefits basis, the plan is 102.7% funded.

Based on applied assumptions the projected expected shortfall slightly decreases to $0.1 billion on an Open group valuation basis by the end of 2018, which implies a required contribution rate of 23,73% needed to fully fund the plan. The actuarial calculations and liability projections in this ALM study including the two-track load were reconciled with the actuarial report and the actuarial consultant.

2.2. UNJSPF Objectives

The UNJSPF desires to fully fund the long-term pension obligation over the long-term. The primary objective is to ensure that all long-term pension obligations are covered by pension assets.

The pension obligations will ultimately be covered by a mix of funding and investment returns. In this way, the funding and investment strategies are linked. Lower investment returns would lead to higher required funding, and vice versa.

The plan's current annual contribution rate is 23.7% of annual pension remuneration. The UNJSPF needs to take investment risk to achieve investment returns sufficient to support the desired level of annual pension funding. However, the UNJSPF must exercise caution to not take too much risk in order to achieve desired investment result.

The plan has defined a 2% corridor around the current contribution rate of 23.7% implying a maximum level of 25.7% for the required contribution rate. The main risk for the fund is that the financial situation would result in a required contribution rate higher than 25.7%.

Finally, the UNJSPF should invest in an asset-liability efficient manner. In a risk/reward context, we have optimized the expected investment return per unit of funded status (i.e., asset-liability) risk via an asset-liability efficient frontier analysis. In order to optimize the asset-liability efficiency of the pension fund, we have considered the pension liability structure when structuring the alternative pension investment portfolios. Portfolios from this asset-liability efficient frontier were then studied further using a stochastic asset-liability projection analysis and evaluated on expected required contribution rate and the

probability that the required contribution rate is lower than 25.7% as main return and risk measures.

2.3. Main Observations and Recommendations

The projection of the average funded ratio looks solid for the fund. In the long run the fund is able to earn on average (more than) sufficient asset returns in relation to the liabilities. Nevertheless the uncertainty increases over time resulting in a considerable high probability of over- and underfunding and corresponding low and high required contribution rates. The probability that the resulting Required Contribution Rate falls outside the corridor is significant. Especially on the lower end, but there is also a good chance that the required contribution rate will end up higher than 25.7% during the next 10 years.

The projections of the liability cash flows (incoming contributions and outgoing benefit payments) show that the net liability cash flow is negative (-350 million. USD) at the start (end 2018) and the liability cash flow deficit is expected to increase over time (-1.1 billion USD after 10 years) due to maturing of the fund. However, the generated cash flows from the assets are more than sufficient to cover the net liability cash flow deficit. During the first 10 years the probability of liquidity issues is negligible.

The future cost of the Two-Track system is highly depending on the exchange rate changes, i.e. if the USD becomes worth less compared to especially the Euro and the Swiss franc. The projections show that these future costs are very volatile and can become quite high.

We recommend a moderate change in the strategic asset allocation as is indicated in below table.

	SAA 2015	SAA 2019
Total assets	**100%**	**100%**
Growth Assets	**72%**	**70%**
Public Equity	58%	45%
Private Equity	5%	9%
Real Estate	9%	12%
Real Assets	0%	4%
Non-Growth Assets	**28%**	**30%**
Fixed income	26.5%	29%
Cash	1.5%	1%

Compared to the old SAA2015 the new SAA2019 consists of a slightly higher allocation to Fixed Income (30% instead of 28%) and higher allocations to private equity and real estate at the cost of a lower allocation to public equities. This shift results in a more efficient portfolio due to better diversification and fits also well with the long-term investment horizon of the Fund.

The new SAA2019 results in lower risk, i.e. the probability of the required contribution rate being smaller than 25.7% is higher. This improvement also holds for other risk and return measures.

To further improve the strategic investment portfolio we also recommend slightly higher allocations to absolute return strategies, infrastructure, timber- agriculture and farmland and US private debt. This will further improve the risk/return profile. These changes also ensures that the strategic asset allocation will be more diversified and robust. The

suggested changes are also in line with what can be observed the last few years at other large pension plans around the globe.

This recommendation depends on the willingness of the fund to take risk (risk tolerance level), which is assumed to be investing 70% in growth (equity-type) assets, which is supported by the ALM analyses.

The intention of the OIM is to implement the new SAA2019 gradually in 4 years' time:

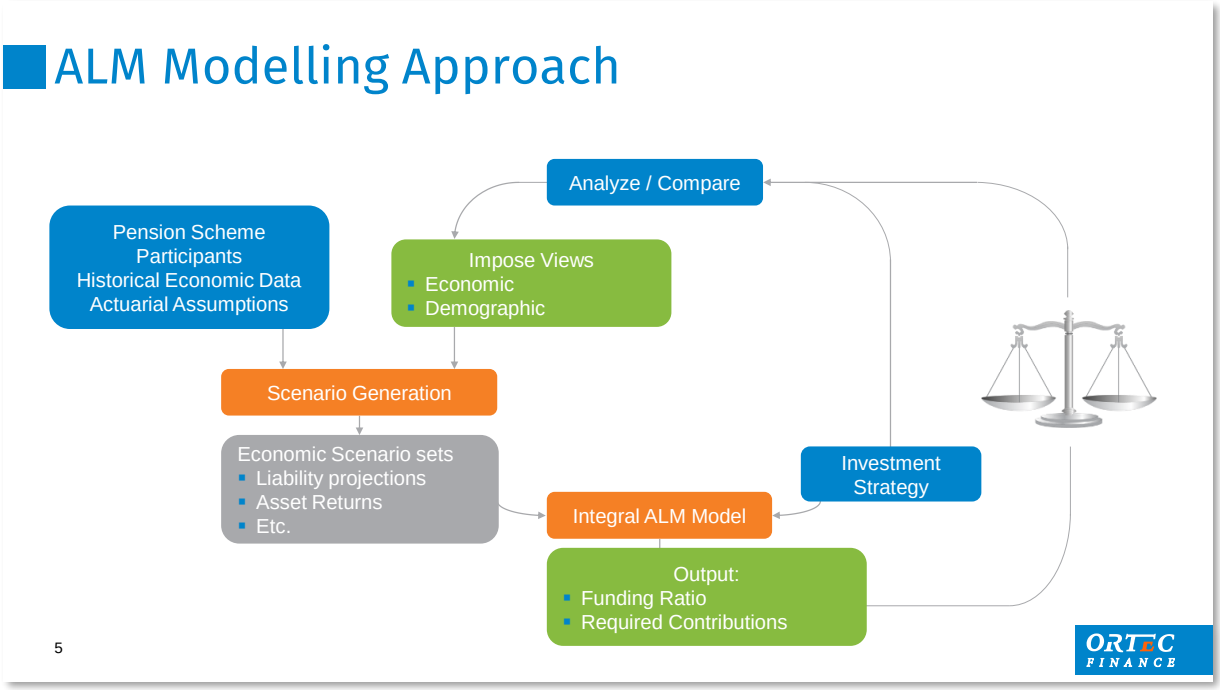
- Applying a glide path approach to get it implemented in reasonable steps
- The Policy benchmark will take this gradual expansion in Private Assets into account.
- All non-implemented Private assets allocations will be temporarily assigned to SAA Public Equity on a quarterly basis to measure the risk and performance of the Fund vs. the policy benchmark correctly, until the target weight in private markets is achieved.

Although the new strategic asset allocation will result in a lower probability that the required contribution rate will be higher than 25.7%, there is still a good chance that this will happen in the next 10 years. We therefore recommend the fund to already analyze and discuss possible policy measures in case this situation arises.

3. Approach and Modeling Assumptions

3.1. Scenario Analysis Approach and Process

Our ALM modeling is based on a stochastic scenario approach to generate future financial projections of the assets and liabilities of a pension plan based on scenario analysis. The quintessence of scenario analysis is that the most relevant economic risk factors (i.e. inflations, yield curves, credit spreads and excess returns, currencies, risk premiums of asset classes etc.) are modeled by a set of possible plausible future developments, referred to as scenarios. These scenarios are generated by a sophisticated economic dynamic scenario generator (please refer to 3.3.1 for more details) and are integrated in an asset / liability framework. This framework ensures a fully consistent modeling of future assets and liabilities projections including interactions between the assets and liabilities including the contribution policy. In this way projections of future P&L's and Balance Sheets of the Fund can be obtained. Defining the appropriate risk and return measures allows us to evaluate, compare and optimize different investment strategies to optimize the financial objectives of the Fund within the appropriate risk levels given the risk appetite of the Fund.



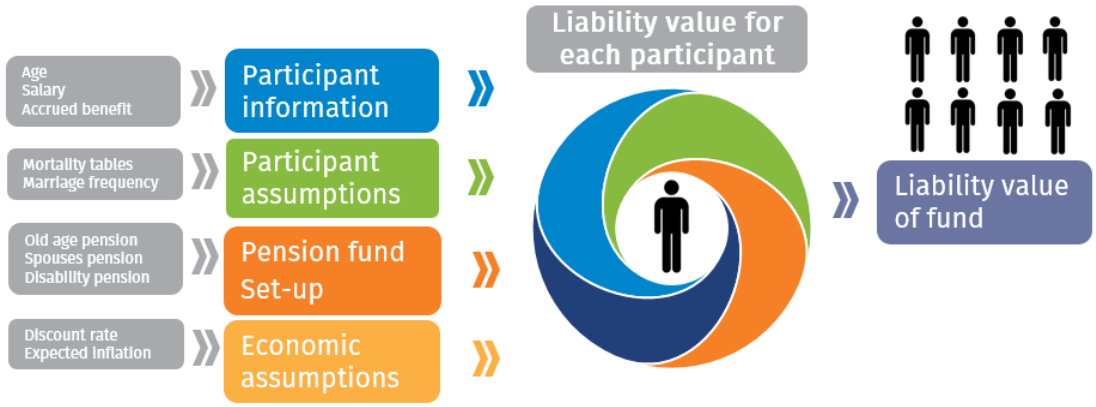
Please note that modeling of the assets is further explained in 3.3 and in 3.2 where we elaborate on the liability modeling.

3.2. Liability Modeling

The liabilities are modelled in line with the latest Actuarial valuation, based on liability replication of underlying membership data allowing for various valuation methods to be applied or actuarial sensitivities to be performed. 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

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 illustrated:



The Actuarial Pension Module is highly flexible to estimate future developments of participants, salaries, benefits and the liabilities. The initial objective of this module was the generation of the liabilities to be used in the ALM study. Over time, however, the module has developed into a complete liabilities prognosis system, which can also be used for contribution calculations, prognosis 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. The relevant information of the current and future members (if so desired), together with forward-looking information on the development of the plan, such as salary policies and specific plan rules, are modelled to build a sound and detailed basis for the liability analysis. On the basis of the life cycles generated in the prognosis, combined with the pension plan rules as defined in the UNJSPF pension scheme, the actuarial amounts (benefits, service costs, liabilities, benefit payments, lump sum etc.) of the various benefit forms are calculated. Different actuarial valuation methods (such as PUC, Buy-out and Present Value) and different valuation parameters (such as discounting with fixed rate or floating term structure, deterministic or stochastic ex-ante inflation, un-inflated or inflated) can be applied. All kind of options for the members are included like early retirement options and lump sum options.

In the next paragraphs we provide an overview of the assumptions used in the modelling of the UN pension fund (UNJSPF). The UN pension fund captures the pension benefits of about 200.000 members (actives and non-actives) and all future active members.

3.2.1. Projection Individual Participants

The plan provided us with the member data. We received an excel file with all active members and a file with non-active members. We also received a file with information on the country of residence and the separation year which is required for the Two-Track.

The data in the file contains date of birth, status, historical payrolls, service years, benefits (a.o. USD track, Local Track, Base amount), Two-Track enrolled, etc. All the information was uploaded in the GLASS application and the resulting information was tested. Below is an overview of the mismatches compared with the annual report.

NUMBERS				
		ORTEC	Actuarial report	Difference
	Actives Professional staff	53,350	53,350	0.00%
	Actives General service staff	63,635	63,635	0.00%
	Disabled	1,583	1,583	0.00%
	Deferred	33,705	33,705	0.00%
	Retirees	29,122	29,122	0.00%
	Spouses	23,396	12,731	83.77%
	Children	0	10,630	-100.00%
REMUNERATION (* bln)		ORTEC	Actuarial report	Difference
	Actives Professional staff	7.33	7.33	0.00%
	Actives General service staff	3.13	3.13	0.01%
BENEFITS (*mio)		ORTEC	Actuarial report	Difference
	Disabled	77.48	77.48	0.00%
	Deferred	858.02	858.02	0.00%
	Retirees	1,233.37	1,233.37	0.00%
	Spouses	252.95	252.95	0.00%
	Children	0.00	32.77	-100.00%

In the model we did not explicitly modelled the Child benefits and liabilities.

3.2.2. Pension Scheme

The plan is a defined benefit plan. During their active career members accrue benefits. After retirement the benefits will be paid out as long as the member lives. In case of death a spouse and child pension is available. In case of disability a disability pension will be paid.

The plan is split in 3 sections; members entitled to a Normal retirement age of 60 (NRA60), a Normal retirement age of 62 (NRA62) and a Normal retirement age of 65 (NRA65). For all current members is known which NRA is applicable to them. All future members will flow in the NRA 65.

Accrual of benefits

For each year of service the active member accrues benefit. This is based on the average of the best 3 year payrolls over the last 5 years. In the GLASS application we assumed that it is the 3-year average.

The accrual rates are show in the table below

Service years	Annual accrual rate
0-5	1.5%
5-10	1.75%
10-35	2.0%
35+	1.0%

There is a total maximum accrual rate of 70%.

The spouse benefit is 50% of the old age benefit expected to be accrued at the normal retirement age. The disability benefit is 100% of the old age benefit expected to be accrued at the normal retirement age.

Early retirement benefits

It is possible to retire before the normal retirement age. If a member opts for that, their benefit will be reduced to compensate for the fact that the payments will start earlier than anticipated. The following conditions apply for the NRA60 and NRA62 members. Depending on the number of service years the reduction rate per year earlier is 6%, 3% in case of more than 25 service years and 1% in case of more than 30 service years.

For members in the NRA 65 section the conditions are 6% and in case of more than 25 years of service 4% per year earlier.

Resignation

In case a member resigns within 5 years of service, the member will lose his/her benefits in the scheme. The member will get his/her share in the contribution (7.9% of payroll) plus interest rate back.

In case the member has between 5 and 10 years of service, the member can opt to stay in the plan or withdraw his/her share of the contributions plus interest plus a bonus. This bonus is 20% additional for each year of service above 5. In the GLASS model we assumed that members who resign within the 5-10 service year window will they leave their benefits in the scheme.

Lump sum

At retirement a member converts part of his/her benefits in a lump sum. The actuary assumes in his valuations that 19% will be converted. In our model we have assumed the same number.

The value of the lump sum is based on a service years weighted valuation. The valuations are based on the past assumptions for mortality and nominal discount rate. In all past lump sum valuation assumptions the mortality improvement and revaluations assumptions were not applied. In the GLASS model we assume that the lump sum value is determined on a fixed discount rate of 6% and the base mortality table without improvements and no expected inflation is applied.

3.2.3. Two-Track benefit

After leaving the Active status a member can opt for the Two-Track. The ambition of the Two-Track is to protect the benefits of a member living in a non-USD country for inflation and exchange rate risk. A member can only opt-in on the Two-Track. It is not possible to revert to the single (USD) track.

At separation 3 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 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. It is then converted to the Local currency by multiplying it with the 36 month average exchange rate between the local currency and the USD currency. For Professional

staff members the benefit is increased with the COLD factor. This Cost of Living Differential (COLD) takes into account the price differential between the country at hand and New York. The calculation is specified in the next paragraph. This local benefit (including the 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 is applied.

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 larger than LT - Pay Base US
      ii) Is Base US Amount smaller than 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

Every quarter these rules are executed to determine the amounts to be paid to the member.

3.2.4. COLD Factor

As described the COLD factor is applied to the Local Track benefit for Professional Staff. It is a compensation for the cost of living difference between the country and the New York price level.

On a monthly basis the cost of living in New York is determined and at the same time in all countries in the world. The cost of living in the non-US countries is expressed in USD terms. Based on these cost of living level a transformation is made to Classes. Then on a 36 month basis the class differentials of each month are determined. Negative ones are floored to 0. Next step is to determine the average of these 36 month observations. Then this average class differential is converted back to a COLD factor.

A detailed description can be found in "General Procedure #2011-77" called "Cost of Living Differential for Professional staff and higher Categories".

3.2.5. Implementation of the Two-Track

For the Non-Active members the 3 base ingredients (USD track, Base Amount and Local Track) are known. Furthermore the country of residence and the separation year is known. For the active members no information is available.

To model the Two-Track correctly the exchange rate and local price inflation in the economic scenario generator are required. Modelling all countries is too complicated because of this. Therefore we need to make a selection of a few countries.

Looking at the Non-Active members we can learn that the distribution over the different countries is as follows:

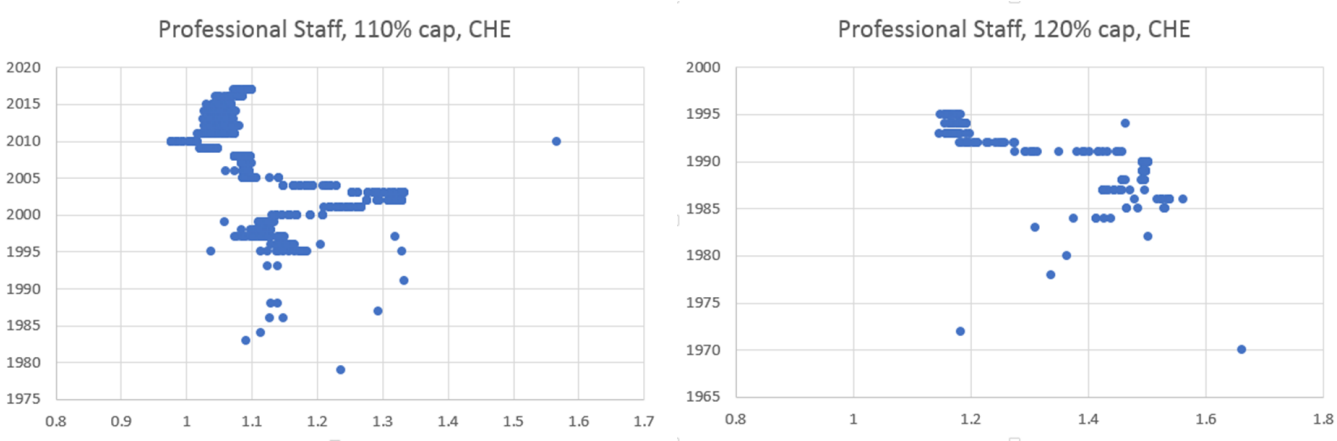
country	weight
USA	61.8%
CHE	11.3%
FRA	8.6%
AUT	4.2%
ITA	4.0%
GBR	1.5%
ESP	1.1%
CAN	0.8%
DEU	0.7%
Other	6.1%

Based on this information we focused for the Two-Track on the Euro zone, Switzerland, United Kingdom, Canada and Japan. With these countries we capture 90% of the Two-Track participation in benefit weighted terms.

In our model we calculate all members on an individual basis and group them on same indexation properties. This works fine for regular plans. But in this case we need to apply additional filtering to make sure the members in the sub-sub groups can be aggregated. In case of the Two-Track we need to filter with respect to the following elements:

- Separation year
- Currency area (Euro, CH, GBP, CAD and JPY)
- Applicable cap (either 120% or 110%)
- General staff or Professional staff (Due to the applicable COLD factor)

To check the validity of this assumption we analyzed the non-active data.

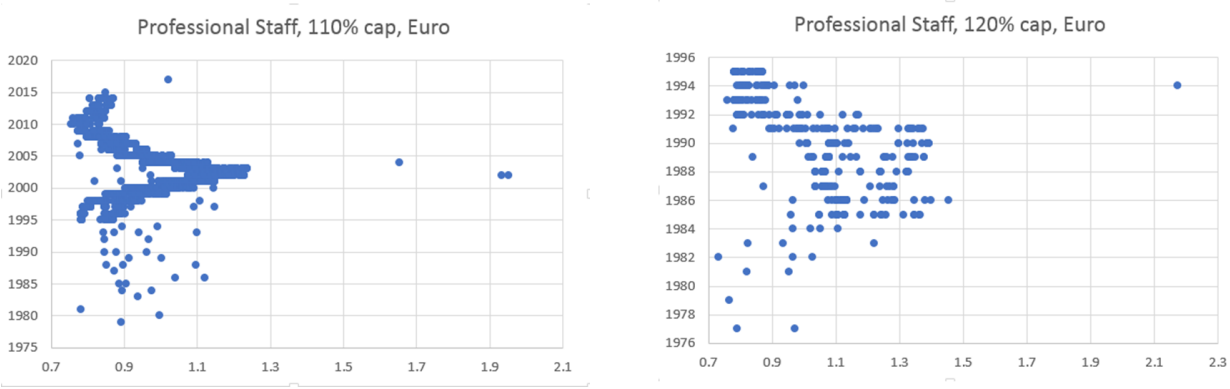


The scatter plots above show the ratio Local Track benefit expressed in USD divided by the USD Track benefit for Switzerland. The left hand graph is for the 110% cap professional members and the right hand graph shows it for the 120% cap participants.

Based on theory one would assume that in a specific separation year all members would have the same ratio, because, as of that separation moment, the Local Track and USD Track got inflated with local CPI and, in this case, with a one off COLD factor on the Local Track. One can see that there is some small dispersion within the separation year. We assume this is caused due to moving exchange rates and as well for the COLD factor. There are also some outliers visible. We understood from the UN plan that these are known and have been checked.

Overall we can conclude that the theory holds for the Swiss area.

In the next graph the situation for the EURO zone is shown. For the 110% CAP members we can see that the theory holds. The ratios within a separation year are very close to each other. For the 120% Cap members this is different. This is related to the fact that the separation years are before the introduction of the EURO. Currencies and inflations were not yet aligned. Therefore the dispersion within a separation year is larger. For more detailed results the Eurozone can be split in the individual countries. In that case the clusters per separation year are expected to be more compact.



For the other countries we found similar results as the Swiss case. Note that the other countries have less members and consequently less members per separation year. In the aggregation this leads automatically to a lower error margin.

For the future members on the Two-Track (all current actives and future actives who separate from the active status in a later year) we will not observe this issue in our model. We assume that the separation is always at the beginning of the year and hence they will face similar economic circumstances.

In the model we assume that a member who separates from the fund will make a random transit to a currency zone. Because we focus on 6 countries only and neglect the others we rescaled the probabilities.

We assume that 61.8% will remain in the USA. The other 39.8% will transit to one of the other 5 countries where we assume the same relative distribution as observed in the Non-Active data.

3.2.6. Decrement assumptions

We apply a so called Markov push and pull process to simulate the current population into the future. This is a random process just like in daily life. Note that for all valuation purposes we apply the decrements in a non-random approach.

Mortality

We apply the base mortality table with 20 year of mortality improvement. For (former) disabled members we apply a separate mortality rate table. Both are in line with the assumptions applied in the Actuarial valuation report.

Disability

We apply the disability probability table used in the Actuarial valuation report for General staff. This table specifies per age and per gender the probability of disability.

Resignation

The resignation probabilities applied in the actuarial valuation report are also taken into account in the GLASS model. The rates are specified per age, Staff type (Professional or General staff), gender and service years. The resignation rates are high for the first years (about 22% for 1 service year, 13% for 2 service years, etc.). If a person resigns with less than 5 years of service, the person will leave with his share of the contributions paid increased with interest. Members who leave with more than 5 years of service will keep their benefits in the plan.

Retirement

All retirement probabilities as applied in the valuation report are taken into account. The retirement rates are specified per NRA, Staff type, Gender, Age and Service years. This results in 12 different matrices (age X service years).

Marriage

For all current participants we import their marital status. For all non-married members we assume that they will marry up to age 40 with a probability of 10%

3.2.7. Merit scale assumptions

The payroll of the members will be increased each year. In the model we distinguish a structural growth component and an individual one. The structural growth is linked to wage inflation and will be stochastically driven by the economic scenario generator. The individual component is an age dependent rate.

In the actuarial valuation a combined increase rate per age and per Staff type (General or Professional) is specified. As discussed, in the GLASS model we split this into the two components. We assumed a structural growth of 3.5% and the remainder is assumed to be individual.

3.2.8. New members

When active members leave active service they will be replaced. For this process also model parameters are required. They will be described in this paragraph.

Number of Actives

The total number of actives is assumed to grow with 0.5% for the first 10 years. After that it is assumed to be constant. This is the same assumption as in the actuarial valuation report.

Age distribution

We applied the same assumptions as in the actuarial valuation report. There some sample members are defined at age 20, 25, ...,60, each with its own probability. This is specified per Gender and Staff type.

Gender distribution

We applied the same assumptions as in the actuarial valuation report. Per Staff type the gender distribution is specified.

Start Salary

We applied the same assumptions as in the actuarial valuation report. Per Age, Gender and Staff type the annual payroll of the new members is specified.

3.2.9. Actuarial valuation of the benefits

In this section the different valuation methods and their parameters are described. In the ALM analyses we only focused on the Open Group valuation as that is the principal valuation method applied within the plan. Only from that valuation method the required contribution rate can be determined.

3.2.9.1. General assumptions

The assumptions described in this paragraph are applicable to all valuations described in the next paragraphs.

For most valuation methods information is required regarding mortality, disability, resignation, etc. All these assumptions are assumed to be equal to the ones specified in the Decrement paragraph in this chapter.

All valuations are based on the USD-track of each member. In case the member is on the Two-Track, a much higher value of the local track is neglected.

The costs of the Two-Track are taken into account by means of a loading on the liabilities. The costs of the Two-Track are expected to be 2.1% of the net present value of the total payroll or all current members and also future members. 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 1.7% for Non-Actives. For Actives and future Actives the load is assumed to be 6.8%. In case of the Open group valuation the value of the loads is by definition equal to the 2.1% of the NPV of Payroll.

The loads of 1.7% and 6.8% are applied to the other valuations as well.

In the valuation the assumed general wage increases on payroll are assumed to be 3.5%. Increases on benefits for non-actives are assumed to be 2.5%. The only exception is benefits from deferred members until the age of 55. These benefits do not increase with inflation.

The discount rate is assumed to be 6.0%.

3.2.9.2. Accrued Liabilities (with and without pension adjustment)

This valuation only takes current accrued benefits into account, i.e. the current USD Track benefit. This is multiplied with the actuarial factor which is based on mortality rates, marriage frequency, inflation and discount rate.

On top of that the loading of 1.7% resp. 6.8% is applied in case of “with pension adjustment”.

3.2.9.3. IAS 26 valuation (with and without pension adjustment)

The methodology for the IAS 26 valuation is based on the Projected Unit Credit methodology. The Active members are projected into the future and based on the probabilities of (early) retirement, disability, resignation, mortality the actuarial costs at all the exit points is determined. Next step is to prorate these costs to past and future. In these valuation the non-linear accrual, merit scale, wage inflation, early retirement benefit reduction, lump sum conversion, etc. are taken into account in today’s liabilities.

In the model we calculate this on a member by member basis and in each simulation year the explicit valuation is done again based on the then current circumstances of the member.

For non-active members the valuation is based on an equivalent basis as the Accrued Liability valuation.

At the end the loadings for the Two-Track are applied (1.7% for non-actives and 6.8% for Active members) in case of the " with pension adjustment"

3.2.9.4. Open Group valuation

The open group is also based on a projection of the active members. It is based on similar techniques as the Pension Unit Credit method, but in this case no proration is applied. Instead the expected contributions are determined. This is based on the probability of being active in the projection period multiplied with the inflated payroll.

In the open group method the expected losses and contributions of future members are taken into account. In the valuation of the then current members in a certain simulation year the expected number of actives in the future projection years can be determined. The required number of active members in the future are known (0.5% growth for the next 10 years, after that flat). Based on the ambition number of actives and the expected number of actives of the valuation of the current actives, the number of new hires for the next projection year can be determined. Because these new hires are also with a certain probability active in later years, the number of new hires in the second projection year is based on the expected actives in the projection year due the current actives and the expected new hires in the previous projection year. This iteration continues until infinity.

The characteristics of the new hires is based on the parameters described in the "new members paragraph in this chapter"

The open group assumes inflow of future members into infinity. One can prove that value of the liability of all future members does not increase to infinity, but has limited value. The discounter of 6% per annum is stronger in pushing the liability of a person who enters in infinity to zero.

In the actuarial report the actuary assumes 30 years of inflow and then determines the limit value of all remainder inflows based on a standardized inflow profile. In the GLASS model we simulate 70 years of inflow and assumes that the remainder term is close to 0.

For the contribution rate we assume 23.34%. It is assumed that the difference between the actual paid contribution rate of 23.7% and 23.34% is spent on costs.

3.2.10. Reconciliation

One important test is the reconciliation of the liability values. This is done by comparing the liability valuation calculated by the Ortec GLASS system with the Actuarial valuation report of December 2017. The table below shows the details of this comparison.

OPEN GROUP LIABILITIES (*bln)		ORTEC	Actuarial report	Difference
	Current Actives	53.54	53.81	-0.5%
	Current Non actives	35.70	35.34	1.0%
	Future actives	58.54	56.91	2.9%
	Current exp contributions	-22.51	-22.93	-1.8%
	Future exp contributions	-62.50	-62.52	0.0%

IAS LIABILITIEs WITHOUT (*bln)		ORTEC	Actuarial report	Difference
	Retirees and spouses	26.932	25.901	1.1%
	vested terminated participants		0.742	
	Active participants	14.792	14.040	-1.1%
	Non-vested benefits		0.921	
	TOTAL	41.724	41.604	0.3%

IAS LIABILITIES WITH (*bln)		ORTEC	Actuarial report	Difference
	Retirees and spouses	35.698	34.057	1.0%
	vested terminated participants		1.278	
	Active participants	21.801	19.277	6.6%
	Non-vested benefits		1.165	
	TOTAL	57.499	55.777	3.1%

ACCRUED LIABILITIES WITHOUT (*bln		ORTEC	Actuarial report	Difference
	TOTAL	41.854	43.394	-3.5%

ACCRUED LIABILITIES WITH (*bln)		ORTEC	Actuarial report	Difference
	TOTAL	59.781	58.836	1.6%

Note that in the study we expressed all results in terms of Open group valuation elements.

We consider this a good reconciliation and in accordance with the professional standards and more than sufficient for the purpose of conducting an ALM study.

3.2.11. Contribution

The actual contribution paid is 23.7% annually. After costs of the scheme, it is assumed that 23.34% will flow into the assets of the plan.

Of the 23.7% 7.9% is paid by the employees and the remainder is paid by the employer.

3.2.12. Actuarial Asset Value

The Actuarial asset value listed on the main balance sheet of the fund. This actuarial value of assets is roughly a 5-year smoothed value of the Market value of assets. In the model we follow the new rules introduced in 2013. These are:

Actuarial Asset Value(t) = Market value of Assets(t) - 80%*E(t-1) - 60%*E(t-2) - 40%*E(t-3) - 20%*E(t-4).

E(t) represents the Gain or Losses at the asset side compared to the Long term investment assumption in the plan. This Long term assumption is assumed to be 6%.

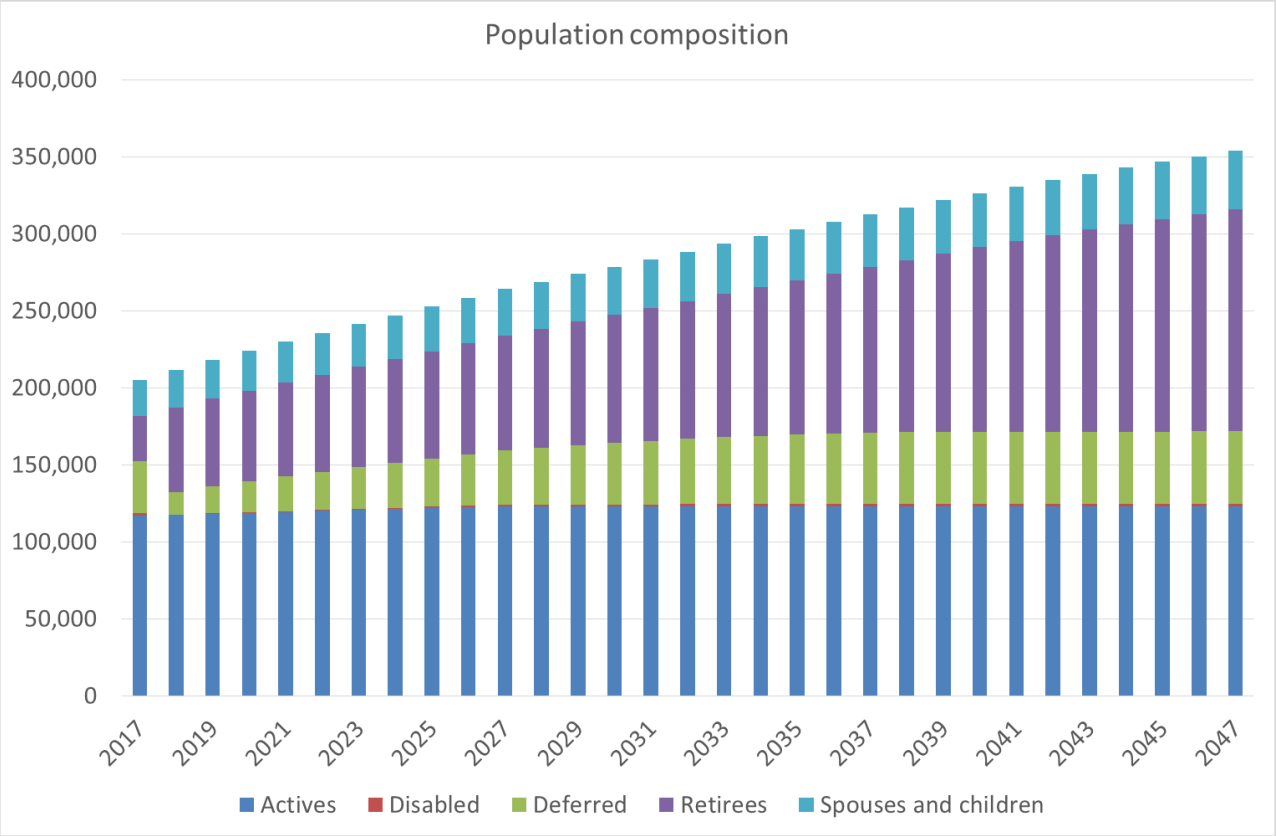
The Actuarial Asset value can deviate maximum 15% to the up- and downside of the actual market value of assets.

3.2.13. Liability Projections

In this paragraph the results are shown for the liability projections. To generate the results we assume the following inflation assumptions:

Price inflation	2.5%
Wage inflation	3.5%
Discount rate	6.0%

In the chart below the development of the population is shown.

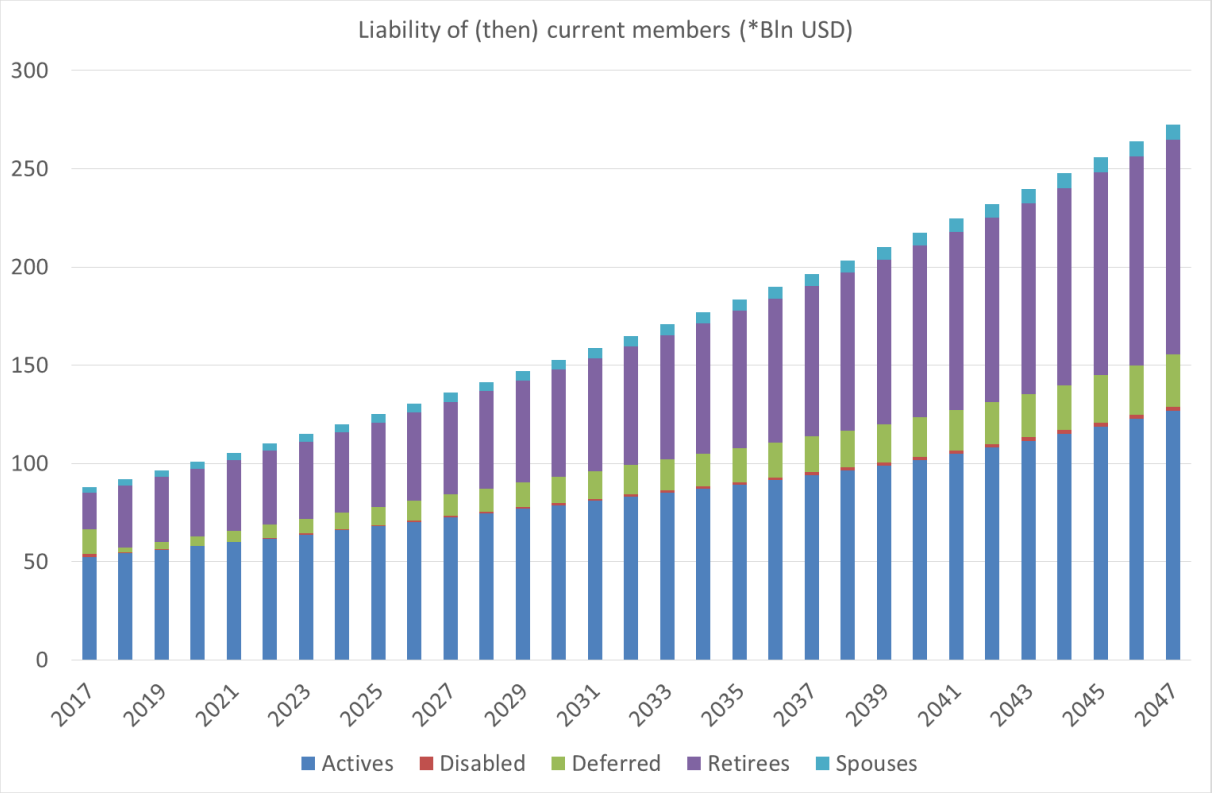


In the participant file a lot of deferred benefits are present. Because these members have an age higher than the retirement age, many of them will convert immediately in the next year to the retiree status. The number of retirees increases in 2018.

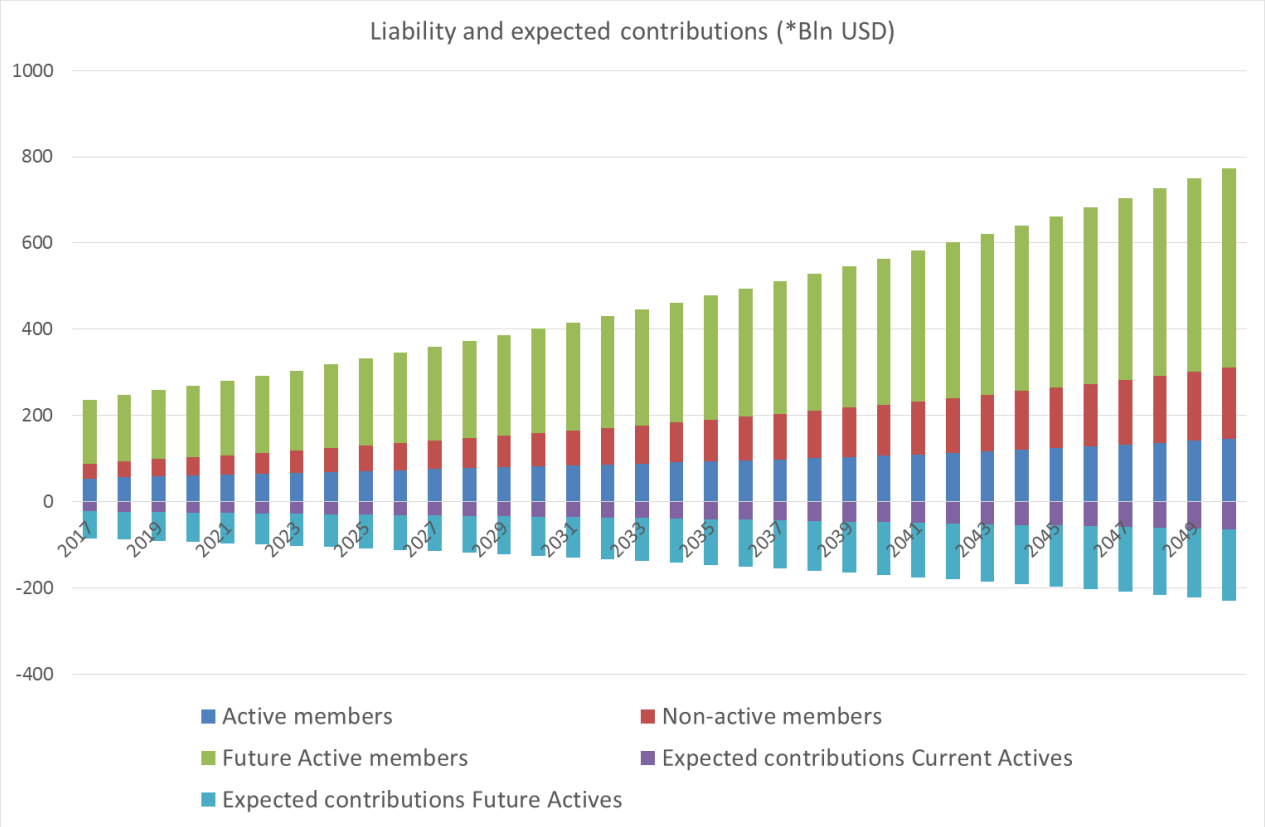
Difficult to see in the chart, but the active population will grow with 0.5% annually for the first 10 years. After that it will remain constant.

The number of retirees will grow rapidly. This is due to the fund getting more mature in the future.

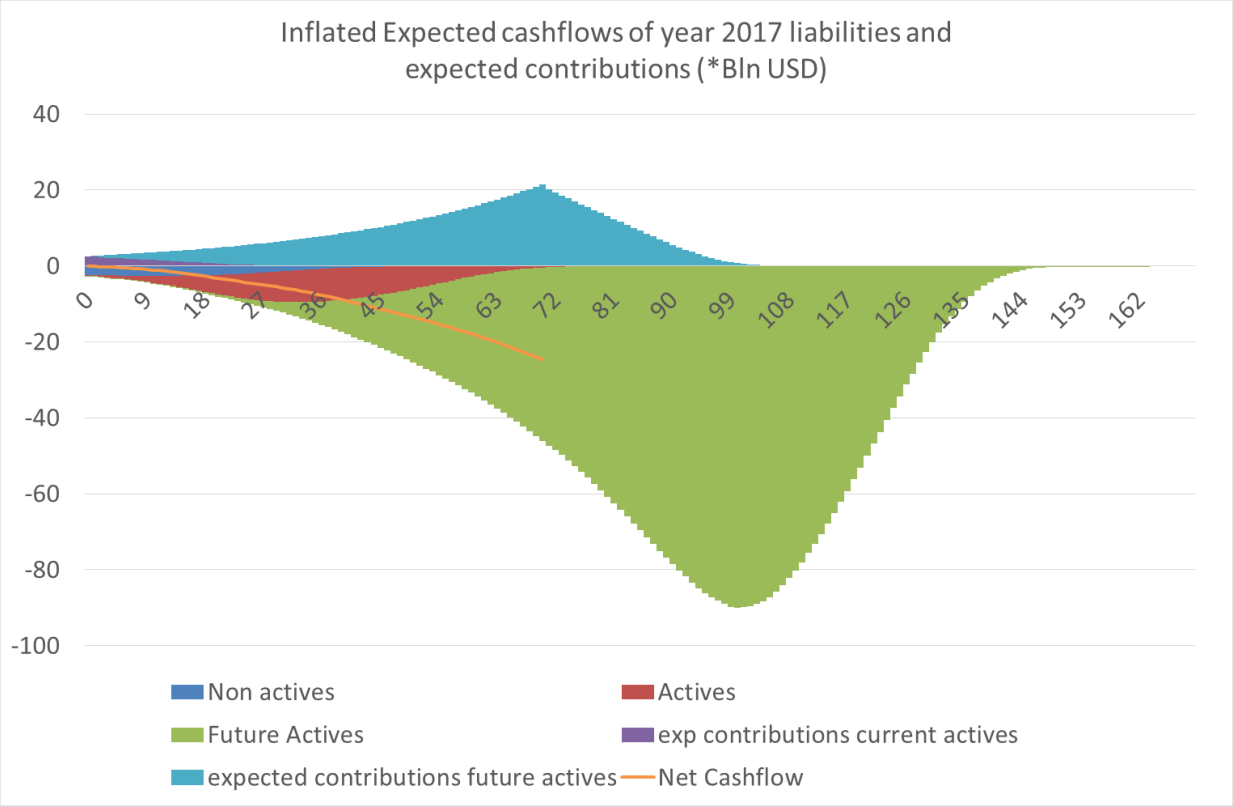
In the chart below the liability development based on Open Group valuation method for the actual members in future years is shown per member category.



In the chart below the development of the liabilities and expected contributions is shown on an Open Group valuation basis.

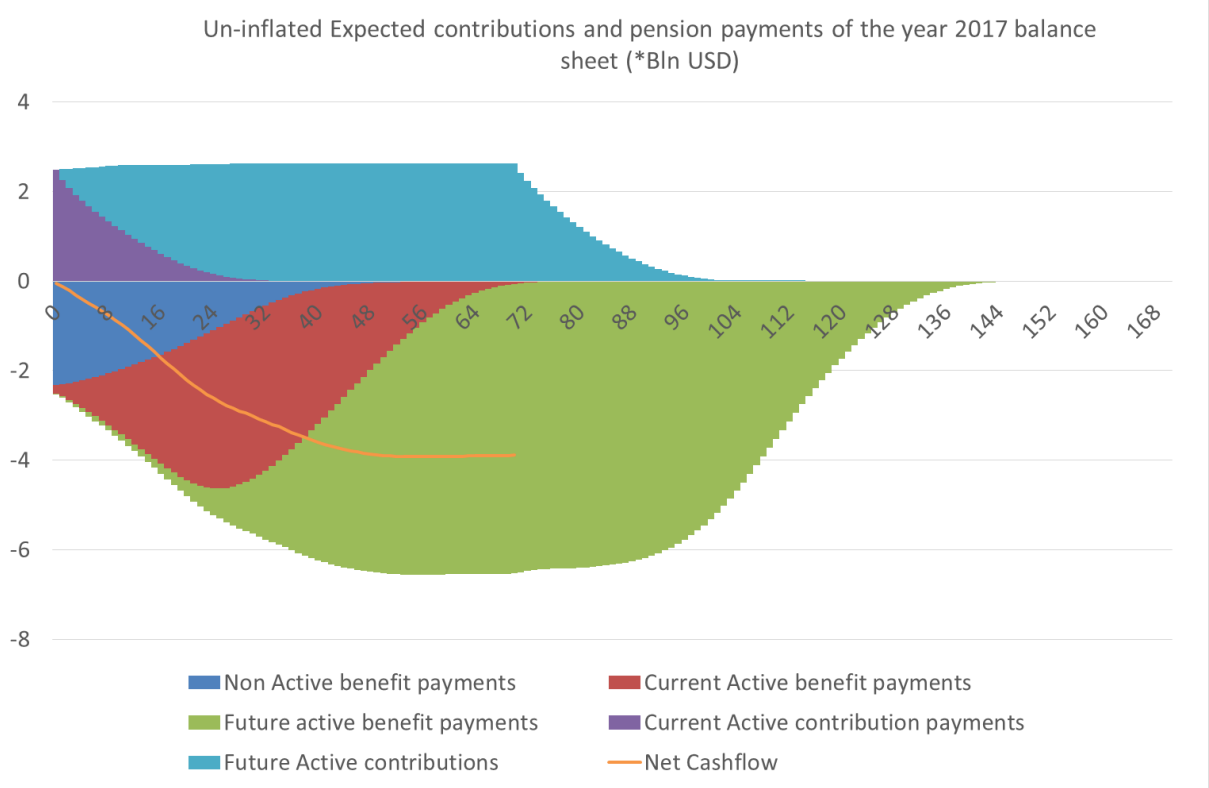


In the chart below the expected cash flow projections for the year 2017 are shown. Both in an inflated way and in an un-inflated way.



After 70 years we stop taking in new future members. The discounting is so strong that the present value of the remainder can be neglected.

In the chart below in an un-inflated manner. Take into account that the difference between price and wage inflation in this case also reduces to 0.



Because of the termination after 70 years of inflow, both the liabilities and contributions for future actives terminates. In the theoretical case of infinite future actives, the expected cash flows of these two components would continue as a straight line to infinity.

3.3. Asset Modeling

Our asset modeling is based on scenarios of financial and economic variables such as GDP, inflation, yield curves, currencies, asset returns etc. and the construction of asset classes. The simulation is based on an annual frequency and default the model assumes an annual rebalancing of asset classes to the prescribed (strategic) asset allocation. In addition hedging strategies can be defined for currency risk. Cash flows from contributions and benefit payments are processed annually. In the following more detailed information is provided on our methodology for scenario generation and asset class construction. We also present the main economic assumptions used for the ALM analysis and the current strategic asset allocation (SAA 2015), which is the starting point for our asset allocation analysis.

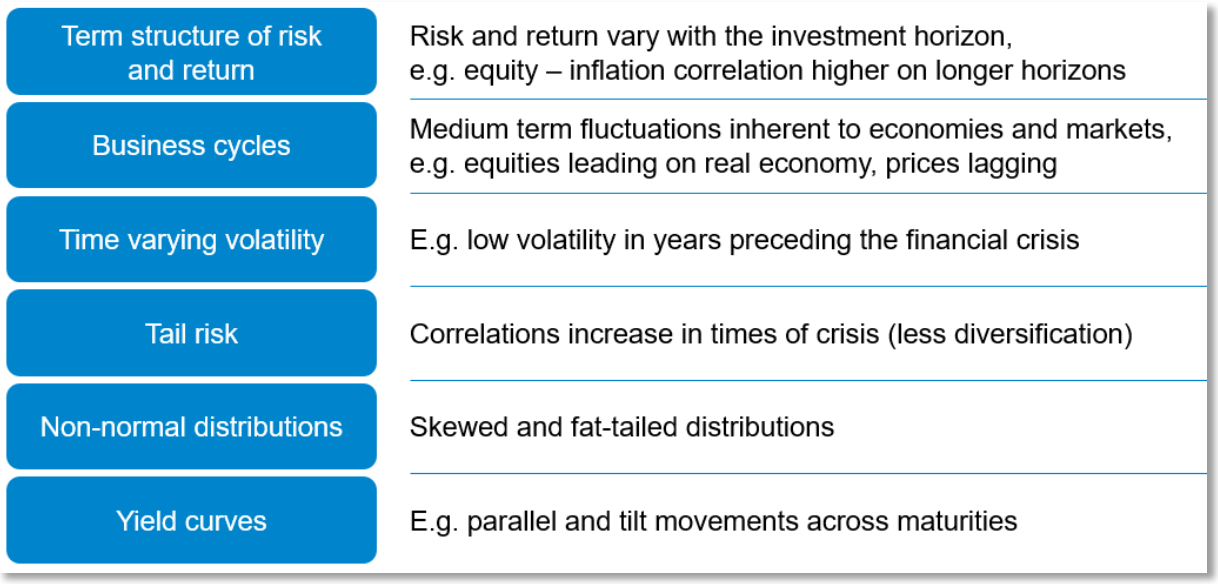
3.3.1. Economic Scenario Generation

In our methodology we distinguish the long, medium and short term aspects of our scenarios, but in the end we combine these into one consistent and realistic reflection of how economies and financial markets might evolve in the future. This makes our scenarios dynamic and unique.

Scenarios exhibiting a wide range of stylized facts

The literature recognizes a number of empirical laws on how economies and financial markets evolve. At Ortec Finance we have taken extreme care that our scenarios behave in line with these laws, or robust “stylized facts”. Our methodology is unique in that it deals with all of these stylized facts at the same time, allowing us to generate scenarios that, as

realistic as possible, describe what might happen in the future. A high level formulation of the stylized facts that are incorporated in OFS is given below.



The Dynamic Scenario Generator (DSG)

The Dynamic Scenario Generator (DSG) is the professional software tool that is used to calibrate, generate and analyze the scenarios of OFS, both by Ortec Finance and her clients. The DSG employs a unique combination of techniques and models in order to meet its objectives:

- Frequency domain filters;
- Spectral analysis;
- Non-normal Dynamic Factor Models (DFMs);
- Principal Component Analysis (PCA);
- Kernel density estimators;
- Stochastic (realized) volatility models;
- Extended Nelson & Siegel yield curve model;

In particular it is important to note that the DSG constructs scenarios from three dedicated Dynamic Factor Models:

1. A long term Trend Model, driving long term (“decade”) returns;
2. A medium term Business Cycle Model, driving medium term (“annual”) returns;
3. A short term Monthly Model, driving short term (“monthly”) returns

In OFS, countries, regions and asset classes are linked together in a consistent manner by the relatively small number of (PCA) factors underlying the dedicated Dynamic Factor Models for the long term (the Trend Model), the medium term (the Business Cycle Model) and the short term (the Monthly Model). Linkages and correlations are therefore obtained via a common factor structure per frequency (long term, medium term and short term are modeled independently). In cases where insufficient data is available for modeling a variable through the Dynamic Factor Models and frequency domain approach, further consistency is obtained by using classical factor modeling on monthly data, where the ‘factors’ are selected from the variables which are modeled through the Dynamic Factor Models.

We model all variables (financial as well as macroeconomic variables but also realized volatility) in this one framework, ensuring full consistency across asset classes, countries and regions, macro and financial markets and horizons.

Brief introduction to our Dynamic Factor Model approach

The scenarios of more than 600 economic and financial market variables covered by OFS, from 1 month until several decades into the future, are generated by a small number of underlying factors. There are (three) dedicated factors for the long term, (nine) dedicated factors for the medium term and (ten) dedicated factors for the short term. These factors are constructed from hundreds of input time series. The dynamics of these factors drive both the expectations and uncertainty of all variables which ensures the consistency that is so important for generating realistic scenarios.

The interplay between the decomposition and the factor modeling approach is summarized in Figure 1. We start by decomposing all input time series into a trend, business cycle and monthly component. Then we calibrate a dedicated Dynamic Factor Model (DFM) for each of the components which produce scenarios for the corresponding components for all variables. And finally, the scenarios of the components of variables are recombined into the scenarios of the total variables.

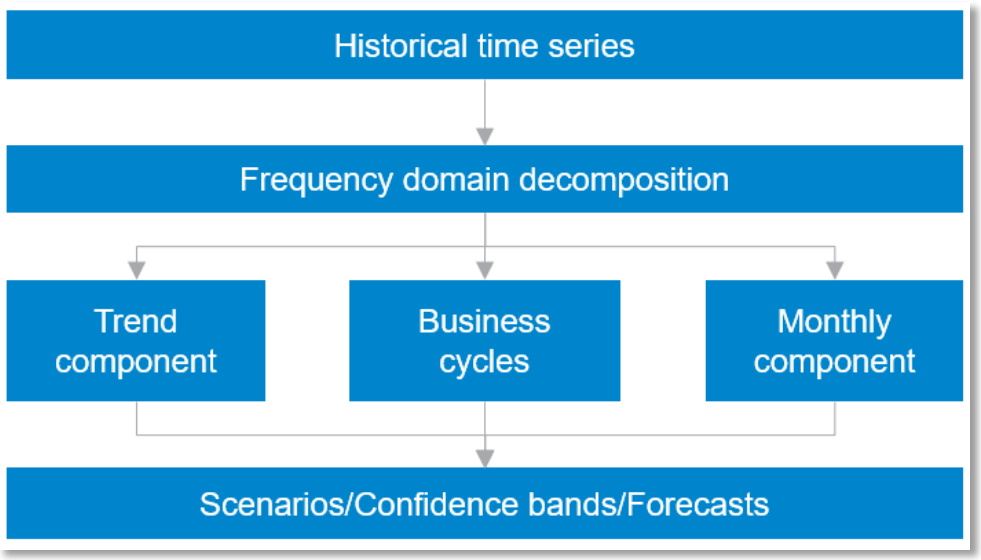


Figure 1: The “bi-orthogonal” decomposition approach as applied in the DSG.

A decomposition into long term trend, medium term business cycle and short term monthly or intra-year components is combined with a Dynamic Factor Model (DFM) per component. “bi-orthogonal” indicates that both the components and the factors in principle have zero correlations, and are therefore orthogonal.

The flow as described in Figure 1 can be explained in words as:

- All available historical time series (700+) are decomposed into an orthogonal (i.e. uncorrelated) Trend, Business Cycle and Monthly Component (please see the answer to question 1 for an example).
- For each frequency component, estimate common factors based on Principal Component Analysis (PCA) on the decomposed data.
- Estimate Vector Autoregressive Models of order 1 on the PCAs (VAR(1) models per frequency factor model). We also call these PCAs ‘Core factors’.

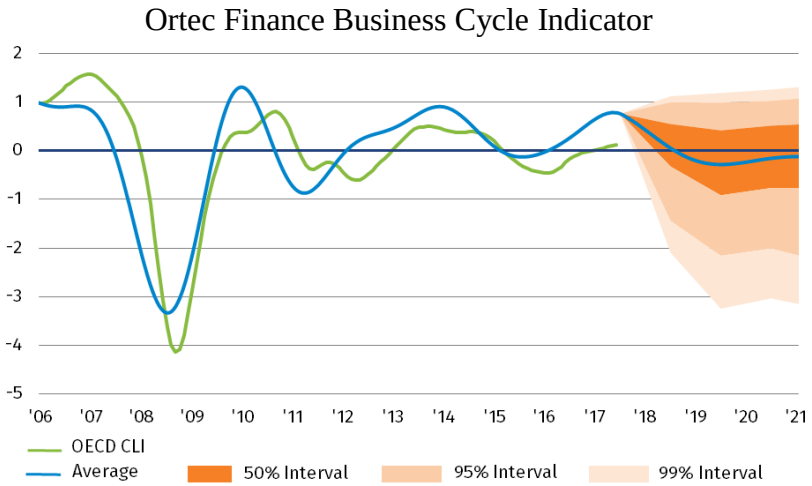
- Link the historical time series (variables) back to the Core factors via a regression approach (this is done per frequency component).

Scenarios can now be generated as follows:

a. The estimated VAR(1) factor models explain only part of the historical variance or variation in historical data. The remainder is captured in an error term. By drawing repeatedly (say 2,000 times) and randomly from the distribution of the error term, we generate many different possible developments of the Core factors consistent with the properties of the historical data.
b. Variables are linked to the Core factors via a regression approach. Scenarios for the variables can therefore be created via this link. In other words, Core factor scenarios translate to variable scenarios via the estimated linear relationship between the variables and the Core factors[1].

Two aspects of this approach to factor modeling in the DSG deserve particular attention. The first is the factor model for the long term trend component. Due to the special nature of truly long term data (e.g. from 1900 until present), we have built more structure into the trend model in the way as described by Boer et al. (2016). This structure enhances the interpretation of the long term aspects of the scenarios, it enforce more consistency and offers more flexibility to impose views or expert opinion consistently.

The second aspect is the Ortec Finance Business Cycle Indicator (OF BCI). It is produced with the general approach to the factor modeling as described by Lee and Steehouwer (2012) and applied to the medium term business cycle and short term monthly factor models. An example of the resulting factor scenarios for the OF BCI is shown in Figure 22. The OF BCI is "just" the first (out of nine) business cycle factors which captures the largest common part of the business cycle components of hundreds of input series. But the DSG approach does not stop with producing (leading) historical data alone. The (nine dimensional) business cycle DFM is used to also produce scenarios of the OF BCI (and the other eight factors) going forward, in this example from the end of December 2017 onwards. These OF BCI scenarios are important drivers of the medium term scenarios for growth, equity returns, credit spreads, real estate, etc.



[1] The estimated regression also has an error term because the linear relationship estimated on the factors does not perfectly capture all historical time series behavior. Additional randomness is added to the variables by also drawing randomly from this error terms distribution to better reflect the properties of the historical data.

Figure 22: Example per December 2017 of the Ortec Finance Business Cycle indicator, the 1st factor from the business cycle factor model, both historically and scenarios for the future. The shaded areas are the 50%, 90% and "100%" confidence bands of the scenarios. The dark blue line is the expectation. For comparison, the light blue line depicts the Composite Leading Indicator for all OECD countries (www.oecd.org/std/leading-indicators/).

To conclude: In OFS, countries, regions, asset classes are linked together in a consistent manner by the relatively small number of factors underlying the dedicated Dynamic Factor Models (DFMs) for the long term (the Trend Model), the medium term (the Business Cycle Model) and the short term (the Monthly Model). In cases where insufficient data is available for modeling a variable through the DFMs, further consistency is obtained by using classical factor modeling on monthly data, where the 'factors' are selected from the variables which are modeled through the DFMs.

3.3.2. Modeling Asset Classes

Our methodology allows modelling asset categories in a great level of detail. As we can model virtually any asset class, the level of detail chosen will be depending on the scope and objectives of the analysis. For an ALM analysis, we typically include assets on sub-class level as just using Equity or Fixed Income alone without adding further detail will be too high level for a meaningful risk analysis. Ortec Finance financial investment methodology allows to model asset classes and investment strategies in a modular and flexible way, including currency hedging, interest and inflation hedging and dynamic asset allocation.

The table below shows a possible way to characterize asset classes, including the level of detail that might be used.

▪ Fixed income
▪ *Characteristics*
  ▪ Coupon
  ▪ Redemption Method
  ▪ Index Linked
  ▪ Method of valuation
  • Nominal Value
  • Market Value
 	
▪ *Examples*
  ▪ Credits
  ▪ EMD
  ▪ Bullet
  ▪ Linear redeemable bond
  ▪ Zero Coupon
  ▪ Swaps
  ▪ Inflation Swaps
	▪ Total return type
	▪ *Characteristics*
	  ▪ Direct returns
	  • Dividend
	  • Rent
	  • Interest
	  ▪ Indirect returns
	
	▪ *Examples*
	  ▪ Equity
	  ▪ Real Estate
	  ▪ Commodities
	  ▪ Hedge Funds
		▪ Derivatives
		▪ *Characteristics*
		  ▪ Coupon
		  ▪ Implied Volatility
		  ▪ Hedge Volume
		  ▪ Underlying Index
		
		▪ *Examples*
		  ▪ Put
		  ▪ Call
		  ▪ APO
		  ▪ Swaptions

For the ALM study for UNJSPF the asset classes mentioned below are explicitly modelled including the economic time series used to estimate the historical statistical structure.

The blue categories are asset classes the UNJSPF currently already invests in. The Green ones are asset classes which are considered for future investment.

Equities

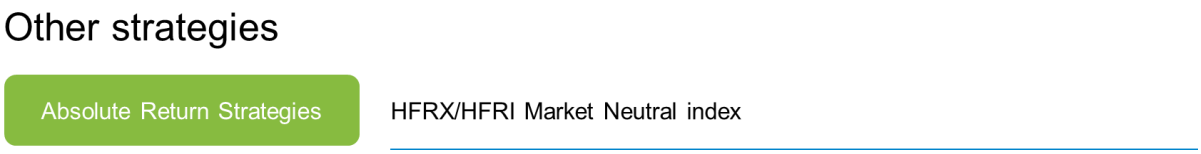
Developed Markets Equities Large and mid caps	MSCI World split into US, EUR, CAD, JP, Pacific ex-JP (for currency analysis)
Developed Markets Equities Small caps	MSCI World small cap split into US, EUR (for currency analysis)
Emerging Markets Equities	MSCI Emerging Markets
Frontier Markets Equities	MSCI Frontier Markets
Private Equity	100% Buy Out, based on a 70%/30% distribution between US en EURO . Based on data from Cambridge Associates, market value model

Real Assets

Real Estate	NCREIF NFI-ODCE
Infrastructure	Burgiss Private IQ Infrastructure Capital
Timberland	NCREIF Timberland index
Commodities	S&P GSCI Commodity index
Gold	London Gold market Fixing

Fixed Income

Government bonds	Bloomberg US Treasury Index
Corporate bonds	Bloomberg US Corporate Investment Grade Index
Inflation linked bonds	Bloomberg US Inflation Linked Bond Index
Private Debt	Credit Suisse US Leveraged Loan Index
Mortgage Backed Securities	Bloomberg US MBS Agency. Proxy by 50% Bloomberg AAA US Corporate Inc and 50% Bloomberg AA US Corporate Index
High Yield	Bloomberg US High Yield Index
Emerging Markets Debt	Bloomberg EMD Hard Currency Index JPMorgan GBI-EM Global Diversified Composite Unhedged



The asset categories are organized in a hierarchical way. In the figure below the hierarchy is illustrated, which is used in the ALM study.

- **Total assets**
- **Growth Assets**
  - Public Equity
    - EQ Developed large cap
    - EQ Developed small cap
    - EQ Emerging markets
    - EQ Frontier markets
  - Private Equity
  - Real Estate
  - Real Assets
    - Absolute Return Strategies
    - Infrastructure
    - Natural Resources
      - Timberland, Agriculture and Farmland
      - Commodities
      - Gold
- **Non-Growth Assets**
  - Fixed income
    - US Government Bonds
    - US Agency MBS
    - EMD
    - US IG Credits
    - TIPS
    - US HY Credits
    - US Private debt
  - Cash

3.3.3. Economic Assumptions

Based on the methodology described in 3.3.2 an economic scenario set is constructed on a monthly basis by Ortec Finance. For this ALM Study we have used the standard Ortec Finance Set (OFS) of December 2018 as the basis. The assumptions below have been arrived at after discussions between Ortec Finance and the OIM and taking into account input provided by the Investments Committee and the ALM Committee. The OIM takes complete ownership of these assumptions.

Dec 2018 OFS with OIM assumptions Risk and return statistics (year 1-10)	Nominal returns		Real returns	
	Geomean	Volatility	Geomean	Volatility
EQ Developed large cap	7.1%	17.6%	5.2%	17.6%
EQ Developed small cap	7.3%	22.9%	5.4%	22.9%
EQ Emerging markets	8.0%	25.8%	6.1%	25.8%
EQ Frontier markets	7.8%	29.9%	5.8%	29.9%
Private Equity	8.0%	25.6%	6.0%	25.7%
Real Estate	7.0%	19.1%	5.1%	19.0%
Infrastructure	5.9%	10.5%	4.0%	10.3%
Timberland	6.1%	18.8%	4.2%	18.2%
Commodities	4.1%	19.2%	2.2%	18.9%
Gold	1.9%	21.7%	0.0%	21.4%
Absolute return strategies	3.8%	6.5%	1.9%	6.6%
US Government Bonds (dur 6)	2.7%	4.7%	0.8%	5.1%
TIPS (dur 8)	2.9%	4.9%	1.1%	4.9%
US IG Credits (dur 7)	3.9%	7.4%	2.0%	7.7%
US HY Credits (dur 5)	4.8%	14.4%	2.8%	14.6%
US Agency MBS (dur 5)	3.0%	3.8%	1.1%	4.3%
EMD	4.7%	13.4%	2.8%	13.5%
Private debt	4.1%	8.5%	2.2%	8.7%
Cash	2.3%	1.1%	0.5%	1.6%

The table above shows the asset returns on a 10 year basis in nominal and real terms.

The table below shows the assumptions for price- and wage inflation over the same period.

Variable statistics	**Nominal returns**	
	Geomean	**Volatility**
Inflation		
Price inflation US	1.9%	1.4%
Wage inflation US	2.2%	1.9%

In the table below you find the return assumptions for the 30 year period.

Risk and return statistics (year 1-30)	Dec 2018 OFS with OIM assumptions Nominal returns	
	Geomean	Volatility
EQ Developed large cap	6.5%	18.0%
EQ Developed small cap	6.6%	23.3%
EQ Emerging markets	7.3%	26.5%
EQ Frontier markets	6.8%	30.5%
Private Equity	7.8%	25.7%
Real Estate	6.7%	19.3%
Infrastructure	5.9%	10.7%
Timberland	6.0%	19.5%
Commodities	4.2%	19.9%
Gold	1.8%	22.7%
Absolute return strategies	3.8%	6.4%
US Government Bonds (dur 6)	3.1%	4.6%
TIPS (dur 8)	3.2%	5.0%
US IG Credits (dur 7)	4.3%	7.7%
US HY Credits (dur 5)	5.3%	15.6%
US Agency MBS (dur 5)	3.4%	4.0%
EMD	4.7%	13.7%
Private debt	4.4%	9.2%
Cash	2.6%	1.6%

And for the price and wage inflation for the same 30 year period the assumptions are:

Variable statistics	Nominal returns Geomean	Volatility
Inflation		
Price inflation US	2.0%	1.8%
Wage inflation US	2.2%	2.2%

Note that in the actuarial valuation a 2.5% expected price inflation and expected wage inflation of 3.0% is assumed.

The average correlations are show in the table below.

	EQ Developed large cap	EQ Developed small cap	EQ Emerging markets	EQ Frontier markets	Private Equity	Real Estate	Infrastructure	Timberland	Commodities	Gold	Absolute return Strategies	US Government Bonds	TIPS	US IG Credits	US HY Credits	US Agency MBS	EMD	Private debt	Cash
EQ Developed large cap	1.00	0.84	0.66	0.62	0.75	0.30	0.59	0.12	0.28	0.00	0.15	-0.11	0.08	0.24	0.39	0.06	0.49	0.40	-0.17
EQ Developed small cap		1.00	0.51	0.50	0.65	0.26	0.53	0.10	0.21	-0.02	0.13	-0.10	0.07	0.20	0.33	0.05	0.38	0.33	-0.14
EQ Emerging markets			1.00	0.68	0.41	0.17	0.30	0.10	0.35	0.11	0.10	-0.12	0.02	0.19	0.23	0.03	0.73	0.26	-0.13
EQ Frontier markets				1.00	0.46	0.21	0.35	0.09	0.25	0.05	0.09	-0.11	0.01	0.15	0.22	0.01	0.50	0.24	-0.13
Private Equity					1.00	0.37	0.64	0.07	0.13	-0.03	0.11	-0.12	0.07	0.23	0.40	0.06	0.34	0.40	-0.15
Real Estate						1.00	0.73	0.11	0.19	0.01	0.03	-0.16	0.03	0.16	0.31	0.02	0.15	0.31	-0.12
Infrastructure							1.00	0.20	0.22	0.03	0.10	-0.16	0.10	0.19	0.39	0.03	0.26	0.40	-0.12
Timberland								1.00	0.19	0.03	0.04	-0.08	0.05	-0.04	0.00	-0.03	0.07	0.07	0.36
Commodities									1.00	0.42	0.01	-0.23	0.00	0.02	0.07	-0.13	0.28	0.15	-0.10
Gold										1.00	-0.03	-0.03	0.09	0.02	-0.03	-0.03	0.12	-0.01	-0.09
Absolute return Strategies											1.00	0.00	0.03	0.04	0.05	0.02	0.07	0.05	-0.01
US Government Bonds												1.00	0.56	0.56	0.06	0.87	-0.09	-0.19	0.38
TIPS													1.00	0.44	0.16	0.56	0.05	0.01	0.18
US IG Credits														1.00	0.58	0.84	0.17	0.38	0.08
US HY Credits															1.00	0.35	0.20	0.88	-0.10
US Agency MBS																1.00	0.04	0.09	0.34
EMD																	1.00	0.21	-0.10
Private debt																		1.00	-0.09
Cash																			1.00

3.3.4. Current Strategic Asset Allocation (SAA 2015)

The Strategic allocation defined in 2015 is presented in the table below.

Asset Allocation	SAA 2015
Total assets	100%
Public Equities	58.0%
Private Equities	5.0%
Real Estate	9.0%
Fixed Income (Global Aggregate)	26.5%
Cash	1.5%

3.4. Balance Sheet Modeling

If we bring together the liabilities and assets we are in a position to simulate the total balance sheet into the future under different economic scenarios.

3.4.1. Initial Financial Situation

The initial balance sheet at the end of 2017 can be found in the actuarial report. In the figure below it is shown.

Assets	Billion	Liabilities	Billion
Actuarial asset value	60.4	Liability Active members	53.8
Expected contribution current members	22.9	Liability Non active members	35.3
Expected contribution future members	62.5	Liability Future members	56.9
		Surplus	-0.2
Total	145.8	Total	145.8

The surplus is expressed as a percentage of the net present value (NPV) of the total payroll of the current actives and future actives. This measure is called Required Excess contribution rate. It shows how much additional or less contribution is required until infinity to make the surplus equal to 0.

At the end of 2017 the NPV of total payroll is equal to 370 billion USD. You can derive this amount by dividing the expected contributions by 23.34%, the contribution rate of 23.7% minus assumed costs.

So expressing the surplus as a percentage of NPV of total payroll leads to -0.2/370=-0.05%. Therefore the Required contribution rate at the end of 2017 is equal to 23.75%

Currently we are mid-2019, so we have updated the values on the balance sheet as well as possible. The new information we have is the market value of assets at the end of 2018. This was 60.8 billion USD. We simulated the model forward from its 2017 position to the end of 2018 by taking into account this updated market value. Based on that deterministic simulation the new Actuarial asset value could be determined. The liabilities were projected forward by applying the actual inflation rates in the different countries around the globe.

This resulted in the following starting balance at the end of 2018.

Assets	Billion	Liabilities	Billion
Actuarial asset value	63.6	Liability Active members	55.2
Expected contribution current members	23.4	Liability Non active members	38.2
Expected contribution future members	64.1	Liability Future members	57.8
		Surplus	-0.1
Total	151.1	Total	151.1

Although the year 2018 was not a good year from an investment perspective, the Actuarial asset value increased. This is related to the way the Actuarial asset value is calculated.

Furthermore the liability and expected contribution amounts increased with inflation.

The end result is a negative surplus of -0.1 billion USD, which is slightly better compared to end of 2017.

The NPV of total payroll has increased as well to an amount of 375 billion USD, so the required excess contribution rate can be derived as -0.1/375=-0.03%. The resulting required contribution rate is then equal to 23.73%

Note that the Market value of assets is about 3 billion USD lower than the Actuarial asset value. This means that in the future this loss will be absorbed in the Actuarial asset value with a negative expected impact on the required contribution rate.

From this starting balance sheet the stochastic simulations will start. The results of these stochastic projections will be discussed in the next chapter.

4. Results Asset & Liability Projections

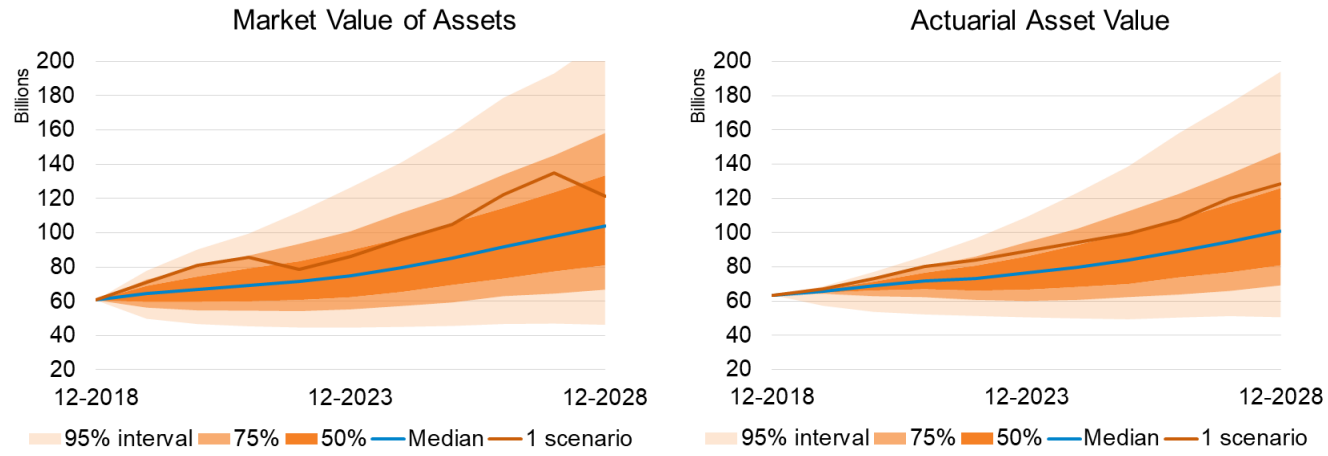
4.1. Scenario Analysis SAA 2015

The first scenario analysis conducted assumes that the assets are invested along the SAA 2015, which allocation looks as follows:

Asset Allocation	SAA 2015
Total assets	100%
Public Equities	58.0%
Private Equities	5.0%
Real Estate	9.0%
Fixed Income (Global Aggregate)	26.5%
Cash	1.5%

For the projections we further apply the modelling assumptions as presented in chapter 3.

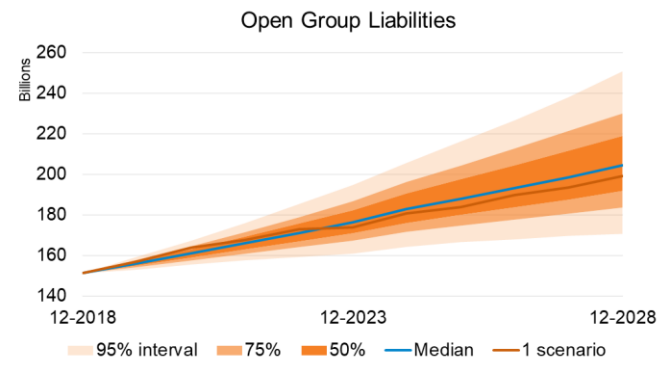
First we analyze the resulting projections for the total assets on market value and actuarial asset value basis.

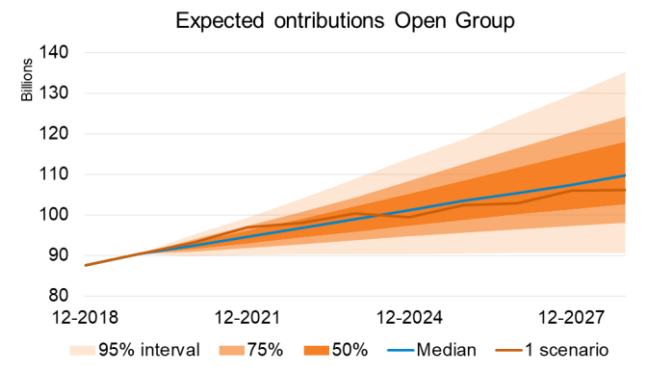


The expected geometric return on assets for the 10 year period is equal to 6.4% (nominal). This results in an expected growth of the Market Value of Assets and the Actuarial Asset Value (median) to approximately $100 billion. in 2028.

Despite taking a 5-years average, the volatility of the smoothed asset returns causes a considerable spread of Actuarial Asset Values at end of the 10 year projection period. At the start of the simulation (2018) the Market Value of Assets is lower than the Actuarial Asset Value, but over time the lower market value will be factored in the Actuarial Asset Value as well.

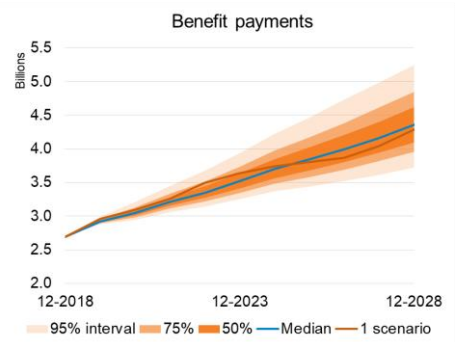
In the following figures the projection of future liabilities is shown for a number of liability components.

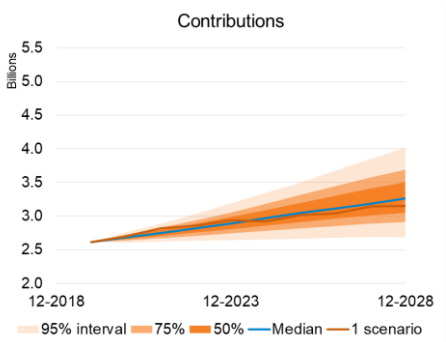


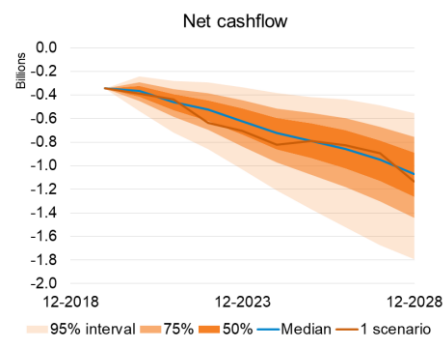


In the projection the expected value of Liabilities (Open Group valuation) increases from 150 billion. to 204 billion. in a 10 year period. The average value of the expected contributions increases from 87 billion. to 110 billion. in 2028.

In the illustrations below we show the projections of the liability cash flows (incoming contribution and outgoing benefit payments) and the resulting net liability cash flow.

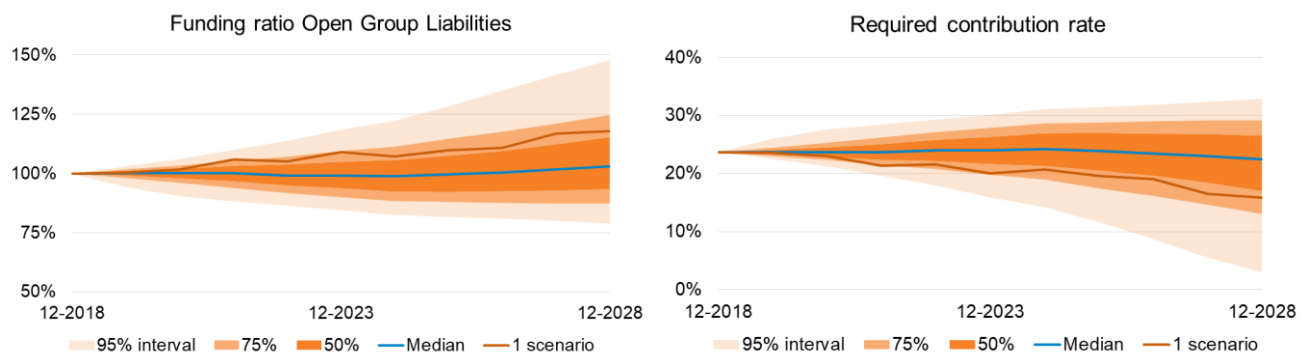






The benefit payment (including lump sum) increase from 2.7 billion. to 4.4 billion. over a 10 year period and the contributions increase in a slower pace from 2.6 billion. to 3.3 billion. The resulting net liability cash flow is at the start slightly negative, but over time this negative net cash flow increases significantly from -0.35 billion to -1.1 Bln. in year 10. This is a consequence of the further maturing of the fund. Please note that we have conducted a liquidity analysis in which we also look at cash flows emerging from the asset slide (please refer to paragraph 6.1). Main conclusion from this analysis is the probability of occurring liquidity issues within the next 10 years is negligible.

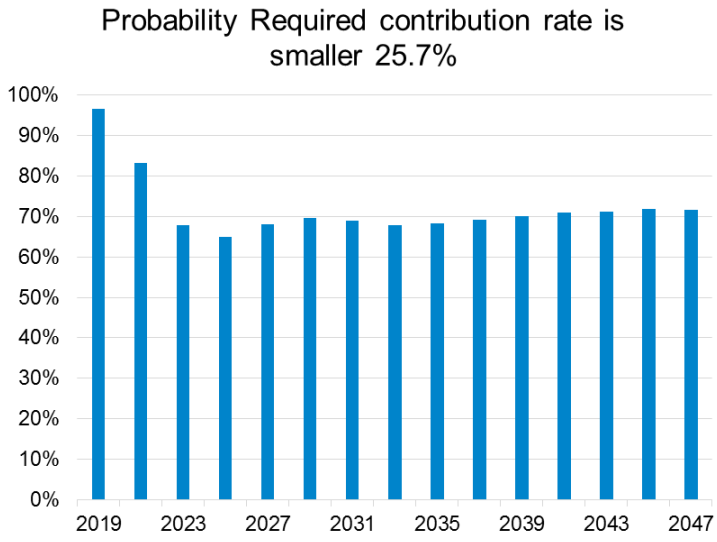
Combining the projections of the liabilities and assets provides us future projections of the funded status of the fund. In the figures below we show the scenario projections of the measures: Funding Ratio (resulting surplus divided by total liabilities) on an Open group basis and Required Contribution Rate (resulting surplus divided by net present value of total payroll times -1 plus 23.7%).



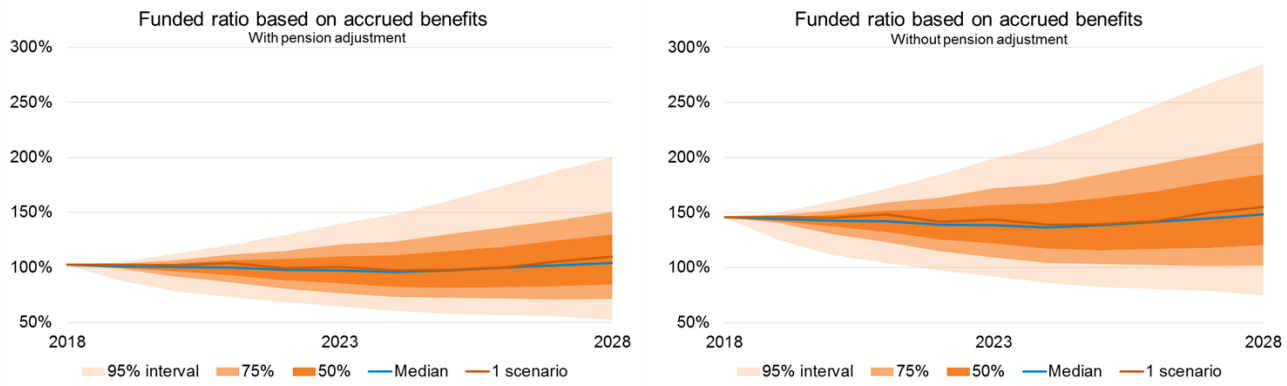
After two years, the expected (median) funded ratio drops slightly under 100% until year 2024 but then gradually increases to approximately 106% by the end of 2028. A similar, but an inverse image on the right side illustrates projections of the Required Contribution Rate (RCR). This drop is caused by the fact that the actuarial asset value is lower than the market value of assets at the start of the projections (initial financial situation). This deficit is amortized in the first years.

The development of the average funded ratio looks good. In the long run the fund is able to earn (more than) sufficient asset returns in relation to the liabilities. Nevertheless the uncertainty increases over time resulting in a considerably high probability of over- and underfunding and corresponding low and high required contribution rates. The probability that the resulting Required Contribution Rate falls outside the corridor is significant, especially on the lower end, but there is also a good chance that the Required Contribution Rate will be higher than 25.7%.

In the figure below the probability that the RCR will be lower than 25.7% is shown for different years during the 30 year projection period.



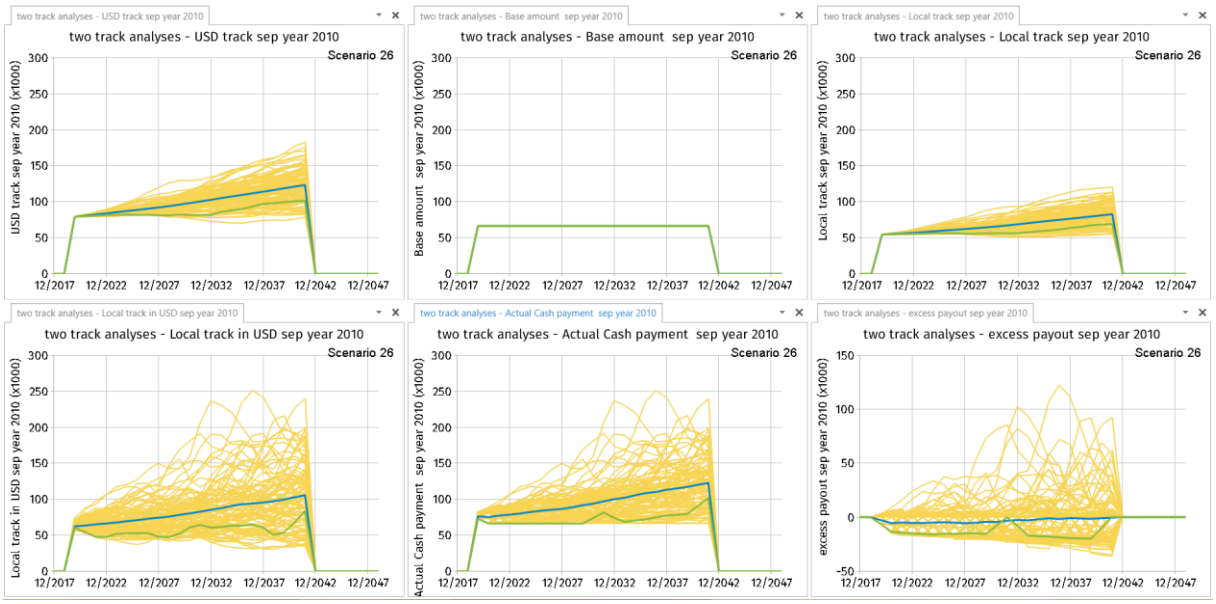
The analyses so far were based on the Open group Liability valuation method. As discussed in the actuarial assumption section there are also other valuation methods in place at the UNJSPF. In the charts below the funded ratios are shown for the Accrued Liability balance sheet. In the left hand panel the Actuarial value of assets divided by the Accrued Liability with pension adjustments is shown. In the right hand graph the Actuarial value of assets divided by the Accrued liability without pension adjustment. The right hand graph has a substantially higher funded ratio.



4.2. Results Projections Two-Track System

To determine the cost of the Two-Track system we start with the current non-active members who already opted in on the Two-Track. Paragraph 3.2.5 describes what their current position is with respect to the local track versus the USD track. Simulating these members into the future requires analysis of the CPI in the countries and also the exchange rates to determine the USD value of the actual payment made at the end of the quarterly process to determine the actual payment for the upcoming 3 months.

In the chart below an example simulation for a current non-Active single person is shown.



In the upper left panel the USD track benefit is shown for future simulation years. The USD track is stochastic due to the assigned CPI in the US.

In the upper middle chart the Base amount is shown. This base amount is determined at separation and is never adjusted. So therefore it is not stochastic.

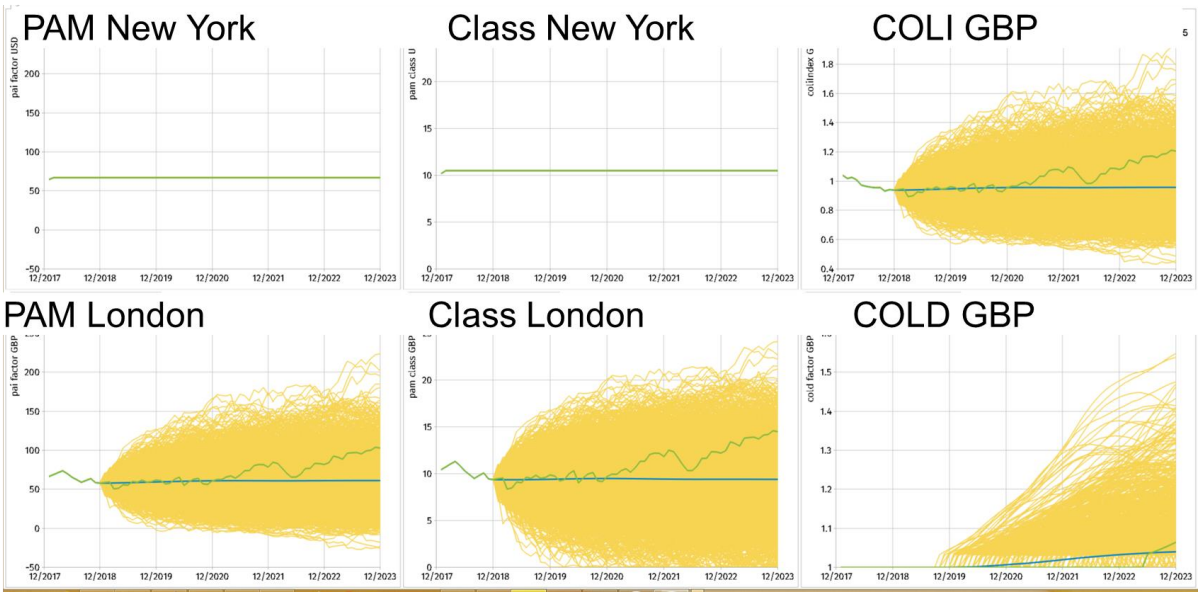
In the upper right chart the Local track benefit is shown in Local currency. This Local track benefit changes over time due to the assigned local CPI.

In the bottom left chart the local track value is shown, but now in USD. In the middle bottom chart the actual payment is shown. This panel is constructed based on the Two-track rules where the USD track, Local Track and Base amount plus the other parameters are used to determine the actual payment done.

In the bottom right chart the excess payment with respect to the USD track is shown. This is the difference in payment between a member who remains on the single track versus a member who opted in on the Two-Track. As can be seen in the chart there is a floor visible. This is the effect of the 80% bottom in the Two-Track ruling. On the upper side the excess is not limited.

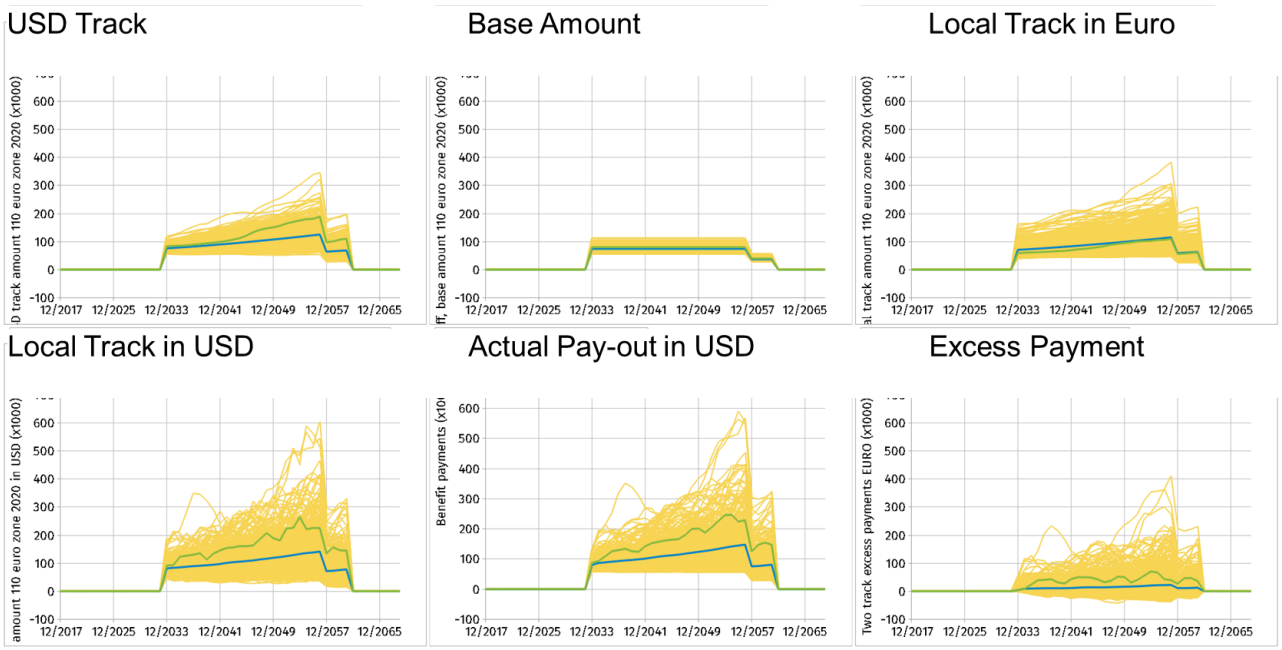
The value of the Two-Track can be determined by discounting these excess payments.

For current active members one can also do these simulations. There is however an additional element to be determined; the COLD factor. At moment of separation this cold factor corrects the local track benefit for the Cost of Living in the country at hand. The COLD factor itself is also a stochastic process. In the chart below the determination of the COLD factor is shown for the United Kingdom (GBP).



The cold factor is based on the 36 month positive differentials in Classes between New York and, in this case, London. The PAM and the CLASS for New York are assumed to be constant. The PAM level is driven by the Cost of Living Index for the UK. This cost of living index measures the price changes in USD terms. The PAM for London is then converted in a Class based on the conversion tables prescribed. As mentioned, the 36 month class differentials are determined, averaged and converted back based on a table to a COLD factor. This results in the right hand chart. Only positive COLD factors are applied. In the chart many scenarios are at the 1.0 level which is difficult to see. Only 30% of the scenarios lead to a COLD factor higher than 1.0.

In the chart below an example calculation for an active member entering the two-track in 2033 is shown.



In 2033 this member retires and opts in on the Two-Track. In the left upper panel his USD track benefit simulated through time is shown. In 2057 the benefit dips, this is because the member passes away and a spouse pension of 50% of the original benefit is being paid. The USD track is stochastically changed due to CPI US. In the middle upper panel the Base amount is shown. It is stochastic due to the stochastic wage inflation up to the separation moment (so the period 2017-2033). After that moment the Base amount is constant as it is not indexed anymore. In the upper right panel the Local track benefit is shown. At separation moment the Local track benefit is determined as the USD track converted based on the 36 month average exchange rate and multiplied by the COLD factor at that moment (only applicable to Professional staff). As of that moment of determining the initial Local track benefit, the local track benefit changes through time by CPI in the Euro zone.

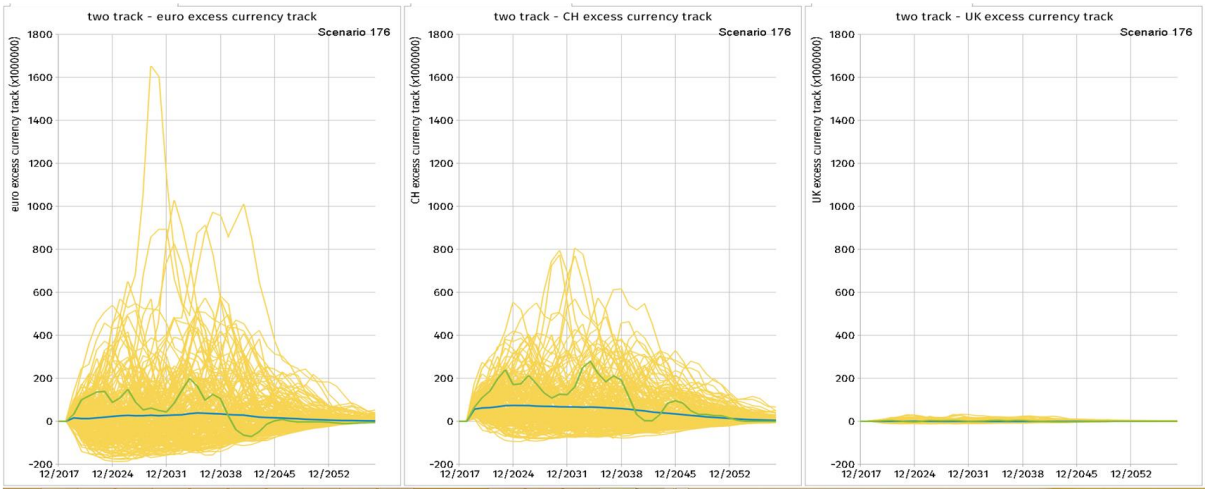
The bottom left chart shows the Local track benefit in USD terms. This is just the conversion of the Local track in local currency to the USD by the spot exchange rates. One can see that in USD terms the local track is much more volatile.

In the bottom chart in the middle the Actual pay-out in USD terms is shown. This is the result of the Two-Track calculation rules where the basic ingredients are the USD track, the Local Track and the Base amount.

The bottom right chart shows the excess payment. This is the Actual pay-out minus the USD track. In the chart the effect of the minimum level of 80% is visible. The upward potential is unlimited. Discounting the excess payment delivers the value of the Two-Track for this member.

The next step is to do these calculations for all members. It highly depends on the separation year which benefit is actually paid out to the members. For the Non-active members the excess payment for the different currency zones look like the below chart.

EURO CHF GBP



As can be seen the major Two-Track excess payments have their origin in Euro and CHF currency.

At initiation there is already an excess amount. For the Euro zone this is 15 million USD, for the CHF zone 56 million USD and for the GBP zone 0 million USD. Depending on development of the exchange rate and the CPI development in the different region, this excess payment will develop over time.

Discounting these payments with the current discount rate of 6% delivers a USD amount of the cost of the Two-Track system. This amount is expressed as a percentage of the NPV of payroll. Currently this amount is about 375 billion USD.

The calculations reveal the following costs:

	EURO	CH	UK	CAN	JPN	Total
Non-Actives	0.05%	0.13%	0.00%	0.00%	0.01%	0.18%
Current Actives	0.26%	0.22%	0.01%	0.00%	0.02%	0.52%
Future actives	0.32%	0.27%	0.02%	0.01%	0.03%	0.64%
Total	0.62%	0.63%	0.03%	0.01%	0.05%	1.34%

The total costs are estimated to be 1.34%. This is without corrections. In the next paragraph these will be added.

Furthermore the costs related to Canada are notably smaller than Japan while the benefits payable in Canada are higher than in Japan. This is related to the high correlation between Canada and US with respect to exchange rate and inflation. Therefore the Two-Track system does not have much value for Canadian Two-Track members.

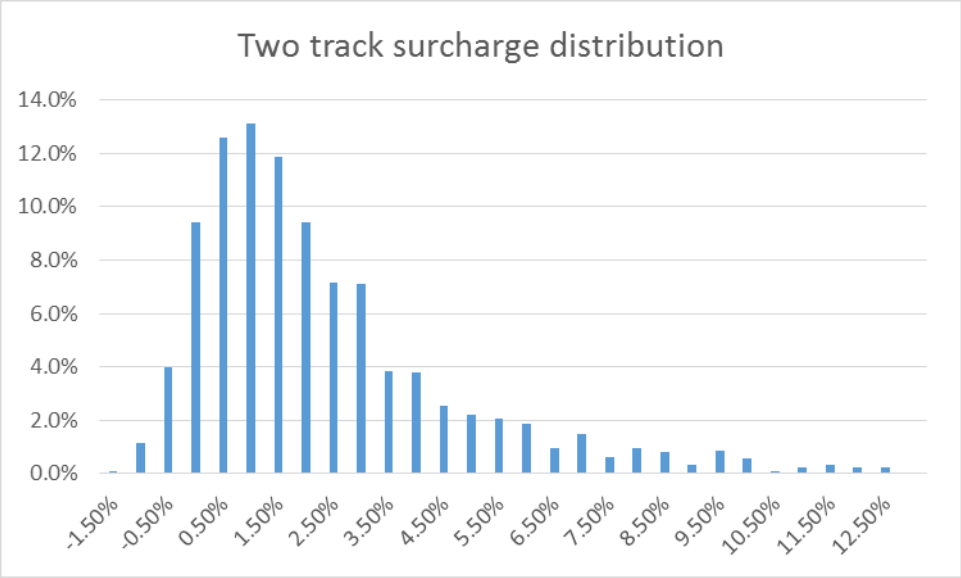
The above numbers were generated for the major countries. So a correction must be made for the countries not taken into account.

In the past Buck Consultants also did a valuation of the Two-Track system. In their valuation they made corrections for the following elements:

1. A higher participation rate was assumed, so 50% instead of the current 40%
2. A load of 8% to take into account the additional risk for soft currencies
3. A load of 20% for sample bias, model bias and error and a margin for conservatism

Applying all these additional loads lead to a value of 2.2% of the NPV of payroll. This is slightly higher than the 2.1% currently assumed by the plan.

The 2.2% of NPV of payroll replicates the average cost of the Two-Track system. It is an average. Especially in case of these kind of options, the value can be very different under different economic scenarios. In the chart below the distribution of costs is presented.



As can be seen there is a low probability that the Two-Track costs are negative. But the probability that the costs are more than 5% of NPV of payroll is considerable (approximately 14%). The outcome it is very skewed.

4.3. Evaluation Criteria

Using the results of the simulated projections of various variables we have defined a number of numerical statistics to evaluate different policy variants which may consist of alternative investment strategies or modelling assumptions (evaluation criteria). In the table below we have calculated these evaluation statistics for the SAA 2015 analyses, which were described in paragraph 4.1. for three evaluation periods: 2019-2028, 2019-2038 and 2019-2048.

UN		SAA 2015		
ALM results		2019-2028	2019-2038	2019-2048
Portfolio Return				
Geometric average investment return	Over period	6.4%	6.3%	6.4%
St. dev. investment return	Over period	12.5%	12.8%	12.9%
5% CVaR investment return	Over period	-20.1%	-20.7%	-20.8%
Probability real return > 3.5%	Over period	56.9%	56.7%	56.6%
Contribution				
Average Required contribution rate	End of period	21.3%	14.4%	3.2%
95% VaR Required contribution rate	End of period	31.7%	35.6%	39.5%
Average Required contribution rate	Over period	23.2%	20.5%	16.6%
95% VaR Required contribution rate	Over period	29.7%	32.0%	34.3%
St.dev. of change Required contribution rate	Over period	1.3%	1.8%	2.3%
Probability required contribution rate is < 25.7%	Over period	74.4%	71.7%	71.5%
Probability required contribution rate is < 23.7%	Over period	50.5%	55.6%	59.3%
Path probability Required contribution rate is < 25.7%	Over period	52.0%	42.8%	40.0%
Path probability Required contribution rate is < 23.7%	Over period	22.9%	18.5%	17.4%
Funded Ratio Open Group Liabilities				
Average funded ratio Open Group Liabilities, AVA	End of period	105.6%	120.4%	143.8%
Probability funded ratio Open Group Liabilities, AVA > 100%	Over period	50.5%	55.6%	59.3%
Probability funded ratio Open Group Liabilities, AVA > 100%	End of period	57.2%	63.6%	68.6%
Funded Ratio Accrued Liabilities (with pension adjustment)				
Average funded ratio Accrued Liabilities (with pension adjustment)	End of period	109.9%	138.1%	183.6%
Probability funded ratio Accrued Liabilities (with pension adjustment) > 100%	Over period	50.6%	54.7%	58.3%
Probability funded ratio Accrued Liabilities (with pension adjustment) > 100%	End of period	55.1%	61.5%	67.4%
Funded Ratio Accrued Liabilities (without pension adjustment)				
Average funded ratio Accrued Liabilities (without pension adjustment)	End of period	156.3%	194.6%	257.0%
Probability funded ratio Accrued Liabilities (without pension adjustment) > 100%	Over period	93.5%	88.9%	86.2%
Probability funded ratio Accrued Liabilities (without pension adjustment) > 100%	End of period	88.6%	82.6%	80.3%

The first section consists of statistics related to the projected returns of the total investment portfolio. In addition to the average and standard deviation (measure for volatility) we have calculated the CVAR 5%, which is equal to the expected return in the 5% worst scenario's and the probability that the real investment return (nominal return minus price inflation) is greater than 3.5%.

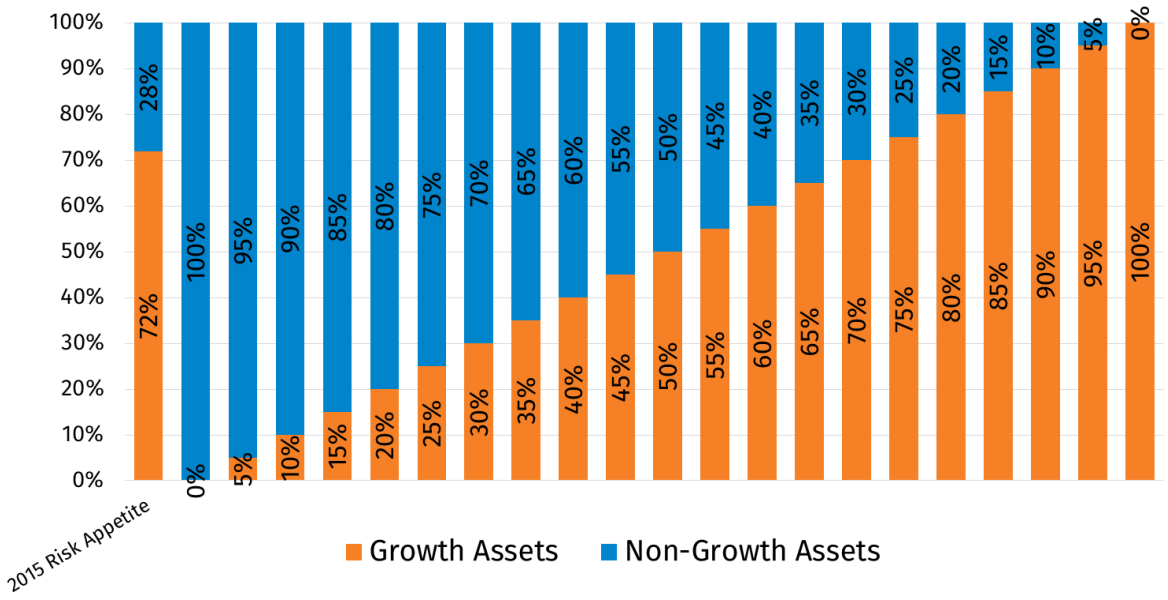
The middle section contains statistics related to the projected Required Contribution Rate (RCR). The 95% VaR calculates the required contribution rate level within a 95% confidence level. In other words if the 95% VaR is equal to 31.7%, this means that with 5% (100%-95%) probability the required contribution rate will be higher than 31.7%. The difference between the normal probability and the path probability is that normal probability is calculated over all scenarios and years and the path probability is calculated over the scenarios, factoring in an event if it happens at least once in a particular scenario. The path probability that RCR is lower than 25.7% is equal to 52%, means that in 48% of the scenarios the RCR is larger than 25.7% at least once during the corresponding projection period (10, 20 or 30 years). The last section contains statistics related to projected funding ratios of the fund on an Open group basis.

4.4. Investing more/less in Growth vs Non-growth assets

To find a suitable investment strategy for the fund we will first analyze the impact of investing more or less in riskier growth assets versus non-growth assets. This analysis can help to fund to identify an appropriate level of risk appetite. In these analyses we only distinguish two asset categories:

- Growth Assets are modelled with a global equity benchmark, a customized MSCI ACWI index.
- Non-growth assets are modelled with US fixed income benchmark, the Bloomberg Barclays US Aggregate.

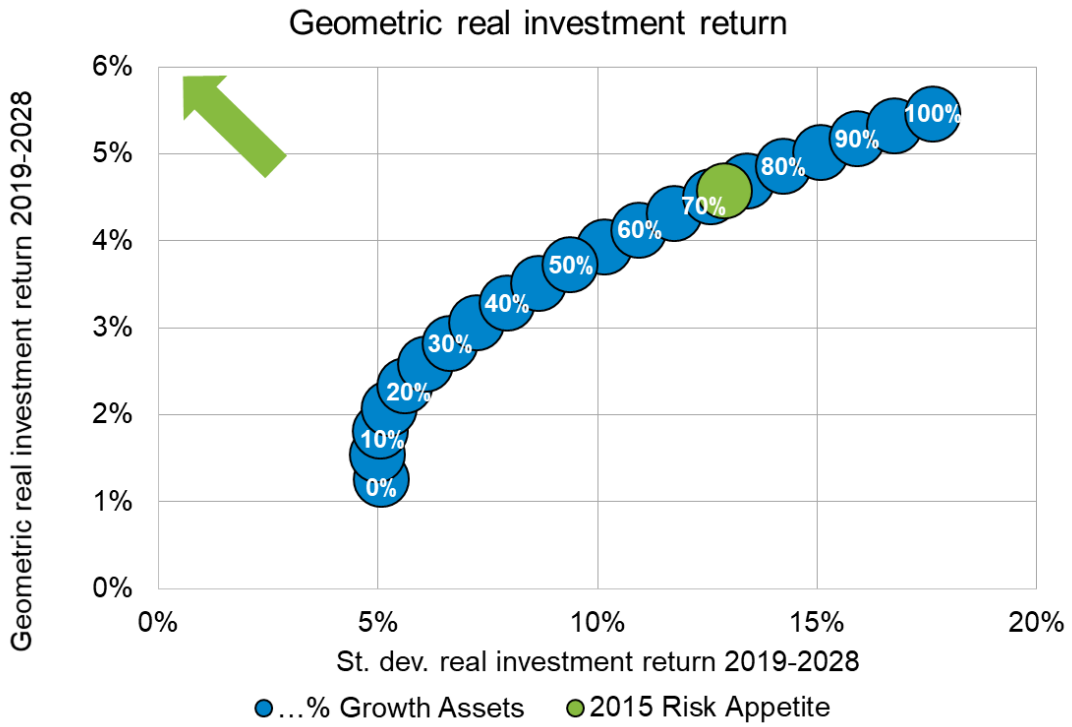
In the figure below we show the different risk profiles we will analyze from 0% invested in growth assets to 100% in %5 increments. The 2015RA is the translation of SAA 2015 into this framework of growth vs non-growth assets. In the table below the mean and standard deviation of corresponding portfolio returns are presented.



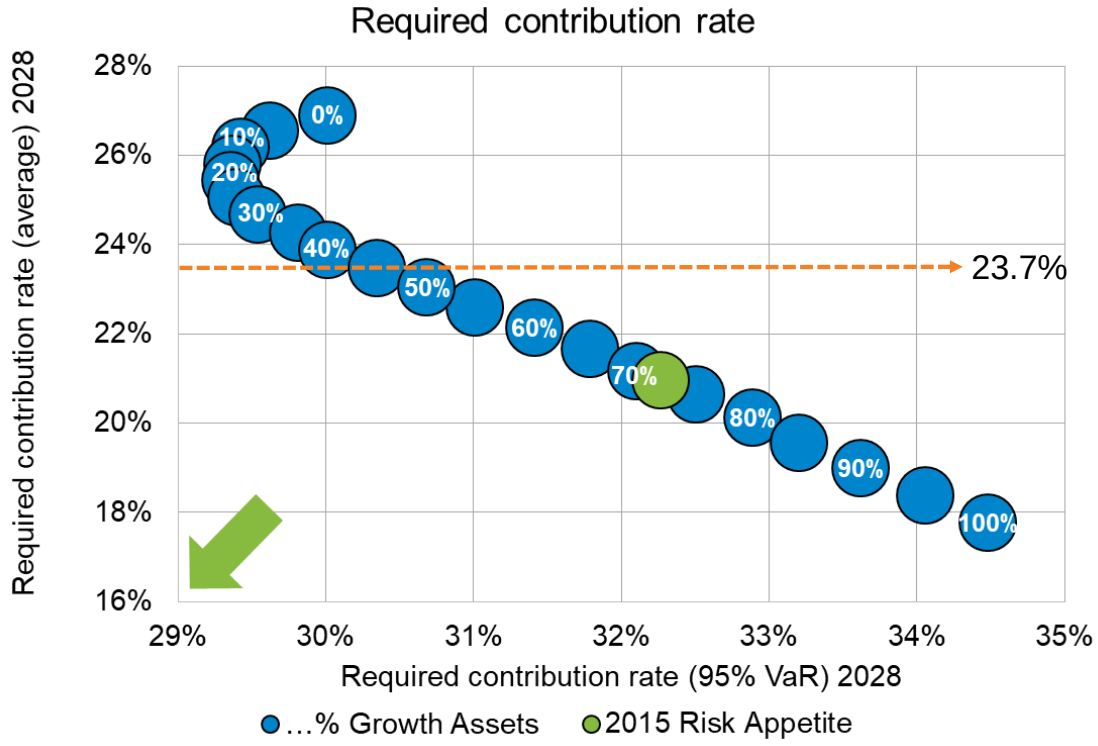
		2015 R.A. 2019-2028	0% Growth 2019-2028	5% Growth 2019-2028	10% Growth 2019-2028	15% Growth 2019-2028	20% Growth 2019-2028	25% Growth 2019-2028	30% Growth 2019-2028	35% Growth 2019-2028	40% Growth 2019-2028	45% Growth 2019-2028
Return												
Geometric average investment return	Over period	6.5%	3.1%	3.4%	3.7%	4.0%	4.2%	4.5%	4.7%	4.9%	5.2%	5.4%
St. dev. investment return	Over period	12.8%	4.7%	4.6%	4.7%	4.9%	5.3%	5.8%	6.4%	7.0%	7.7%	8.5%

		50% Growth 2019-2028	55% Growth 2019-2028	60% Growth 2019-2028	65% Growth 2019-2028	70% Growth 2019-2028	75% Growth 2019-2028	80% Growth 2019-2028	85% Growth 2019-2028	90% Growth 2019-2028	50% Growth 2019-2028	100% Growth 2019-2028
Return												
Geometric average investment return	Over period	5.6%	5.8%	6.0%	6.2%	6.4%	6.6%	6.7%	6.9%	7.1%	7.2%	7.4%
St. dev. investment return	Over period	9.2%	10.0%	10.8%	11.6%	12.5%	13.3%	14.2%	15.0%	15.9%	16.7%	17.6%

In the next figure the various portfolios of the table above are shown graphically in a graph with on the horizontal axis the volatility (standard deviation) of the real investment (portfolio) return and on the vertical axis the (geometric) average of the real investment return.



Above picture show a traditional risk/return trade-off in an asset-only context. Minimum risk position contains 5% growth assets and by increasing the proportion of growth assets in the portfolio, the higher the average investment return and standard deviation. More interesting for a pension fund is to present a risk/return trade-off taking into account the liabilities by using risk and return measures which are directly related to the balance sheet of the pension fund.

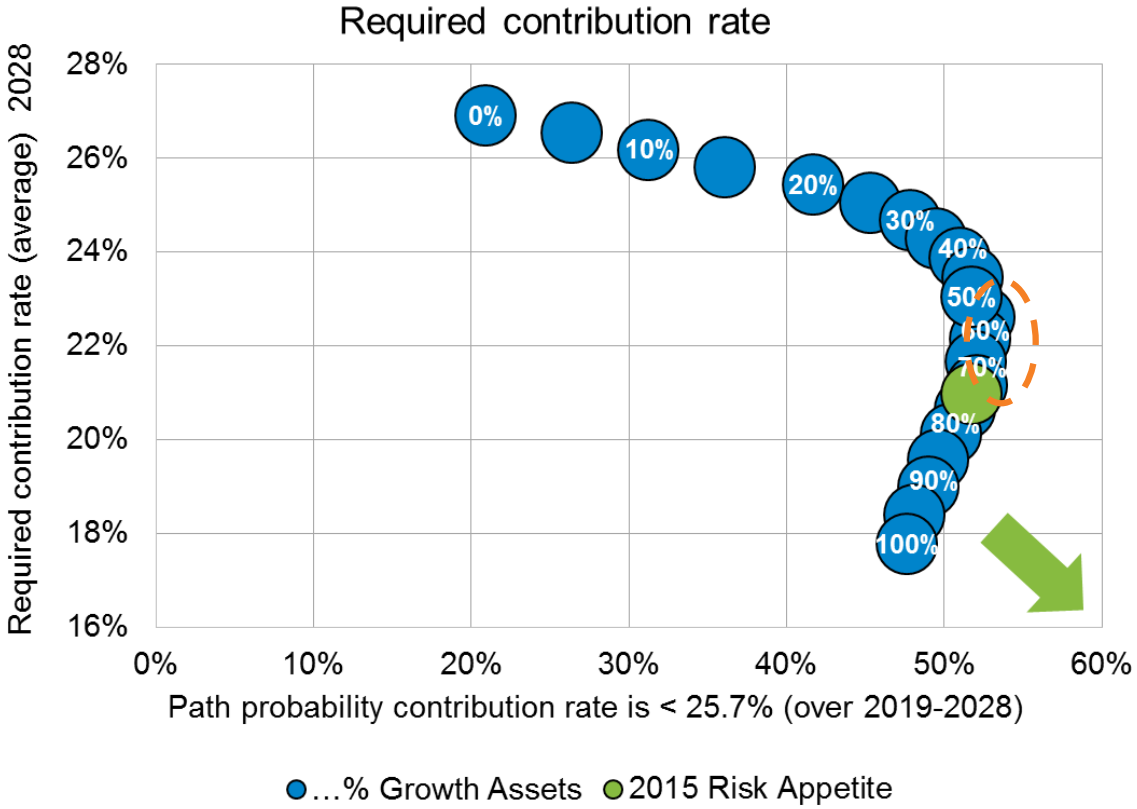


In the figure above the same portfolio are presented in a graph with on the vertical axis the average Required Contribution Rate (RCR) and on the horizontal axis first the 95% VaR. One important observation is that based on this trade-off, the minimum risk position shifts to a portfolio with more growth assets; 20% instead of 5%. For a pension plan the minimum risk position does not have to match with an investment portfolio with minimal standard deviation due to the need for return to fund future liabilities.

The graph also shows that the portfolio containing 45% growth assets results in an average Required Contribution Rate (RCR) equal the current rate (23.7%). Investing less than 45% growth assets will on average generate insufficient investment income and will lead to upward pressure to increase the RCR.

From 45% onwards increasing the proportion of growth assets will not only lower the average RCR, but also increase the risk in terms of 95% VaR of the RCR (the highest RCR level with 95% confidence level).

In the next slide the portfolios are presented using a different risk measure: the path probability that the RCR is smaller than 25.7% measured over a 10 year horizon.



The most interesting observation is that in above graph the minimum risk position / zone shifts even more. Minimum risk portfolios based on this risk measure are in a range between 55% and 70% of growth assets invested. These findings can effectively be used by the pension fund to determine their risk tolerance level.

5. Optimized Strategic Asset Allocation 2019

5.1. Optimization Asset Allocation

In this paragraph we will search for possible efficiency improvements through optimizing the asset allocation of the fund. We will conduct this optimization in the range between 55% and 70% of growth assets within the portfolio in response to the findings explained in paragraph 4.4.

In the table below you can find the individual asset categories we have modelled in our ALM framework to conduct the optimization.

Asset Universe

- Current asset categories:
  - Developed equity markets large cap
  - Developed equity markets small cap
  - Emerging market equity
  - Frontier equity markets
  - Private equity
  - Real Estate
  - Infrastructure
  - Timberland, Agriculture and Farmland
  - Commodities
  - US Government bonds
  - US IG Credits
  - US Agency MBS
  - Emerging market debt
  - Cash
- Possible new asset categories to be analyzed:
  - Inflation linked bonds (TIPS)
  - Private debt
  - HY Credits
  - Gold
  - Absolute return strategies

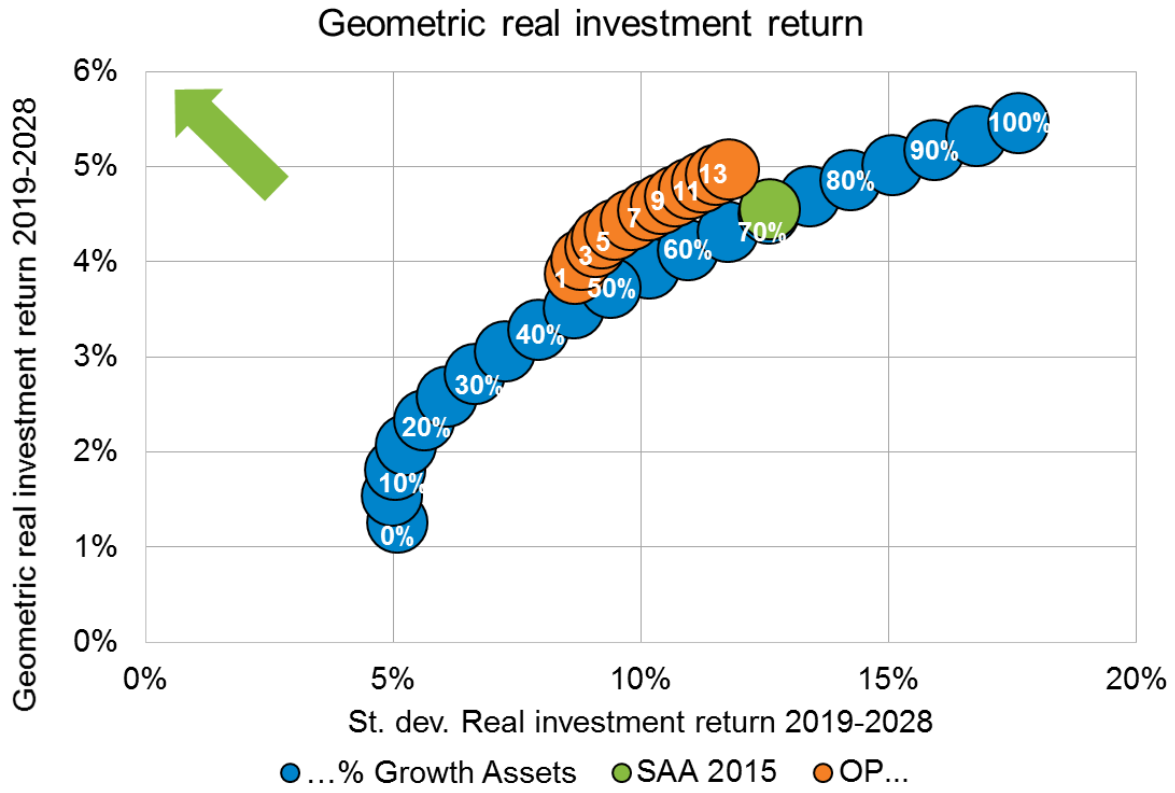
On the left we have listed the asset categories in which the fund is already investing in. On the right new asset categories are listed which will be analyzed in addition to test if they can further improve the risk/return profile of the investment portfolio.

Portfolio modelling restrictions

- Equity has a minimum allocation of 35% and maximum of 60% of Total Assets
  - Emerging market equity and Frontier equity markets maximum 20% of Public Equity
  - Developed equity markets small cap maximum 15% of Public Equity
- Private equity has a minimum allocation of 4% and maximum of 9% of Total Assets
- Real Assets has a minimum allocation of 5% and maximum of 16% of Total Assets
  - Real Estate has a minimum allocation of 5% and maximum of 12% of Total Assets
  - Infrastructure has a minimum allocation of 0% and maximum of 2% of Total Assets
  - Timberland, Commodities and Gold have a minimum allocation of 0% and maximum of 0.5% of Total Assets
  - Absolute Return Strategies has a minimum allocation of 1% and maximum of 2% of Total Assets
- Fixed Income has a minimum allocation of 29% and maximum of 44% of Total Assets
  - The ratio of US Government Bonds, US Agency MBS and EM Debt minimum is kept constant at 35%, 50%, 15% respectively, based on OIM's primary objectives for the fixed income portfolio being capital preservation, liquidity, and returns – in descending order
  - US IG credits maximum 15% of Fixed Income
  - TIPS maximum 6% of Fixed Income
  - US HY Credits maximum of 6% of Fixed Income
  - Private Debt maximum of 6% of Fixed Income
- Cash is set to 1%

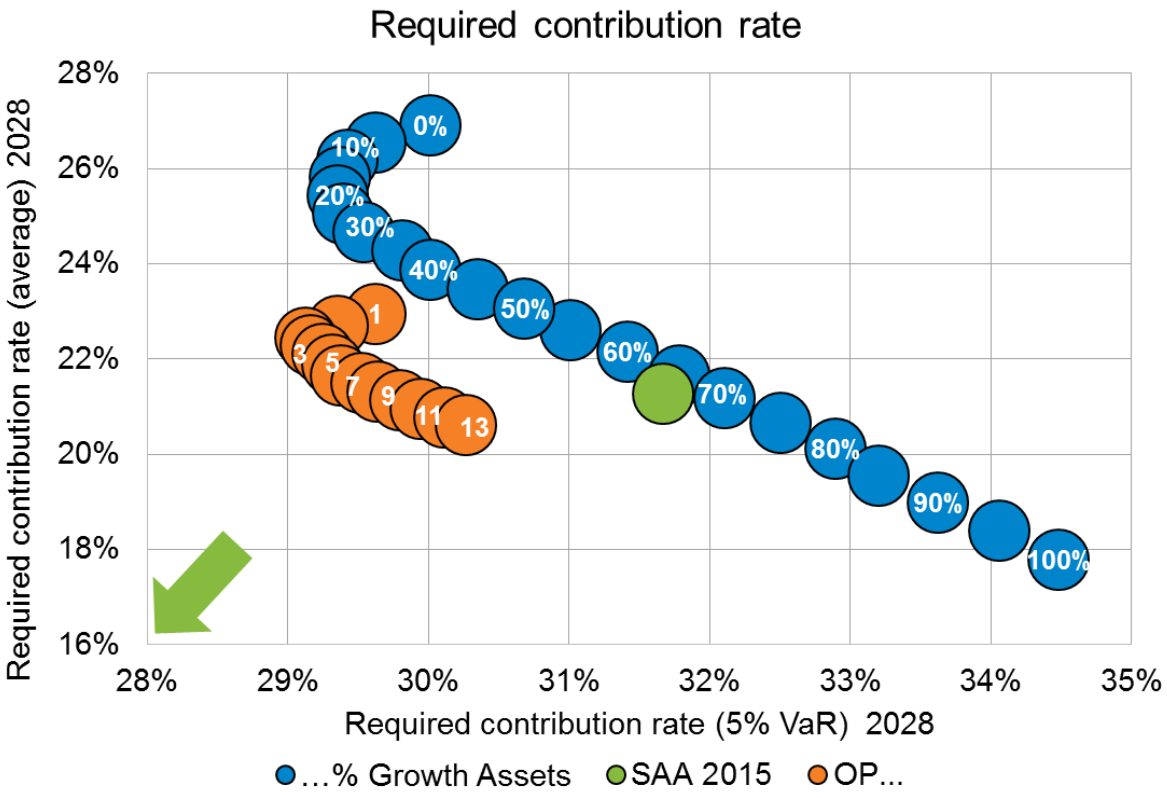
When carrying out the optimization we have applied portfolio modelling restrictions described above. These modelling restrictions result from capital market conditions and/or internal restrictions related to capacity of the investment organization of the OIM.

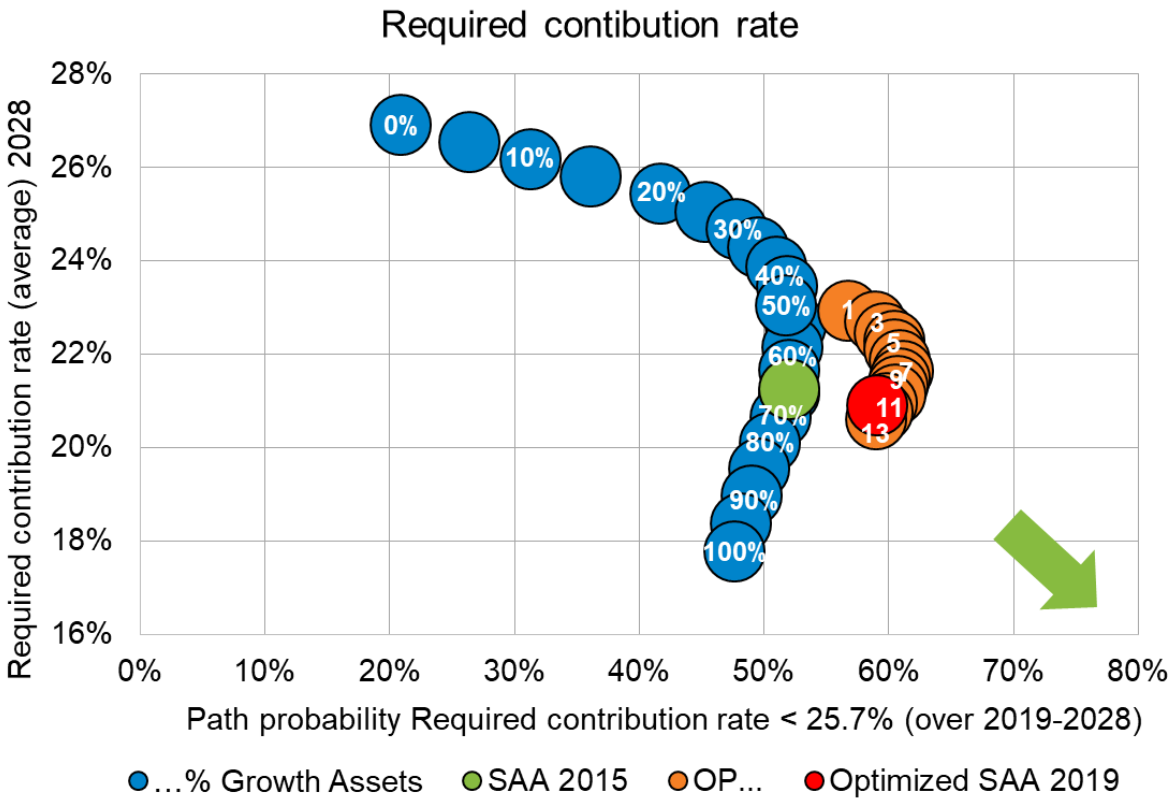
In the figure below the optimization results are showed in asset-only context with on the horizontal axis the standard deviation of real portfolio return and on the vertical axis the average real portfolio return. The orange pies are the optimized portfolios which are compared with the results of paragraph 4.4 (blue pies) and the SAA2015 (green pie).



The position of the optimized portfolios compared to SAA2015, towards the left/upper corner, already indicate that efficiency improvements are possible.

This becomes even more visible when we present the optimization results in ALM context in the following graphs. In the first graph we have plotted the results with on the horizontal axis the risk measure 95% VaR of the Required Contribution Rate (period 2019-2028) and on the vertical axis the average Required Contribution Rate. Since we would like to minimize both measures, efficiency improvements are indicated towards the left/lower corner. The first graph shows that based on these criteria, the efficiency improvements look more substantial. The same observation can be made based on the second graph on the next page in which we compare the portfolios based on a different risk measure: path probability that the Required Contribution Rate is lower than 25.7% measured on a 10 year horizon. In this graph efficiency improvements are in the direction of the right/lower corner.


Required contribution rate
Required contribution rate (average) 2028
28%
26%
24%
22%
20%
18%
16%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
1
3
5
7
9
11
13
28%
29%
30%
31%
32%
33%
34%
35%
Required contribution rate (5% VaR) 2028
…% Growth Assets
SAA 2015
OP...


Required contibution rate
Required contribution rate (average) 2028
28%
26%
24%
22%
20%
18%
16%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
1
3
5
7
9
11
13
0%
10%
20%
30%
40%
50%
60%
70%
80%
Path probability Required contribution rate < 25.7% (over 2019-2028)
…% Growth Assets
SAA 2015
OP...
Optimized SAA 2019

We can observe in this last graph that the optimized portfolios result in a considerably higher probability that the Required Contribution Rate of 25.7% will be sufficient during the first 10 years, i.e. that no additional policy measures are required. The efficient frontier with orange pies contains a number of portfolios which result in comparable risk outcome. After careful consideration the OIM chooses the pie colored red in the graph as the optimized SAA2019, which is based on the orange pie OP13. This optimized SAA2019 consists of 70% growth assets and 30% non-growth assets. The table below shows the allocation towards the individual asset classes of the optimized policy benchmark.

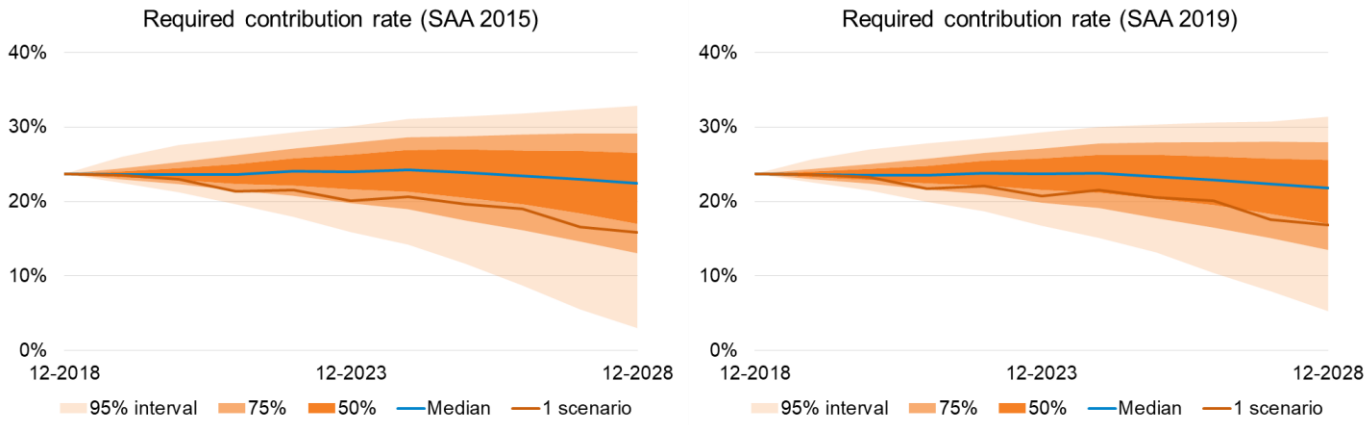
Optimized Allocation	OP13	Optimized SAA 2019
Total assets	**100.0%**	**100.0%**
Growth Assets	**70.6%**	**70.0%**
Public Equity	45.6%	45.0%
EQ Developed large cap	29.7%	36.0%
EQ Developed small cap	6.8%	0.0%
EQ Emerging markets	7.5%	8.0%
EQ Frontier markets	1.6%	1.0%
Private Equity	9.0%	9.0%
Real Estate	12.0%	12.0%
Real Assets	4.0%	4.0%
Absolute Return Strategies	1.0%	1.0%
Infrastructure	2.0%	2.0%
Natural Resources	1.0%	1.0%
Timberland, Agriculture and Farmland	0.5%	1.0%
Commodities	0.0%	0.0%
Gold	0.5%	0.0%
Non-Growth Assets	**29.4%**	**30.0%**
Fixed income	28.4%	29.0%
US Government Bonds	7.3%	9.4%
US Agency MBS	10.4%	13.5%
EMD	3.1%	4.0%
US IG Credits	4.3%	0.0%
TIPS	0.0%	0.0%
US HY Credits	1.7%	0.0%
US Private debt	1.7%	2.0%
Cash	1.0%	1.0%

On the 10 year horizon the expected portfolio return of the Optimized SAA2019 is equal to 6.7% with a standard deviation of 11.3%.

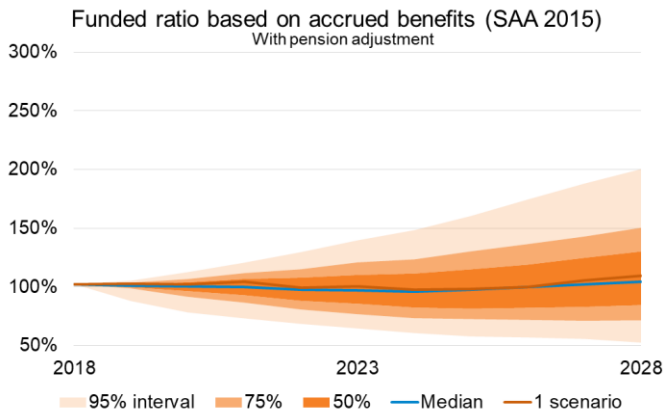
	SAA 2015	SAA 2019
Total assets	**100%**	**100%**
Growth Assets	**72%**	**70%**
Public Equity	58%	45%
Private Equity	5%	9%
Real Estate	9%	12%
Real Assets	0%	4%
Non-Growth Assets	**28%**	**30%**
Fixed income	26.5%	29%
Cash	1.5%	1%

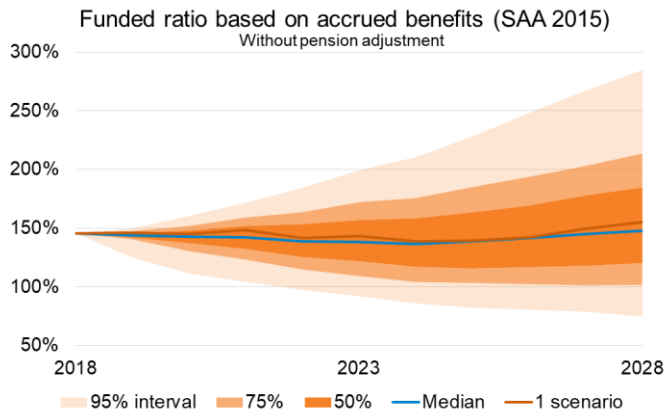
Comparing the optimized policy benchmark with the SAA2015 shows that the optimized policy benchmark (and corresponding SAA2019) contains a slightly higher allocation to Fixed Income (30% instead of 28%). Larger differences are the higher allocation to private equity and real assets (almost doubling the allocation) at cost of a lower allocation to public equities. In addition we see on a lower level higher allocations to absolute return strategies, infrastructure, timber- agriculture and farmland and US private debt. These changes ensures that the strategic asset allocation will be more diversified and robust. The suggested changes are also more in line with what can be observed over the last few years at other large pension plans around the globe.

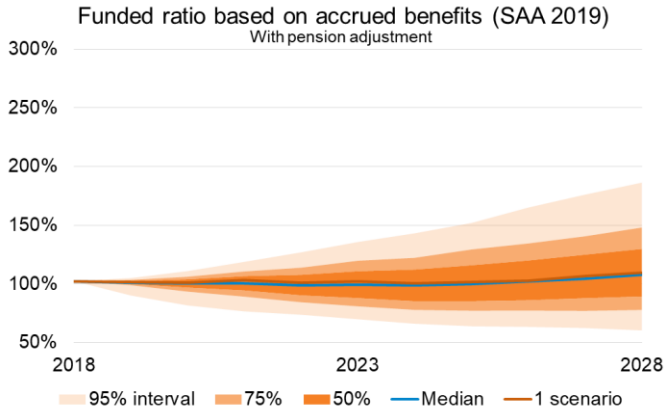
In the chart below the Required contribution rate is shown for the SAA2015 and SAA2019.

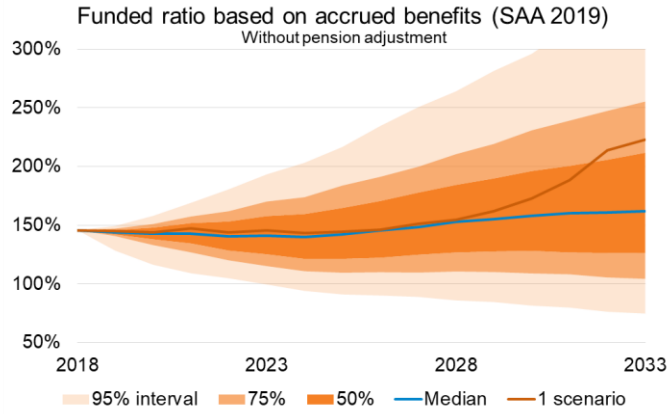


From an Accrued liability perspective the funding ratios can be compared as well. In the graphs below the funding ratios with and without pension adjustment are shown for the SAA2015 and SAA2019 allocations.







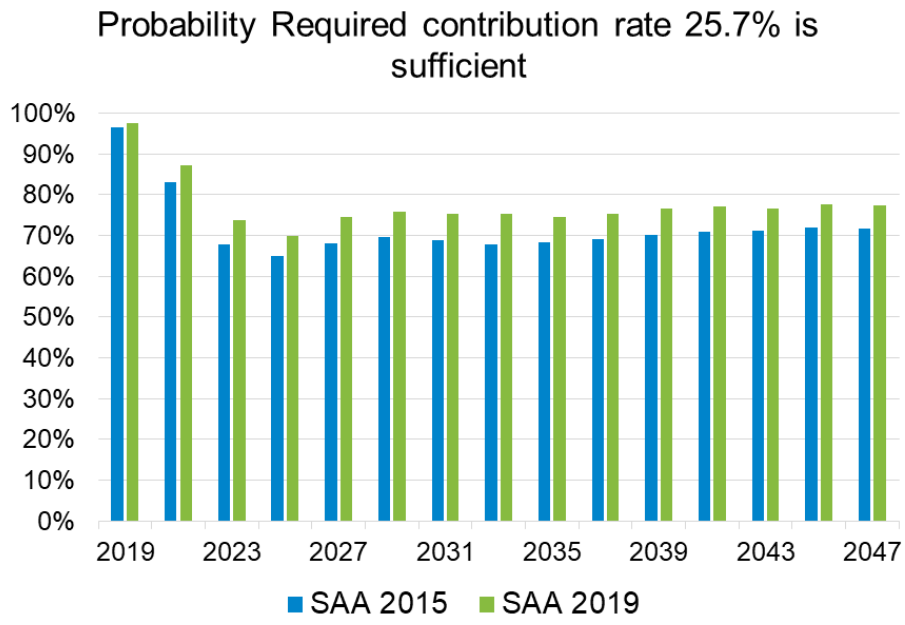


Also from this perspective the cone representing the distribution of possible outcomes narrows for the SAA2019 allocation.

In the table below the numerical statistics from the simulation are shown for the optimized policy benchmark compared to SAA2015 for various horizons. The efficiency improvement is well illustrated by better results for all evaluation criteria.

UN		SAA 2015			SAA 2019		
ALM results		**2019-2028**	**2019-2038**	**2019-2048**	**2019-2028**	**2019-2038**	**2019-2048**
Portfolio Return							
Geometric average investment return	Over period	6.4%	6.3%	6.4%	6.7%	6.5%	6.5%
St. dev. investment return	Over period	12.5%	12.8%	12.9%	11.3%	11.6%	11.7%
5% CVaR investment return	Over period	-20.1%	-20.7%	-20.8%	-17.3%	-18.1%	-18.2%
Probability real return > 3.5%	Over period	56.9%	56.7%	56.6%	58.3%	57.6%	57.4%
Contribution							
Average Required contribution rate	End of period	21.3%	14.4%	3.2%	20.9%	14.1%	2.9%
95% VaR Required contribution rate	End of period	31.7%	35.6%	39.5%	30.2%	33.7%	37.1%
Average Required contribution rate	Over period	23.2%	20.5%	16.6%	23.0%	20.2%	16.3%
95% VaR Required contribution rate	Over period	29.7%	32.0%	34.3%	28.7%	30.4%	32.3%
St.dev. of change Required contribution rate	Over period	1.3%	1.8%	2.3%	1.1%	1.6%	2.0%
Probability required contribution rate is < 25.7%	Over period	74.4%	71.7%	71.5%	79.1%	77.3%	77.2%
Probability required contribution rate is < 23.7%	Over period	50.5%	55.6%	59.3%	53.8%	59.8%	63.8%
Path probability Required contribution rate is < 25.7%	Over period	52.0%	42.8%	40.0%	59.1%	50.1%	47.3%
Path probability Required contribution rate is < 23.7%	Over period	22.9%	18.5%	17.4%	24.4%	20.7%	19.7%
Funded Ratio Open Group Liabilities							
Average funded ratio Open Group Liabilities, AVA	End of period	105.6%	120.4%	143.8%	106.4%	121.0%	144.5%
Probability funded ratio Open Group Liabilities, AVA > 100%	Over period	50.5%	55.6%	59.3%	53.8%	59.8%	63.8%
Probability funded ratio Open Group Liabilities, AVA > 100%	End of period	57.2%	63.6%	68.6%	62.6%	68.8%	73.3%
Funded Ratio Accrued Liabilities (with pension adjustment)							
Average funded ratio Accrued Liabilities (with pension adjustment)	End of period	109.9%	138.1%	183.6%	111.7%	139.4%	185.0%
Probability funded ratio Accrued Liabilities (with pension adjustment) > 100%	Over period	50.6%	54.7%	58.3%	53.5%	58.6%	62.5%
Probability funded ratio Accrued Liabilities (with pension adjustment) > 100%	End of period	55.1%	61.5%	67.4%	60.4%	66.9%	72.0%
Funded Ratio Accrued Liabilities (without pension adjustment)							
Average funded ratio Accrued Liabilities (without pension adjustment)	End of period	156.3%	194.6%	257.0%	158.8%	196.5%	259.1%
Probability funded ratio Accrued Liabilities (without pension adjustment) > 100%	Over period	93.5%	88.9%	86.2%	96.5%	93.0%	90.4%
Probability funded ratio Accrued Liabilities (without pension adjustment) > 100%	End of period	88.6%	82.6%	80.3%	93.1%	87.6%	84.5%

In the graph below the improvements are shown for the risk measure: path probability that Required Contribution rate is lower than 25.7% for projection period (± 8%)



5.2. Implementation approach SAA2019

In the table below the allocations of the optimized policy benchmark (SAA2019) can be compared with the current asset allocation of the fund (end Q1 2019).

	CAA Q1 2019	Optimized PB
Total assets	**100.0%**	**100.0%**
Growth Assets	**69.3%**	**70.0%**
Public Equity	58.0%	45.0%
EQ Developed large cap	47.2%	36.0%
EQ Developed small cap	3.9%	0.0%
EQ Emerging markets	6.7%	8.0%
EQ Frontier markets	0.3%	1.0%
Private Equity	4.3%	9.0%
Real Estate	6.5%	12.0%
Real Assets	0.4%	4.0%
Absolute Return Strategies	0.0%	1.0%
Infrastructure	0.2%	2.0%
Natural Resources	0.2%	1.0%
Timberland, Agriculture and Farmland	0.0%	1.0%
Commodities	0.2%	0.0%
Gold	0.0%	0.0%
Non-Growth Assets	**30.7%**	**30.0%**
Fixed income	25.5%	29.0%
Global Aggregate	25.5%	0.0%
US Aggregate (customized)	0.0%	29.0%
Cash	5.2%	1.0%

The intention of the OIM is to implement the new SAA2019 gradually in 4 years' time:

- Applying a glide path approach to get it implemented in reasonable steps
- The Policy benchmark will take this gradual expansion in Private Assets into account.
- All non-implemented Private assets allocations will be temporarily assigned to SAA Public Equity on a quarterly basis to measure the risk and performance of the Fund vs. the policy benchmark correctly, until the target weight in private markets is achieved.

In the table below you can find the benchmark proposals for the SAA2019:

- Public Equity: 80% customized MSCI world (DM) 20% customized MSCI (EM)
- Private Equity: Public equity customized benchmark + 200bp
- Real Estate: NCREIF NFI-ODCE + 100bp
- Real Assets (without Real Estate): Benchmark is CPI US + 400bp
- Fixed Income: 35% US Treasuries, 50% US Agency MBS, 15% EMD Local Currency *)
- Cash: US Treasury bills

*) Investment Grade Corporate Bonds and High Yield Bonds are not included in the fixed income benchmark since the OIM does not currently have in-house capabilities in these sub-asset classes, and therefore they would not meet the 'reasonable and feasible' test.

6. Sensitivity Analyses

6.1. Liquidity analyses

In the analyses so far, we have focused on the balance sheet. But obviously it is also important to look at the liquidity in the plan. The benefits have to paid in time. The goal is of course to avoid situations where you are forced to liquidate your asset investments against high costs.

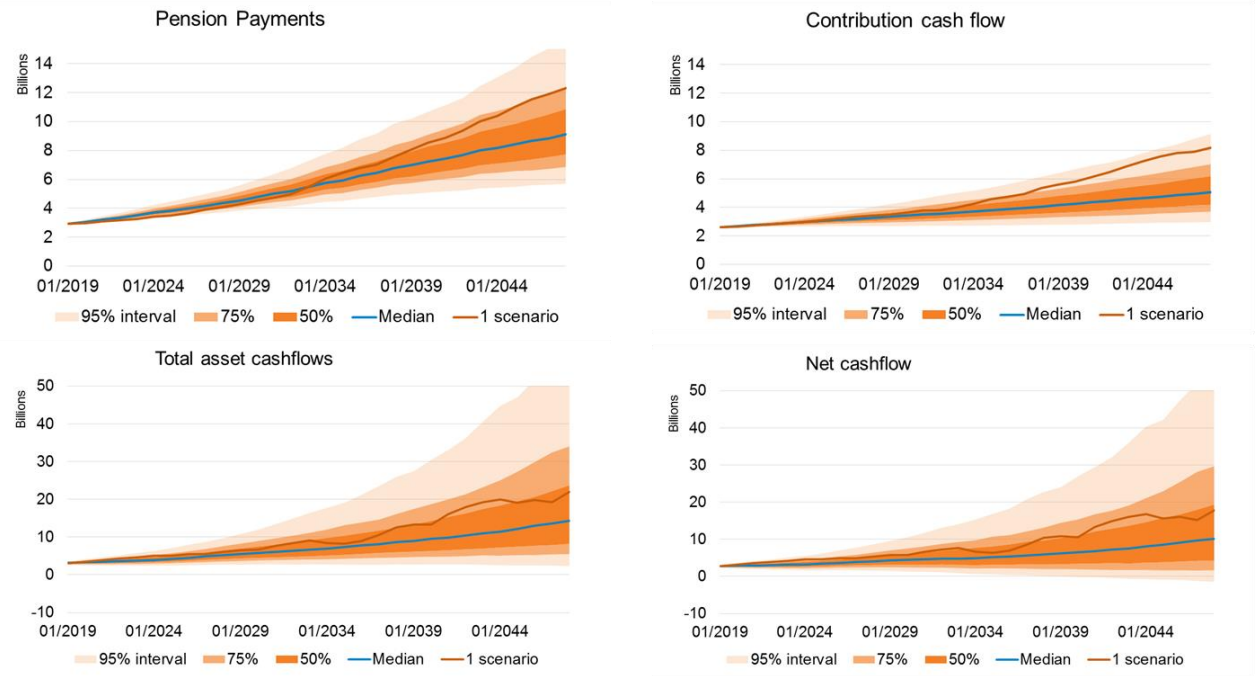
The cash flows in the plan originate from a few sources:

- Benefit payments and lump sum payments
- Contributions paid by members and employee
- Coupons from fixed income instruments
- Expiring fixed income products
- Dividends from other investment products

In the model the fixed income products are modelled explicitly. Therefore the cycles of the coupons and expiring fixed income products are taken into account correctly. For all other total return categories we assume that 2% dividend on an annual basis will be generated.

Cash flows due to rebalancing, trading, commitments to private assets, etc. will be neglected.

In the chart below the cash flows of the different components are shown.



In the upper charts the pension payments and the contribution inflow are shown. The pension payments are expected to grow faster than the contribution cash flow. So looking at these two components in isolation, it will result in a negative cash flow. But the asset side will also generate cash flows. These cash flows are larger (remark the scale of the y-axis), but also more volatile. They are mainly volatile due to the volatile nature of the total asset value. If we take these cash flows into account, we have the bottom right graph. In this graph the net cash flow is shown. As can be seen, it is for at least the first 10 years

above zero. So the probability of a net cash flow below zero is very small. In later years the probability grows, but it remains small.

Besides this the pension payments and contribution inflow are quite well predictable. Therefore years ahead a liquidity planning can be made, and if required, the investment strategy can be adjusted to these circumstances (e.g. invest in more liquid products).At the moment, the plan also takes this into account by investing about 30% in fixed income products which are relatively easy to liquidate.

6.2. Alternative Economic Assumptions

All the previous analyses are based on an economic scenario set with a certain view on the world. In this paragraph we will analyze the robustness of the proposed SAA2019 for other views on the world and a sensitivity check.

Therefore we composed two alternative economic scenario sets:

1. Low for Longer economic view
2. Higher risk premium

1) The low for longer economy is a view on the world. The philosophy is a Longer low interest rate environment instead of a reversing interest rate to higher levels. GDP growth is lower due to:

- The maturing population in the western world will have a reducing impact on the productivity
- The high debt ratio's in the world need to be paid-off, this will have a negative effect on the spending of consumers and governments.
- The QE programs are not successful in accelerating the economy

The lower GDP growth will translate itself into lower equity and real asset returns.

2) In this sensitivity check we increase the risk premium by 1%point. Depending on their beta, the individual risk premiums per portfolio are adjusted.

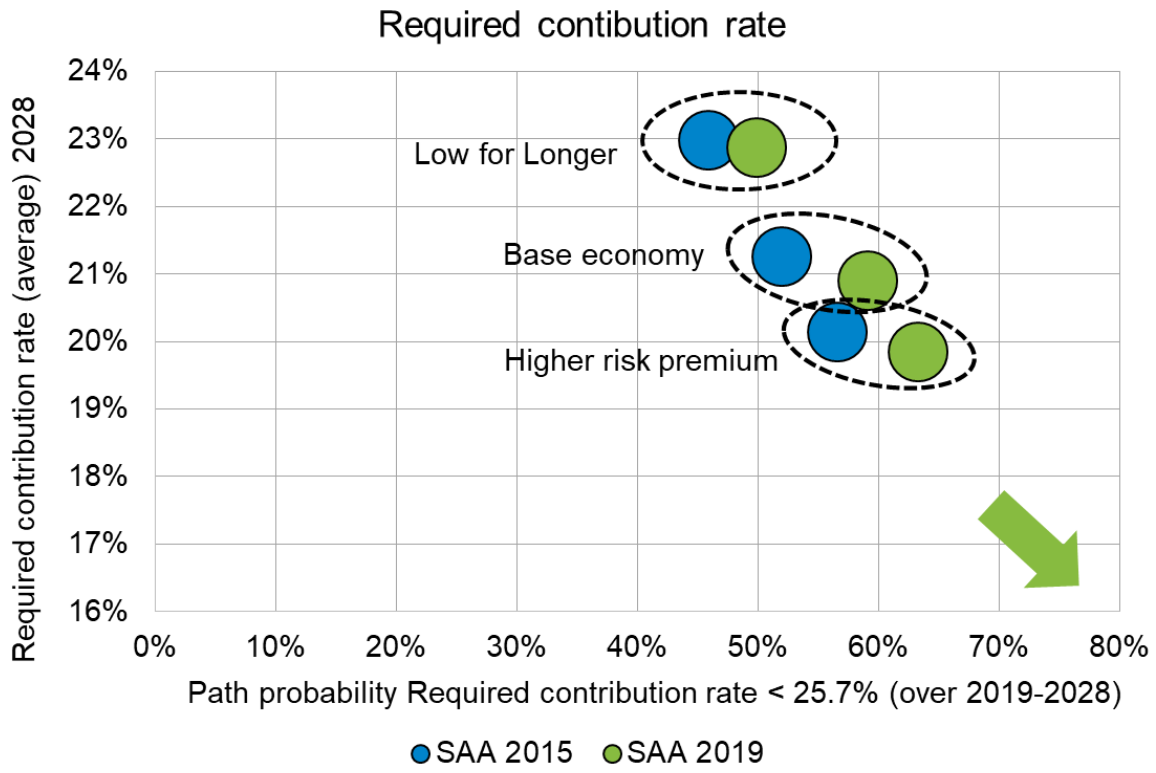
In the table below the economic assumptions per portfolio are shown.

Risk and return statistics (year 1-10)	Base Economy		Low For Longer		Higher Risk premium	
	Nominal returns		Nominal returns		Nominal returns	
	Geomean	Volatility	Geomean	Volatility	Geomean	Volatility
EQ Developed large cap	7.1%	17.6%	4.8%	17.5%	7.9%	17.7%
EQ Developed small cap	7.3%	22.9%	4.6%	22.6%	8.2%	23.1%
EQ Emerging markets	8.0%	25.8%	5.4%	25.6%	8.7%	25.9%
EQ Frontier markets	7.8%	29.9%	5.1%	29.5%	8.6%	30.1%
Private Equity	8.0%	25.6%	4.5%	25.0%	8.9%	25.8%
Real Estate	7.0%	19.1%	2.8%	18.3%	7.7%	19.2%
Infrastructure	5.9%	10.5%	3.6%	10.4%	6.4%	10.6%
Timberland	6.1%	18.8%	4.0%	18.5%	6.5%	18.9%
Commodities	4.1%	19.2%	3.3%	19.0%	4.1%	19.2%
Gold	1.9%	21.7%	1.0%	21.4%	1.9%	21.7%
Absolute return strategies	3.8%	6.5%	3.6%	6.5%	3.9%	6.5%
US Government Bonds (dur 6)	2.7%	4.7%	2.7%	4.6%	2.7%	4.7%
TIPS (dur 8)	2.9%	4.9%	2.6%	5.1%	2.9%	4.9%
US IG Credits (dur 7)	3.9%	7.4%	4.0%	7.7%	3.9%	7.4%
US HY Credits (dur 5)	4.8%	14.4%	4.4%	14.8%	4.8%	14.4%
US Agency MBS (dur 5)	3.0%	3.8%	2.8%	3.8%	3.0%	3.8%
EMD	4.7%	13.4%	3.9%	13.5%	4.9%	13.5%
Private debt	4.1%	8.5%	2.8%	8.6%	4.1%	8.5%
Cash	2.3%	1.1%	1.4%	1.2%	2.3%	1.1%

		Base Economy 2019-2028	Low for Longer 2019-2028	Higher Risk premium 2019-2028
Return				
Average price inflation	Over period	1.9%	1.4%	1.9%
Average wage inflation	Over period	2.2%	1.0%	2.2%

The Low for Longer return assumptions are considerably lower. Especially on the Growth assets. The lower interest rate will have a positive effect in the short term for the fixed income portfolios. In the long run however a negative. Because of the 10 year reporting period, the returns on fixed income are only a little lower than the base Economy. Also remark that the average price and wage inflations are considerably lower than in the Base economy.

The higher risk premium shows higher returns for the Growth assets. The fixed income and inflation assumptions are equal to the Base Economy.



The chart shows in blue the SAA2015 and in green the SAA2019. In all three clusters the SAA2019 improves on both the average Required contribution rate and on the Path probability criterion.

So this brings us to the conclusion that the change from SAA2015 to SAA2019 seems to be robust under alternative economic views.

6.3. Alternative Growth Assumptions Active Population

In the valuation assumption and also the real life simulation we assume a 0.5% growth of the active population for the first 10 years and that it remains constant afterwards. So we assume that after 10 years the active population has grown by about 5%.

In the open group valuation this expected growth assumption is taken into account.

In the analyses we look at the following cases:

1. 2% expected decline for the first 10 years, constant afterwards.
2. Expected growth of 0.5% for the first 10 years but an unexpected decline in 2020-2021 of -20%.

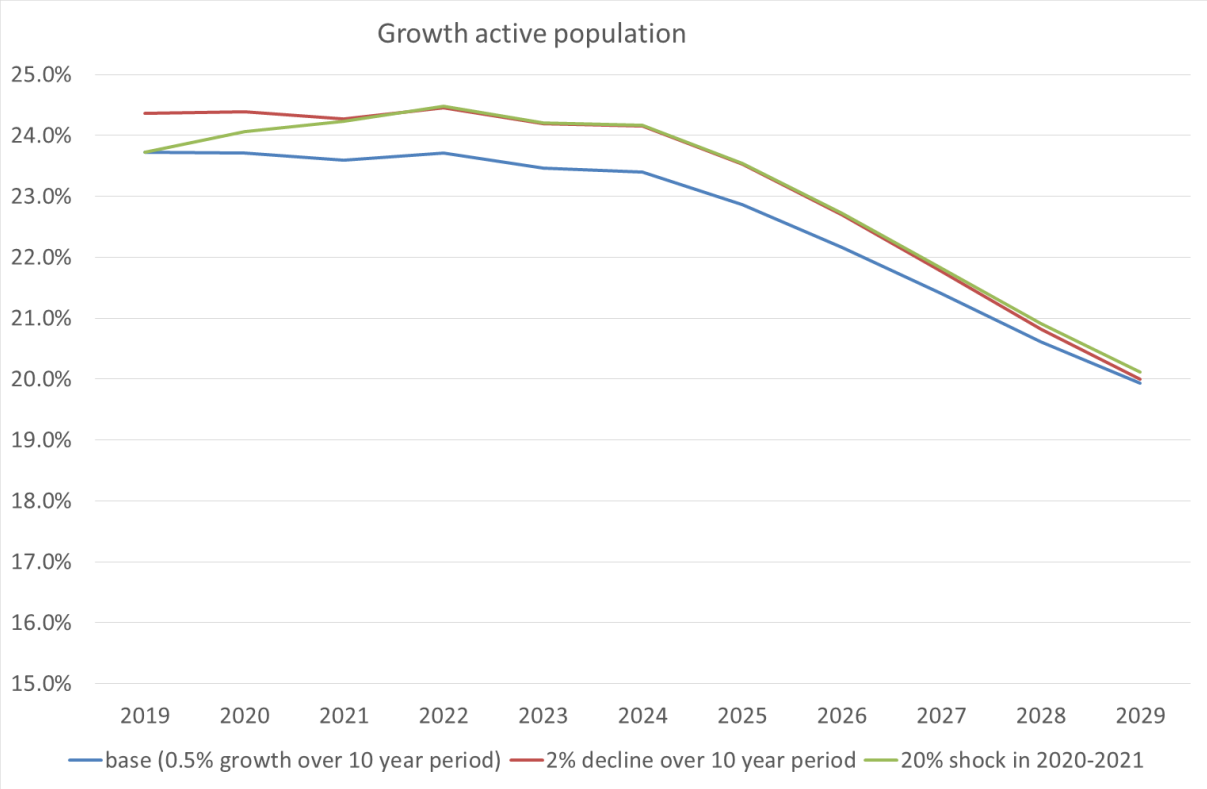
So in the second case the -20% decline comes as a surprise. All the other assumptions are expected and will have their (immediate) impact on the Liability of Future actives and Expected contributions of Future actives.

The left chart shows the Liability of the (then) current actives. The Liabilities all start at the same point. In the 2% expected decline, the liability value immediately starts to decrease. In the 2) case the liability value will be equal to the base case, but in 2021 it will start to drop as many leaving actives will not be replaced by new active members. Both alternative variants align, because in the end both alternatives assume more or less a -20% decline in the longer term.

The middle chart shows the liability of the future actives. Alternative 1) immediately shows an impact on the liability value at initiation. This is due to the 2% decline which is, in this case, immediately factored in in the liability of the future actives and obviously also in the expected contribution of the future actives. For the alternative 2) case the liability of the future actives is equal to the base case. Both situations assume the same growth rate of 0.5%. In 2020-2021, however, the unexpected decline in active population occurs. Because of the lower number of active members, also fewer future actives will be assumed. Therefore there is a steep decline in the liability for the future actives.

The right chart shows the impact of the two alternative cases for the expected contribution for current actives. The pattern is quite similar to the left chart (current active liabilities). The effect is, however, more pronounced. The explanation is that the non-entrance of new (young) members has very little impact on the liability, but a considerable impact on the payroll. The liability has an accumulating effect, unlike the payroll.

Below chart shows the Required contribution rate for the base case and the 2 alternatives.



The red line, the -2% expected growth case shows an immediate offset in the Required contribution rate. This is caused by the immediate reduction in future active liabilities and future expected contribution on the balance sheet. In the current assumptions an expected gain is assumed on the future population. And because that expected gain reduces, the surplus on the open group balance sheet will decline and hence the Required contribution rate will go up.

The alternative 2) and the base case start at the same Required contribution rate levels because in 2019 the expectations are equal. After the unexpected decline in 2020-2021 the required contribution rate will increase for the same reasons described for alternative 1).

The increases due to these alternative growth assumptions have, on average, an impact of about 0.8%. Based on today's balance sheet, the plan would remain within the corridor.

In the longer run we see that the Required contribution rate achieves similar levels. The initial offset disappears for two reasons:

1. The net present value of payroll declines in the two alternative cases. Consequently the expected gains are distributed over a lower base and the Required contribution rate declines faster.
2. In the long run, the cost of the plan does not change, so the model will eventually return to its steady state levels.

A decline in active population has also its impact on liquidity. In the first 10 years the benefit payments will not change substantially. At the contribution side, however, there is an immediate impact, the contributions will decrease significantly.

In the table below the risk of a net cash flow below 0 is shown.

	base (0.5% growth over 10 year period)	2% decline over 10 year period	20% shock in 2020-2021
2019-2026	very small	very small	very small
2027	0.0%	0.1%	0.1%
2028	0.0%	0.2%	0.2%
2029	0.0%	0.4%	0.4%
2030	0.1%	1.0%	0.9%
2031	0.2%	1.6%	1.3%
2032	0.2%	1.9%	1.9%
2033	0.3%	3.2%	3.0%
2034	0.8%	4.7%	4.1%
2035	1.1%	5.0%	4.4%
2036	1.6%	6.5%	5.9%
2037	1.9%	6.8%	6.5%
2038	2.3%	8.5%	8.0%
2039	2.6%	9.0%	8.7%
2040	2.9%	10.3%	9.7%
2041	3.1%	10.7%	9.8%
2042	3.9%	11.8%	11.1%
2043	4.2%	12.7%	11.7%
2044	4.8%	12.9%	12.1%
2045	5.4%	12.9%	11.9%
2046	5.7%	13.5%	12.1%
2047	6.1%	13.2%	12.7%
2048	6.7%	13.4%	12.8%

The table shows that the risk increases significantly in the long run. For the first ten years, the risk remains very small.

The table below shows the statistics for the three variants. The overall impact is limited.

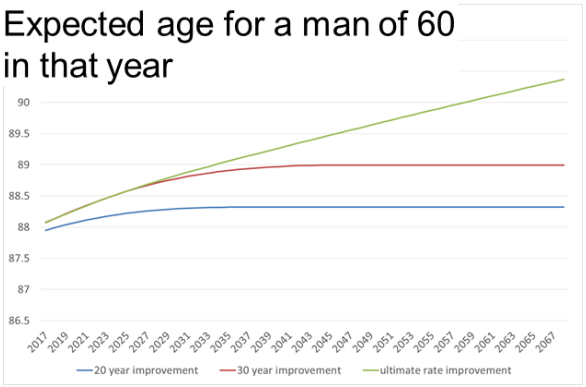
UN		Base		2% decline in 10 year		20% shock 2020-2021	
ALM results		2019-2028	2019-2048	2019-2028	2019-2048	2019-2028	2019-2048
Portfolio Return							
Geometric average investment return	Over period	6.7%	6.5%	6.7%	6.5%	6.7%	6.5%
St. dev. investment return	Over period	11.3%	11.7%	11.3%	11.7%	11.3%	11.7%
5% CVaR investment return	Over period	-17.3%	-18.2%	-17.3%	-18.2%	-17.3%	-18.2%
Probability real return > 3.5%	Over period	58.3%	57.4%	58.3%	57.4%	58.3%	57.4%
Contribution							
Average Required contribution rate	End of period	20.9%	2.9%	21.2%	0.8%	21.3%	1.6%
95% VaR Required contribution rate	End of period	30.2%	37.1%	33.0%	41.8%	32.8%	41.3%
Average Required contribution rate	Over period	23.0%	16.3%	23.6%	15.9%	23.5%	16.1%
95% VaR Required contribution rate	Over period	28.7%	32.3%	30.9%	35.8%	30.7%	35.4%
St.dev. of change Required contribution rate	Over period	1.1%	2.0%	1.3%	2.3%	1.3%	2.3%
Probability required contribution rate is < 25.7%	Over period	79.1%	77.2%	69.2%	70.0%	70.4%	70.6%
Probability required contribution rate is < 23.7%	Over period	53.8%	63.8%	42.4%	57.2%	46.7%	58.7%
Path probability Required contribution rate is < 25.7%	Over period	59.1%	47.3%	45.4%	36.5%	46.7%	37.4%
Path probability Required contribution rate is < 23.7%	Over period	24.4%	19.7%	10.0%	8.4%	19.3%	15.9%
Funded Ratio Open Group Liabilities							
Average funded ratio Open Group Liabilities, AVA	End of period	106.4%	144.5%	105.1%	146.7%	105.1%	145.8%
Probability funded ratio Open Group Liabilities, AVA > 100%	Over period	53.8%	63.8%	42.4%	57.2%	46.7%	58.7%
Probability funded ratio Open Group Liabilities, AVA > 100%	End of period	62.6%	73.3%	57.2%	70.0%	57.1%	69.9%
Funded Ratio Accrued Liabilities (with pension adjustment)							
Average funded ratio Accrued Liabilities (with pension adjustment)	End of period	111.7%	185.0%	108.9%	186.0%	108.5%	185.2%
Probability funded ratio Accrued Liabilities (with pension adjustment) > 100%	Over period	53.5%	62.5%	50.8%	59.1%	50.2%	58.8%
Probability funded ratio Accrued Liabilities (with pension adjustment) > 100%	End of period	60.4%	72.0%	55.8%	69.1%	55.4%	69.1%
Funded Ratio Accrued Liabilities (without pension adjustment)							
Average funded ratio Accrued Liabilities (without pension adjustment)	End of period	158.8%	259.1%	154.7%	257.0%	153.8%	256.4%
Probability funded ratio Accrued Liabilities (without pension adjustment) > 100%	Over period	96.5%	90.4%	95.5%	87.5%	95.1%	87.4%
Probability funded ratio Accrued Liabilities (without pension adjustment) > 100%	End of period	93.1%	84.5%	90.6%	80.3%	89.9%	80.4%

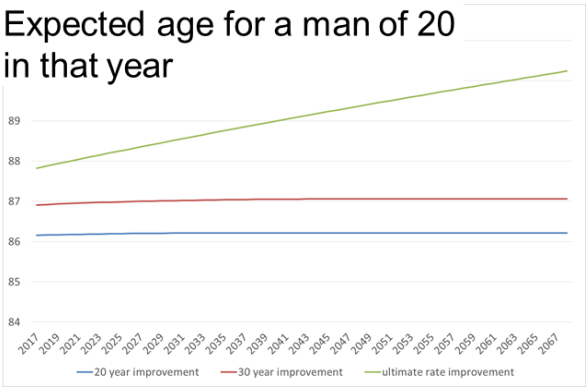
6.4. Alternative Mortality Rates

In the valuation assumptions it is assumed that mortality rates improve for another 20 years. In this paragraph we analyze the impact of alternative mortality rate improvements. These alternatives are:

- Change of the improvement period from 20 to 30 years
- After the base case improvement for 20 years, it is assumed that the mortality rates keep improving until infinity, at the smaller of the improvement rate (age, gender) and 0.0075

The graphs below show the impact of these alternative mortality rate assumptions for a man aged 60 and for a man aged 20.

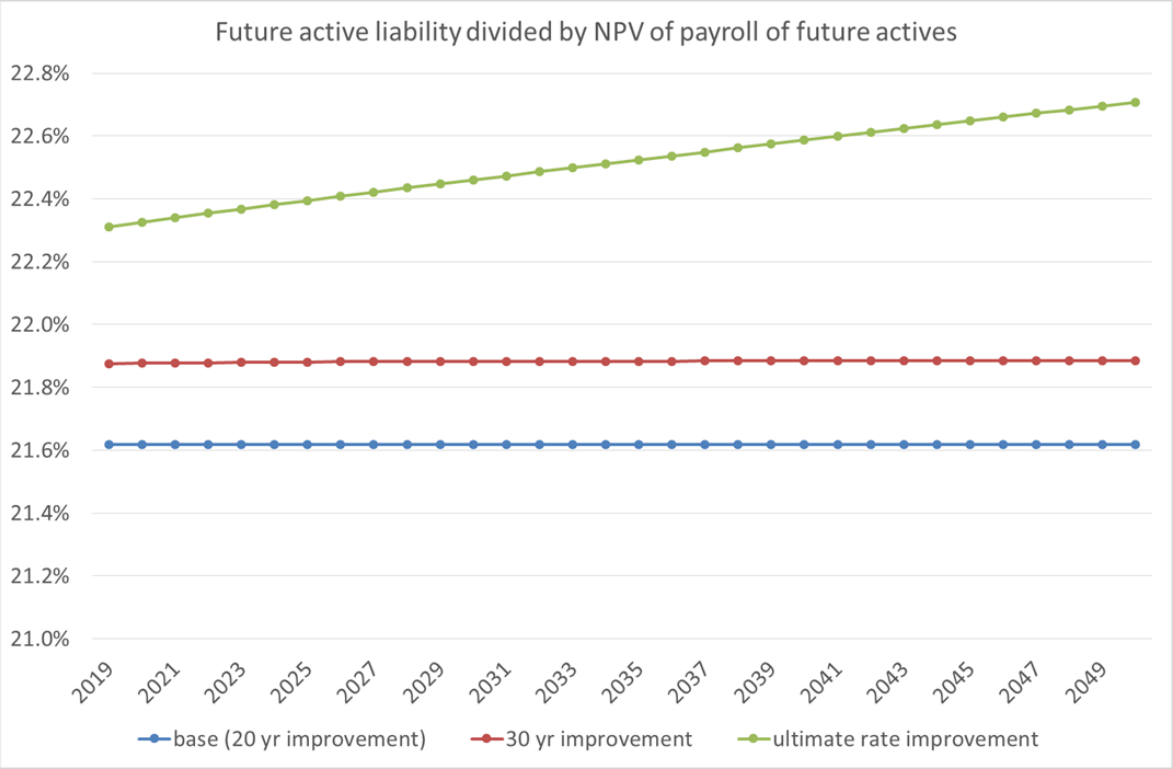




In the left chart we see that for the base case (blue) and 30 year improvement (red), the expected age of a 60 year old man remains constant. The green line keeps improving.

The mortality assumptions are a crucial part in the valuation of a plan and a fundamental element in determining the cost of the scheme.

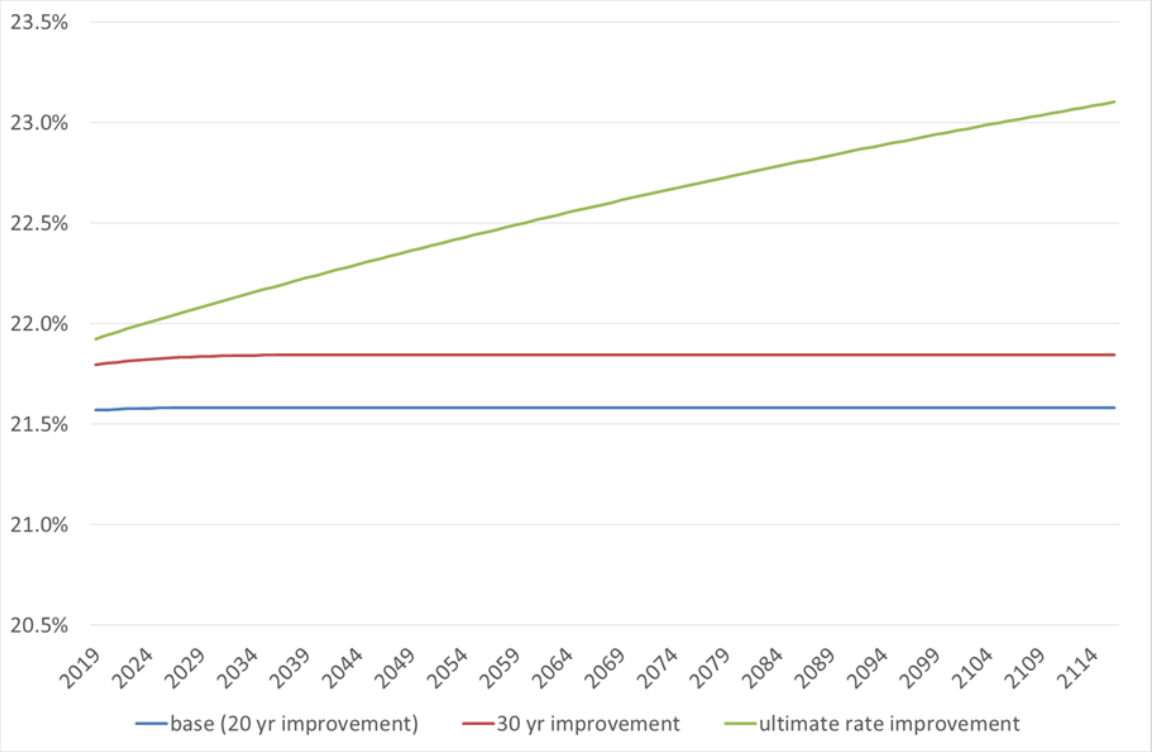
In the chart below the Future Active Liability is divided by the NPV of the payroll of these future actives. This gives an indication of the structural cost of the pension plan.



The blue (base case) and red (30 year improvement period) lines are nearly constant at levels of 21.6% versus 21.9%, so the cost of pension ruling increases by 0.3% of payroll. The green line (improvement until infinity) continues to increase over time as the mortality rate continues to improve.

In the above chart All future active members are taken into account. So all future improvements are already factored in, but due to the discounting there is an increase visible over time.

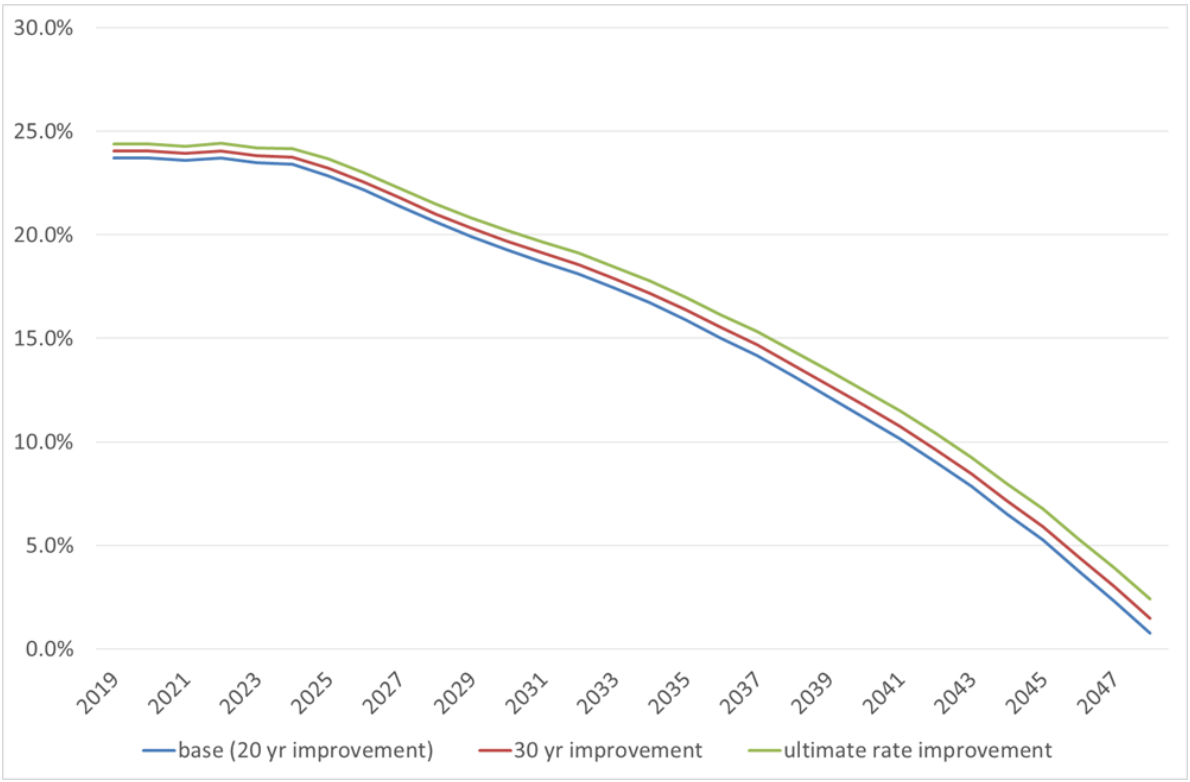
You could even zoom in more. In the chart below we only take into account the population in a single entrance year; so we isolate all members entering in the sample year 2025. We then look at their total expected liability and compare this with their NPV of payroll, the chart below shows the results.



Because we show a single entrance year and not All future actives like in the other chart, the effects are slightly more pronounced, e.g. the increase in the first years for the blue (base case) and red (30 year improvement) is now better visible.

In case of the green line, with improvement of mortality rates until infinity, the cost of a member entering in 2020 is about 21.9%. In 100 years from now, the cost of a member entering the plan in 2119 will have increased by 23.2%.

The charts up to now are based on actuarial analyses of the liabilities only. If we put this into perspective at a total plan level, we have the following results.



This chart shows the Required contribution rate for the base case (blue), the 30 year improvement (red) and the ultimate improvement (green). On a total plan level, there is some offset between the lines in terms of Required contribution rate, but it is quite small.

Mortality improvements is in this type of analyses a relatively slow process with low impact.

In the table below the statistics for the 3 assumptions are shown.

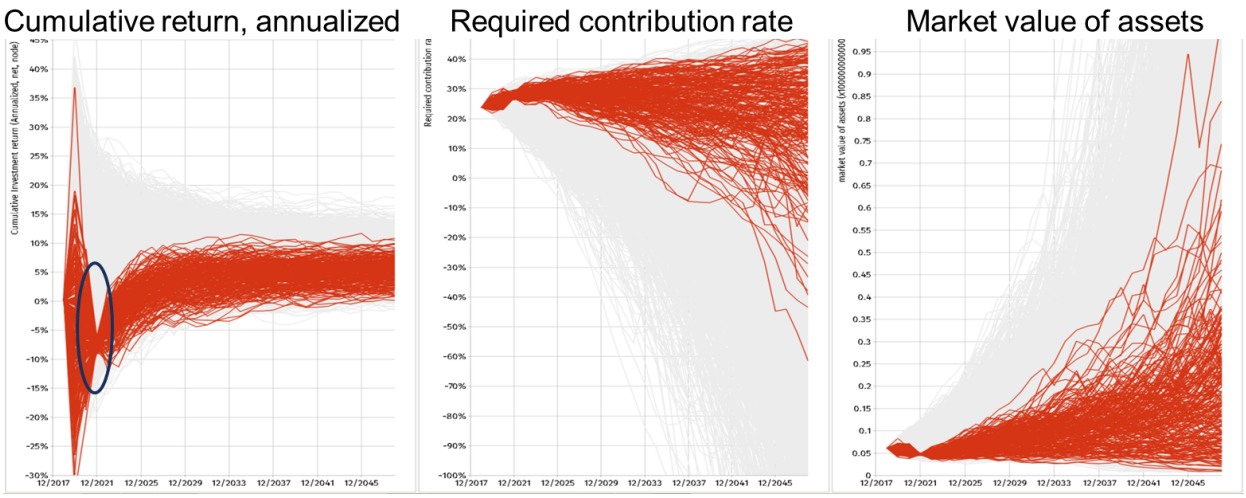
UN		Base		30 yr improvement		Ultimate improvement	
ALM results		2019-2028	2019-2048	2019-2028	2019-2048	2019-2028	2019-2048
Portfolio Return							
Geometric average investment return	Over period	6.7%	6.5%	6.7%	6.5%	6.7%	6.5%
St. dev. investment return	Over period	11.3%	11.7%	11.3%	11.7%	11.3%	11.7%
5% CVaR investment return	Over period	-17.3%	-18.2%	-17.3%	-18.2%	-17.3%	-18.2%
Probability real return > 3.5%	Over period	58.3%	57.4%	58.3%	57.4%	58.3%	57.4%
Contribution							
Average Required contribution rate	End of period	20.9%	2.9%	21.2%	0.8%	21.3%	1.6%
95% VaR Required contribution rate	End of period	30.2%	37.1%	33.0%	41.8%	32.8%	41.3%
Average Required contribution rate	Over period	23.0%	16.3%	23.6%	15.9%	23.5%	16.1%
95% VaR Required contribution rate	Over period	28.7%	32.3%	30.9%	35.8%	30.7%	35.4%
St.dev. of change Required contribution rate	Over period	1.1%	2.0%	1.3%	2.3%	1.3%	2.3%
Probability required contribution rate is < 25.7%	Over period	79.1%	77.2%	69.2%	70.0%	70.4%	70.6%
Probability required contribution rate is < 23.7%	Over period	53.8%	63.8%	42.4%	57.2%	46.7%	58.7%
Path probability Required contribution rate is < 25.7%	Over period	59.1%	47.3%	45.4%	36.5%	46.7%	37.4%
Path probability Required contribution rate is < 23.7%	Over period	24.4%	19.7%	10.0%	8.4%	19.3%	15.9%
Funded Ratio Open Group Liabilities							
Average funded ratio Open Group Liabilities, AVA	End of period	106.4%	144.5%	105.1%	146.7%	105.1%	145.8%
Probability funded ratio Open Group Liabilities, AVA > 100%	Over period	53.8%	63.8%	42.4%	57.2%	46.7%	58.7%
Probability funded ratio Open Group Liabilities, AVA > 100%	End of period	62.6%	73.3%	57.2%	70.0%	57.1%	69.9%
Funded Ratio Accrued Liabilities (with pension adjustment)							
Average funded ratio Accrued Liabilities (with pension adjustment)	End of period	111.7%	185.0%	108.9%	186.0%	108.5%	185.2%
Probability funded ratio Accrued Liabilities (with pension adjustment) > 100%	Over period	53.5%	62.5%	50.8%	59.1%	50.2%	58.8%
Probability funded ratio Accrued Liabilities (with pension adjustment) > 100%	End of period	60.4%	72.0%	55.8%	69.1%	55.4%	69.1%
Funded Ratio Accrued Liabilities (without pension adjustment)							
Average funded ratio Accrued Liabilities (without pension adjustment)	End of period	158.8%	259.1%	154.7%	257.0%	153.8%	256.4%
Probability funded ratio Accrued Liabilities (without pension adjustment) > 100%	Over period	96.5%	90.4%	95.5%	87.5%	95.1%	87.4%
Probability funded ratio Accrued Liabilities (without pension adjustment) > 100%	End of period	93.1%	84.5%	90.6%	80.3%	89.9%	80.4%

6.5. Sequencing

The plan needs to be managed in a stochastic environment. The most dominant stochastic elements enter the plan by means of asset returns, interest rate levels, price inflations and exchange rates; the stochastic economic drivers. Furthermore, there are the unexpected events at the liability side; e.g. other observed transition probabilities versus the expected decrement tables. All of these unexpected events lead to gains and losses on the balance sheet of the plan. Normally the plan is designed in such a way that it can absorb certain shocks and can recover. In this paragraph we focus on the economic uncertainty and we will show what the impact is in the longer term in case the plan ends up in less favorable economic circumstances.

For the analyses we apply the filtering technique. So we simulate 10,000 economic scenarios into the future for the plan. Then we can determine how the plan will react to these scenarios. By filtering the scenarios at certain negative return levels over a certain period of time, we can measure the response of the plan in these specific cases.

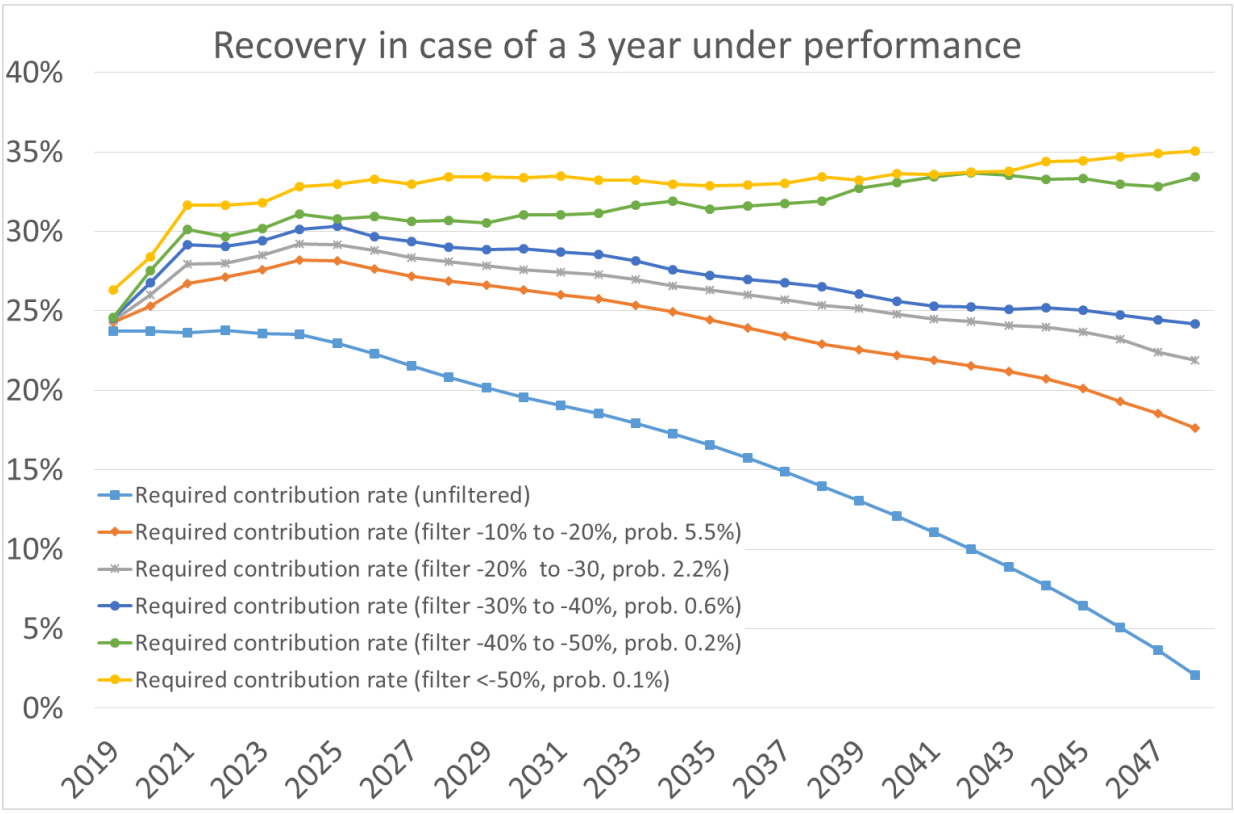
In the chart below we show how that filtering process works.



The left chart shows the cumulative annualized return. In this specific case we filtered the scenarios with an underperformance between -20% and -30% over a 3 year period. So technically described, we assume that the plan will make on average about 6.5% annually. Over a 3 year period, this means a 20.8% expected return. Next we filtered the scenarios with a return between [20.8%-30%, 20.8-20%]=[-9,2%, 0.8%].

The middle chart shows the scenarios which comply with this filter property for the Required contribution rate. The right chart shows the scenarios for the market value of assets which comply with this same filter.

In the next chart we show the average development of the Required contribution rate for the filtered scenarios, i.e. the average of the red scenarios in the middle chart.

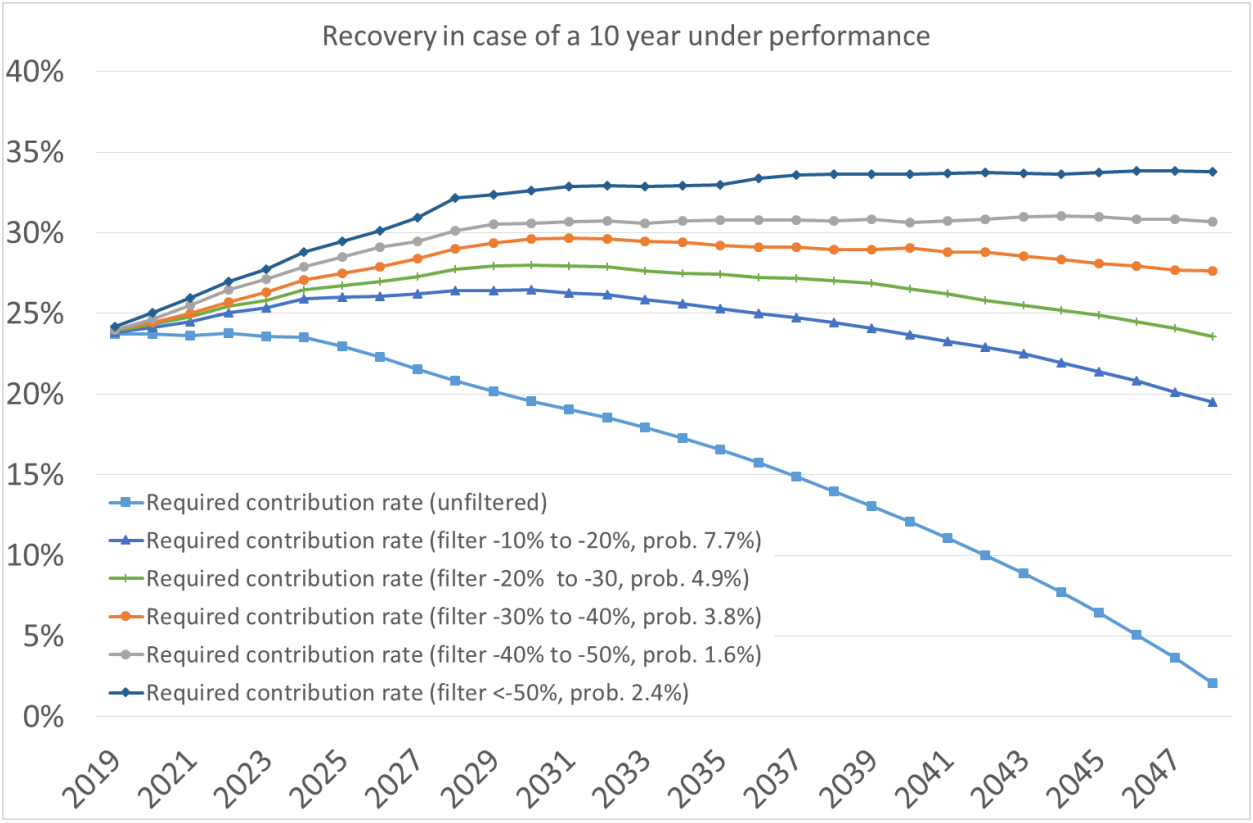


The chart above shows the average Required contribution rate for different filters. As can be observed, the average required contribution rate has a downward tendency in the long run for the filter cases up to -40%. The other two, more extreme cases show a constant development at high levels.

The description of the lines indicating the probability that one of the possible future outcomes is in a specific filter is also plotted. So in this case the probability that the plan is on the green line is about 0.2%. The probability that the plan is on the orange line is about 5.5%.

So based on this we can observe that the average Required contribution rate goes out of the corridor, but shows recovery strength.

In the chart below the same analyses is done, but now the filter is applied on a 10 year period.



The chart above shows the average required contribution rate for the different filters applied 10 years from now. Here we see that there is recovery possible up to an underperformance of -30%. Worse case economic circumstances lead to high level required contribution rates.

In case these negative downturns occur, the policies should be adjusted, either by changing the plan rules or increasing the contributions.

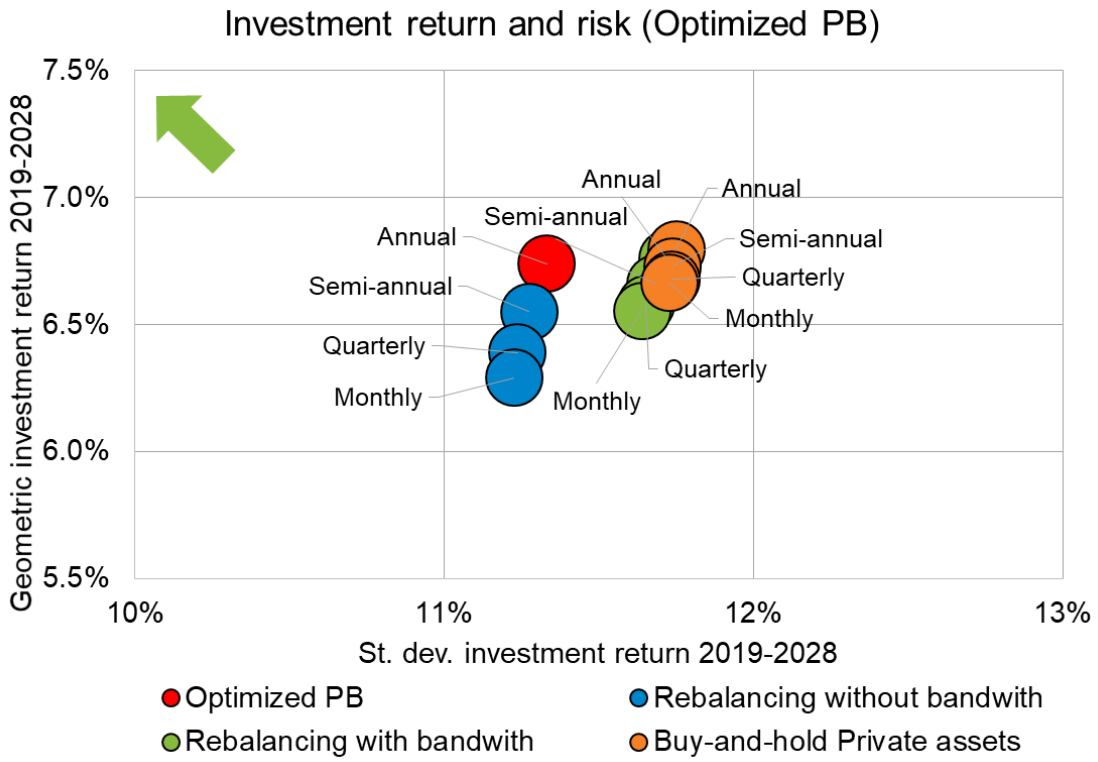
6.6. Rebalancing

In the analyses so far we assumed annual rebalancing to the strategic allocation. In this paragraph we will analyze the impact of higher frequency rebalancing, i.e. monthly, quarterly and semi-annual. Furthermore, we look at the impact of bandwidths on the target allocation at the top level in the fund hierarchy and a buy-and-hold strategy for Private Assets (including Private Equity, Real estate and Real assets).

Asset categories	Minimum	Optimized PB	Maximum
Public Equity	30%	45%	60%
Private Equity	4%	9%	15%
Real Estate	5%	12%	15%
Real Assets	1%	4%	5%
Fixed Income	10%	29%	60%
Cash	0%	1%	10%

We assume that the rebalancing costs are negligible. We have tested this as well, and the impact is indeed very small.

The chart below shows the impact of the rebalancing frequency, bandwidth and buy-and-hold.



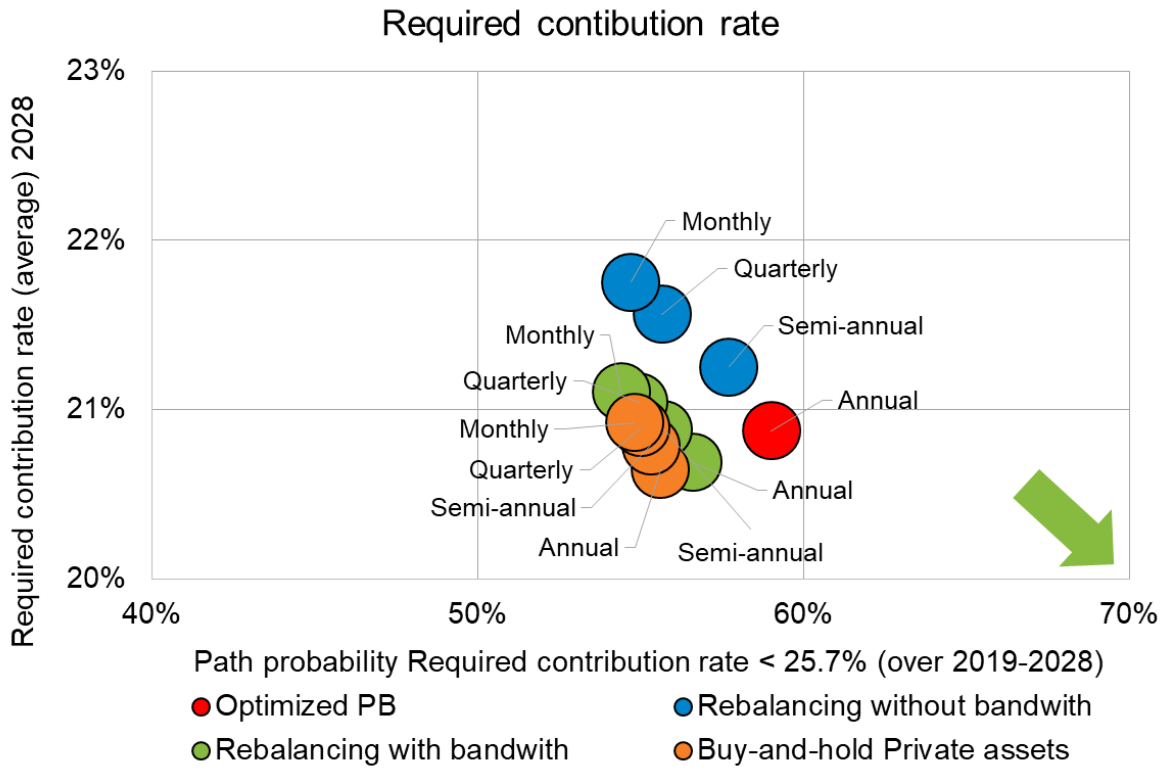
The red pie represents the SAA2019. As can be observed a higher frequency of rebalancing reduces the investment returns considerably and slightly reduces the volatility of the portfolio.

The reasons for this impact are:

- Higher return categories are overweight if a lower rebalancing frequency is applied
- Due to autocorrelation properties in asset returns the rebalancing timing is less favorable at higher frequencies

Introducing a bandwidth mainly has an impact on the high rebalance frequency cases. Due to the high bandwidth less rebalancing will take place at the monthly level and therefore it behaves more like an annual rebalancing strategy. The green pies cluster together closer to the SAA2019 strategy. This effect is also visible in the orange pies, which represent a buy-and-hold strategy for the private assets. The orange pies show even more clustering as rebalancing only takes place for the public asset classes when they exceed their bandwidths and therefore the difference between rebalancing frequencies is smaller.

The next chart shows the impact in Required contribution terms.



The chart shows the impact of higher rebalance frequency (blue), bandwidth (green) and buy-and-hold (orange). As expected, a higher rebalancing frequency has a negative impact on the average Required contribution rate and also on the path probability of a Required contribution rate below 25.7% due to lower average investment returns.

6.7. Currency exposure and Currency hedge

Many plans have currency exposure on the asset side on their balance sheet due to their investments in foreign countries. For the UNJSPF this holds as well. But in this plan there is also currency exposure at the liability side. The Two-Track option introduces currency exposure and risk to the plan.

First we will have a closer look at the currency exposure on the liability side, and in the following paragraph on the asset side and finally the combination.

6.7.1. Currency exposure at the liability side

Due to the Two-Track the plan pays part of the benefits in foreign currency. This introduces currency exposure.

In the Two-Track ruling the member ultimately is entitled to one of the following payments.

- Local Track benefit
- Cap amount (related to the 110% or 120% cap)
- Base amount
- Guaranteed amount (related to the 80% floor)
- USD track benefit

The first two are values denominated in a NON-USD currency and hence are currency exposure. The last 3 are denominated in USD and therefore are not currency exposure. The plan may pay these amounts in a different currency, but then the plan just converts the amounts to the other currency, it is not exposed to the currency risk, implying that changes in exchange rate will introduce a gain\loss for the plan.

At an individual level the actual pay-out will be determined for each member on the Two-Track. Depending on how the amounts evolve over time (due to CPI US, CPI local and exchange rates) the currency exposure can change at an individual level, and hence also at the total level of the plan.

So when simulating the Two-Track benefit payments, we can make a split between the amounts paid with exposure and without exposure. Taking the exposure payments and discounting them with the 6% discount rate gives a value for the currency exposure.

This only has to be done for current Non-active members. They already have opted in on the Two-Track and their local track benefit has been determined.

For Active members, the local track is not determined yet, and is dependent on the average exchange rate at a future point in time when the active member separates from his active status based on a 36 months average exchange rate. This exposure is neglected.

Below table shows the numbers for the current non-active members.

Bn USD	EURO	CH	UK	CAN	JPN	Total
Current Non-Actives	$3.29	$2.41	$0.20	$0.12	$0.11	$6.14

The major Two-Track currencies show up again; the Euro and the CHF. The total currency exposure due to the Two-Track is estimated to be 6.1 billion USD.

Due to the option nature of the Two-Track this exposure can change rapidly. If the USD weakens, the exposure to foreign currencies will rapidly grow.

In the table below the exposure at different percentile levels is determined.

BN USD	EURO	CH	UK	CAN	JPN	Total
0	$0.43	$0.30	$0.01	$0.04	$0.01	$1.01
0.1	$1.99	$1.35	$0.15	$0.09	$0.05	$3.79
0.2	$2.40	$1.59	$0.16	$0.10	$0.06	$4.43
0.3	$2.66	$1.81	$0.17	$0.11	$0.07	$4.95
0.4	$2.86	$2.04	$0.18	$0.11	$0.08	$5.35
0.5	$3.06	$2.30	$0.19	$0.11	$0.10	$5.83
0.6	$3.29	$2.54	$0.20	$0.12	$0.12	$6.29
0.7	$3.65	$2.82	$0.21	$0.12	$0.14	$6.92
0.8	$4.17	$3.18	$0.24	$0.13	$0.16	$7.71
0.9	$4.92	$3.68	$0.28	$0.15	$0.20	$9.00
1	$10.76	$6.77	$0.47	$0.31	$0.43	$17.49

There is some diversification effect between the currencies, but that is relatively low. This is mainly due to the central role of the USD which determines, for a large part, the outcome.

Furthermore, note that the dispersion in Japanese Yen is larger than in the Canadian dollar. This is also related to the high correlation between the economies of Canada and the US.

The discussion so far is about measuring the exposure by means of discounting the actual payments.

In the liability valuation, however, this exposure is not taken into account. All benefits are valued on the USD track benefit. Even if the Local Track benefit is much higher in value than the USD track benefit, the valuation only looks at the USD track benefit. The cost of the

Two-Track is factored in by adding a loading on the liability value. This is done by splitting the expected cost of the Two-Track (2.1% of NPV of payroll) over the liabilities for current Actives, Non-actives and future actives at a ratio of 4:1 for Active membership versus non-active membership. This exercise results in a loading on the non-active liabilities of 1.7% and a loading of 6.8% for the current Actives and Future actives liabilities.

This could lead to the strange situation that hedging the currency risk of the liabilities (in this case buying exposure in the euro and CHF currency) will be rewarded in the long term as the actual benefit payments will show the same exposure, but in the short term in balance sheet terms, e.g. the Required contribution rate would show more volatility behavior because the balance sheet definition does not take this currency exposure into account on the liability side.

6.7.2. Currency exposure at the asset side

On the asset side of the balance sheet there is currency exposure. The plan is a global investor. In the modelling of the assets we assumed a currency exposure in the public and private Equity investments. The real assets were modelled based on a USD denominated benchmark. The plan, however, invests for instance in real estate on a global basis. In the modelling of the fixed income portfolio we assumed that the new US only benchmark would already be implemented. In the current allocation, however, global fixed income investment are still present.

Therefore the estimate of the currency exposure based on the benchmark modeling we applied will be an underestimation of the current currency exposure.

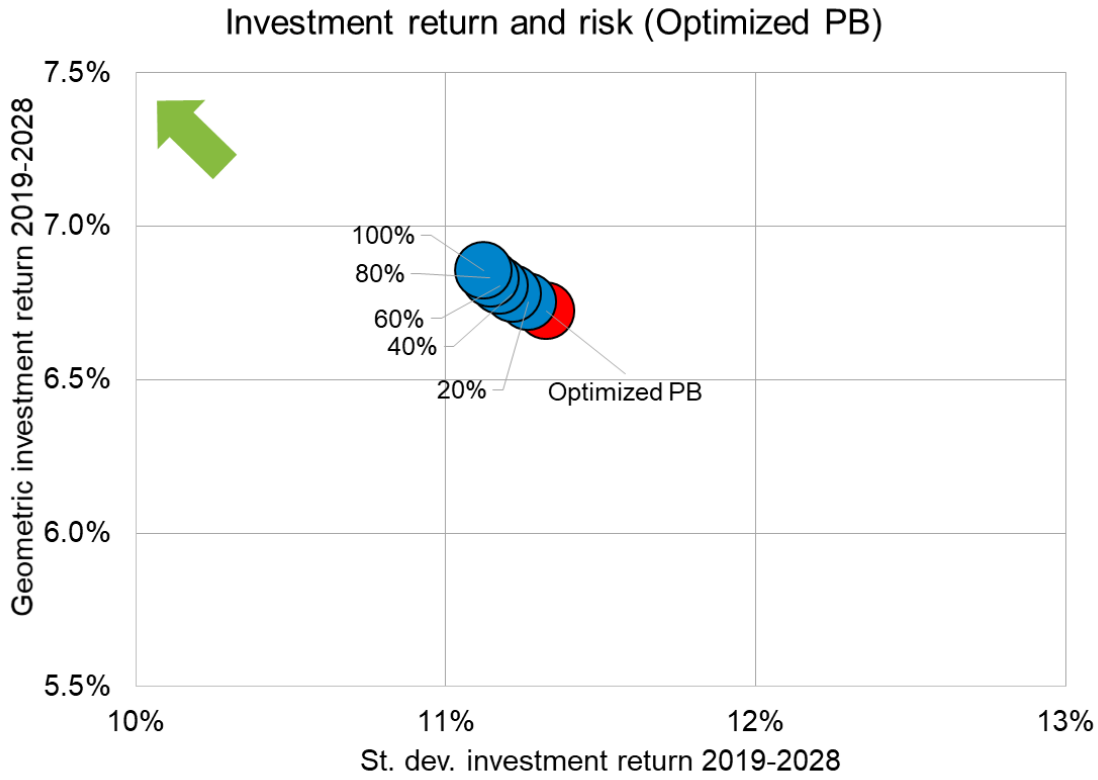
The table below shows the currency exposure based on these benchmark modeling

	Exposure (Bn USD)
EUR	3.5
JPY	2.7
GBP	1.9
CAD	1.1
CHF	1.0

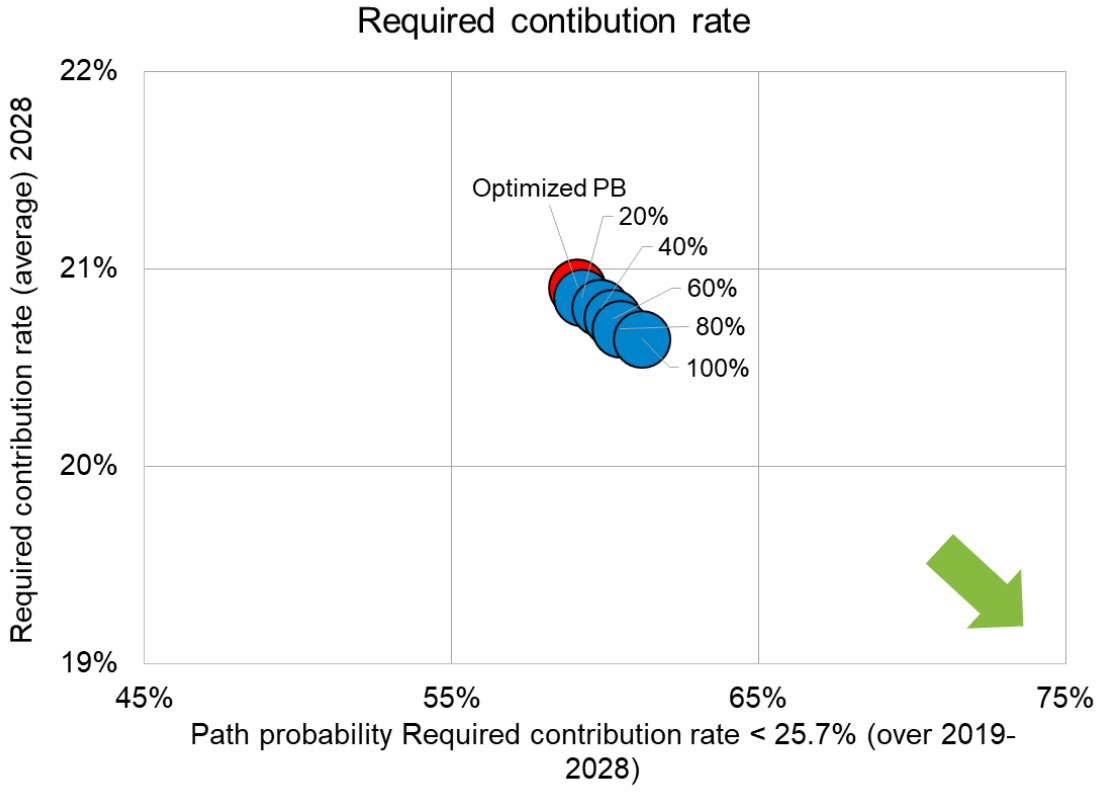
6.7.3. Currency exposure at the total balance sheet level

At the balance sheet level we are confronted with the exposures at the asset side and in an indirect way with the currency exposure at the liability side. In the balance sheet change from year to year, the currency risk from the liabilities is hardly visible because this risk will only emerge in the asset value of the plan via the benefit payment. So to measure the currency risk from the liabilities we would need to simulate the balance sheet for instance 30 years from now because in that case the cumulative effect of the realized currency exposures will be visible in the asset value after 30 years.

In the graph below we apply a currency hedge at the asset side of the balance sheet on all foreign currency exposures.



We can see that currency hedging improves the average and risk for the Required contribution rate. This is the result of interest rate differentials between USD and other currencies, and shows that it is profitable to hedge foreign currency exposure.



In the table below statistics are summarized.

UN ALM results		Optimized PB 2019-2028	20% hedge 2019-2028	40% hedge 2019-2028	60% hedge 2019-2028	80% hedge 2019-2028	100% hedge 2019-2028
Portfolio Return							
Geometric average investment return	Over period	6.7%	6.8%	6.8%	6.8%	6.8%	6.9%
St. dev. investment return	Over period	11.3%	11.3%	11.2%	11.2%	11.1%	11.1%
5% CVaR investment return	Over period	-17.3%	-17.2%	-17.1%	-17.1%	-17.0%	-17.0%
Probability real return > 3.5%	Over period	58.3%	58.5%	58.7%	58.8%	58.9%	59.0%
Contribution							
Average Required contribution rate	End of period	20.9%	20.9%	20.8%	20.7%	20.7%	20.6%
95% VaR Required contribution rate	End of period	30.2%	30.1%	30.1%	30.0%	30.0%	30.0%
Average Required contribution rate	Over period	23.0%	23.0%	22.9%	22.9%	22.9%	22.8%
95% VaR Required contribution rate	Over period	28.7%	28.7%	28.6%	28.5%	28.5%	28.5%
St.dev. of change Required contribution rate	Over period	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%
Probability required contribution rate is < 25.7%	Over period	79.1%	79.4%	79.7%	80.1%	80.4%	80.7%
Probability required contribution rate is < 23.7%	Over period	53.8%	54.2%	54.6%	55.1%	55.4%	55.8%
Path probability Required contribution rate is < 25.7%	Over period	59.1%	59.3%	59.9%	60.3%	60.5%	61.2%
Path probability Required contribution rate is < 23.7%	Over period	24.4%	24.8%	25.2%	25.5%	25.7%	26.1%
Funded Ratio Open Group Liabilities							
Average funded ratio Open Group Liabilities, AVA	End of period	106.4%	106.5%	106.7%	106.8%	106.9%	107.0%
Probability funded ratio Open Group Liabilities, AVA > 100%	Over period	53.8%	54.2%	54.6%	55.1%	55.4%	55.8%
Probability funded ratio Open Group Liabilities, AVA > 100%	End of period	62.6%	63.1%	63.5%	64.5%	65.0%	65.7%
Funded Ratio Accrued Liabilities (with pension adjustment)							
Average funded ratio Accrued Liabilities (with pension adjustment)	End of period	111.7%	112.0%	112.2%	112.5%	112.8%	113.0%
Probability funded ratio Accrued Liabilities (with pension adjustment) > 100%	Over period	53.5%	54.0%	54.5%	54.9%	55.2%	55.6%
Probability funded ratio Accrued Liabilities (with pension adjustment) > 100%	End of period	60.4%	61.0%	61.7%	62.2%	62.5%	62.9%
Funded Ratio Accrued Liabilities (without pension adjustment)							
Average funded ratio Accrued Liabilities (without pension adjustment)	End of period	158.8%	159.2%	159.6%	160.0%	160.3%	160.7%
Probability funded ratio Accrued Liabilities (without pension adjustment) > 100%	Over period	96.5%	96.7%	96.8%	96.9%	97.0%	97.1%
Probability funded ratio Accrued Liabilities (without pension adjustment) > 100%	End of period	93.1%	93.2%	93.6%	93.5%	93.7%	93.8%

As discussed, the currency exposure due to the Two-Track comes in the balance sheet in an indirect way, and only cumulates in the longer run in the asset value of the plan. Due to the interaction between all the risk drivers this expected effect could not be found. Some experiments have been done for the non-actives in isolation, where we assumed an investment in a fictive index linked bond, i.e. matching with the liabilities. In that experiment we could see the improvement in the long run by taking currency exposure on the balance sheet.

7. Benchmarks for performance measurement

7.1. Benchmark introduction

Measuring the performance of a pension plan is usually done by comparing the actual returns of the plan with a relevant benchmark. For some asset classes this is relatively straight forward, e.g. for Equity returns one could take the MSCI as the benchmark.

For Private asset investments this is more difficult. The market is not very liquid and it is hard to find comparable investments. In this chapter we present an overview what other plans do, from a regional perspective, size of the plan and per type of private asset investment.

7.2. Types of benchmarks

Below diagrams give an overview of the different methods. Per method we give a definition, in which region it is applied most 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 UK, Canada and Australia	Occasionally used, mainly in the Netherlands	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, and the 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	Hedge Fund indices
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	Hedge funds use comparable strategies
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	Occasionally used by the largest pension funds worldwide
Example	Return of private equity portfolio	CEM benchmarking	Beat a 6% hurdle rate, or return more than 0%	HFRI Equity Distressed for distressed private debt investments

So 10 different methodologies can be defined.

There are a number of criteria which make a certain benchmark approach more suitable than another one. The table below shows the different benchmark methodologies with a score on the different criteria.

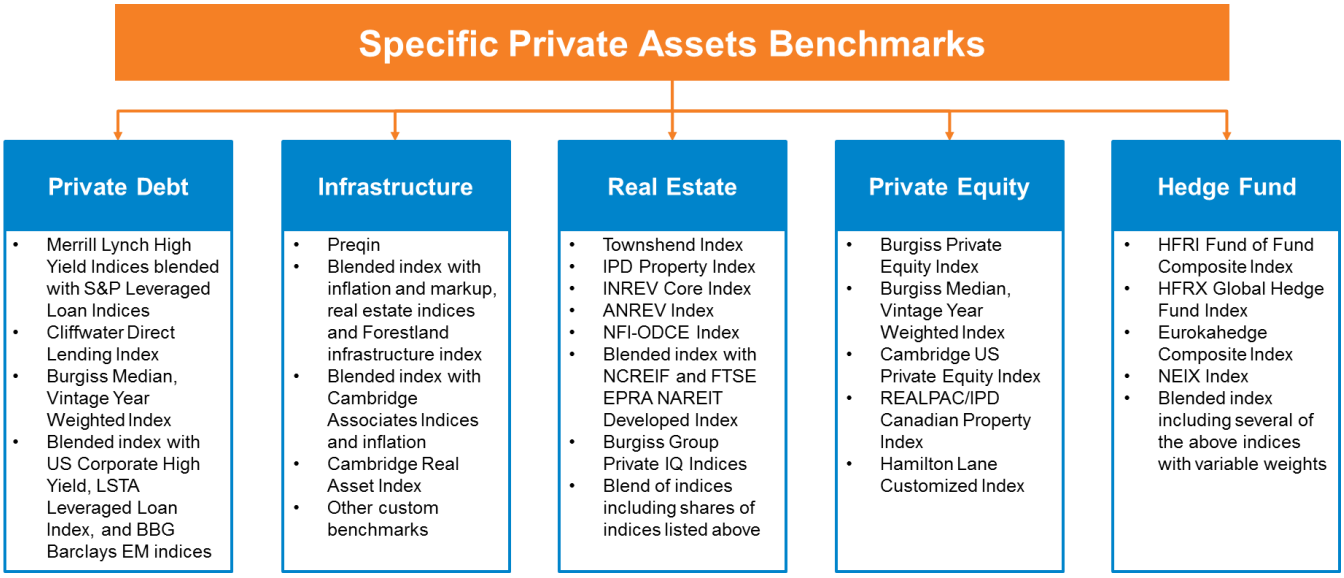
	Representative for the investment universe	*Representative for the risk profile of the investment*	*Representative for the goal of the investment*	*Transparent methodology*	*Investable*	*Availability (timely and against low costs)*	*Independent*	*Accepted by peer group*
Specific private assets benchmark	✓	✓	✓	✗	○	✗	○	✓
Listed equivalent + additional return	○	○	✓	✓	○	✓	✓	✓
Opportunity cost / reference portfolio	✗	✗	✓	✓	○	✓	✓	○
Listed equivalent	○	○	○	✓	✓	✓	✓	○
Portfolio return	○	○	✗	○	✗	✓	✗	✗
Short rate + additional return	✗	✗	○	✓	○	✓	✓	○
Inflation + additional return	✗	✗	○	✓	○	✓	✓	✓
Absolute Return	✗	✗	✗	✓	✗	✓	✓	✗

✓ Adequate ✗ Inadequate ○ Suboptimal

The first 4 score well in general. But in some cases other benchmark methods might be preferable for specific reasons. e.g. the specific private assets benchmark scores an inadequate for Availability. At the UNJSPF there is a preference to report timely, therefore it might not be a suitable approach.

Another consideration is the allocation to the specific private asset. If the allocation is low, the overall impact of the benchmark choice on the aggregate levels is small.

The chart below shows examples of specific private asset benchmarks per type of private asset.



7.3. Benchmarks for UNJSPF

Based on the information provided the benchmarks currently applied were reviewed. The most important criteria applied were:

- Availability (timely delivery)
- Representative for the actual investment
- The asset allocation

For the Private equity the Public equity customized benchmark + 200bp was chosen. There are private asset benchmarks, but the delivery is too slow. Therefore, a public benchmark plus spread was preferred.

For the Real Estate the NCREIF NFI-ODCE was chosen. This benchmark is representative for the actual investment. The benchmark is published with a delay, but that delay is accepted.

For Real Assets the CPI US+400bp was chosen. The allocation to this category is relatively low and the underlying assets are difficult to replicate with a private asset benchmark. Therefore, this method was the most practical one.

8. Conclusions and Recommendations

8.1. Current and Recommended Strategic Asset Allocation

The current strategic asset allocation (SAA2015) consists of 1.5% cash, 26.5% global fixed income, 9% real estate, 5% private equity and 58% public equity. The expected portfolio return is on average sufficient, assuming a contribution rate of 23.7%, to result in an increasing projected average funded ratio for the coming years.

However, due to increased uncertainty, the volatility of the future projected funded ratio also increases significantly; on the upside as well as on the downside. This will lead to an increasing probability that the required contribution rate will fall outside the 2% corridor of being smaller than 21.7% and larger than 25.7%, reaching a 50% chance for both sides in 10 years' time.

Based on the ALM analyses we recommend a moderate change in the strategic asset allocation as is indicated in below table.

	SAA 2015	SAA 2019
Total assets	**100%**	**100%**
Growth Assets	**72%**	**70%**
Public Equity	58%	45%
Private Equity	5%	9%
Real Estate	9%	12%
Real Assets	0%	4%
Non-Growth Assets	**28%**	**30%**
Fixed income	26.5%	29%
Cash	1.5%	1%

Compared to the old SAA2015, the new SAA2019 consists of a slightly higher allocation to Fixed Income (30% instead of 28%), and higher allocations to private equity and real estate at the cost of a lower allocation to public equities.

The ALM analyses clearly show that the new SAA2019 results in lower risk, i.e. the probability of the required contribution rate being smaller than 25.7% is higher. This improvement also holds for other risk and return criteria.

To further improve the strategic investment portfolio we recommend on lower asset level slightly higher allocations to absolute return strategies, infrastructure, timber- agriculture and farmland and US private debt. This will further improve the risk/return profile. These changes also ensure that the strategic asset allocation will be more diversified and robust. The suggested changes are also in line with what can be observed during the last few years at other large pension plans around the globe.

This recommendation depends on the willingness of the fund to take risk (risk tolerance level), which is assumed to be investing 70% in growth (equity-type) assets and supported by the ALM analyses.

Although the new strategic asset allocation will result in a lower probability that the required contribution rate will be higher than 25.7%, there is still a good chance that this will happen in the next 10 years. We therefore recommend the fund to already analyze and discuss possible policy measures in case this situation arises.

8.2. Liquidity

In the ALM study we have analyzed the liquidity risk for the fund. By liquidity risk we mean the risk that the fund comes in a position that assets have to be sold to be able to make cash payments (e.g. benefit payments).

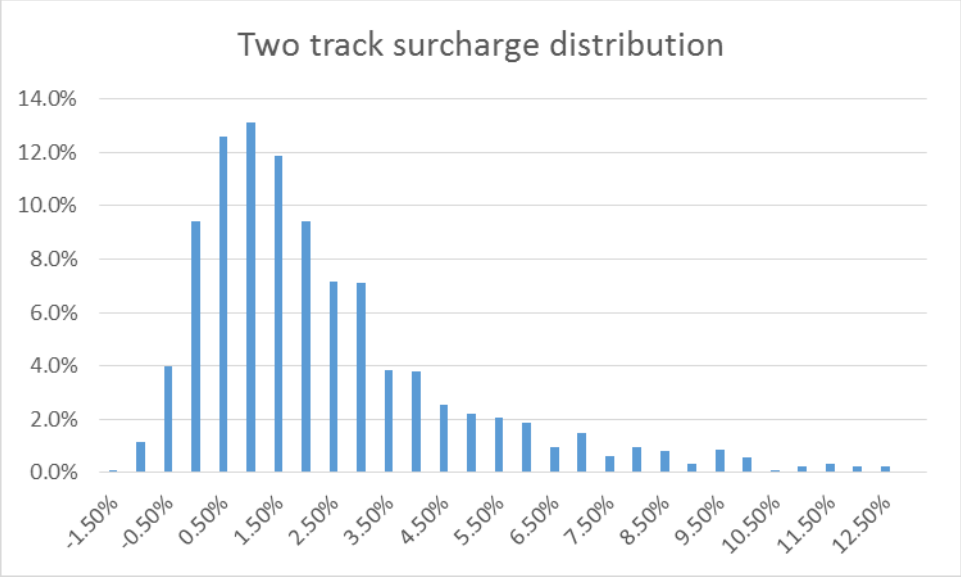
First we have projected the liability cash flows: incoming contributions and outgoing benefit payments. The net liability is negative (-350 million. USD) and the liability deficit is expected to increase over time (-1.1 billion USD after 10 years) due to maturing of the fund.

However, the incoming cash flows from the assets are more than sufficient to cover the net liability cash flow deficit. During the first 10 years the probability of liquidity issues is negligible.

8.3. Two-Track system

In the ALM study we have also modelled and analyzed the Two-Track system. Based on our projections the expected cost loadings are comparable to the figures and results of the latest actuarial report.

We have also found that the projected cost level of the Two-Track system can vary considerably as is indicated in the table below.



The future cost of the Two-Track system is highly depending on the exchange rate changes, i.e. if the USD decreases in value compared to the especially the Euro and the Swiss franc.

The Two-Track system results in liability currency exposures for various foreign currencies. The exposures for the Euro and Swiss Franc are the largest. The Euro exposure is hedged with sufficient Euro exposures on the asset side, this is not the case for the Swiss franc.

We recommend to further investigate the possibilities of implementing strategic currency hedging within the fund.

9. Appendices

9.1. Benchmarks per region, asset type and benchmark method

Based on desktop research the benchmarks applied by the largest plans around the globe were determined. The Willis Towers Watson 2017 list of largest plans in the world was used as the list of plans to look at. In the tables below an overview of their preferences is shown. Remark that in some categories the number of plans is relatively low. So the law of large numbers does not apply.

9.1.1. Private Debt

Asset Size (billion USD)	0-20	20-50	50-100	>100	Total
Opportunity cost / reference portfolio	n.a.	9%	20%	20%	14%
Listed equivalent	n.a.	36%	0%	20%	24%
Specific private assets benchmark	n.a.	27%	20%	0%	19%
Portfolio return	n.a.	0%	60%	0%	14%
Short rate + additional return	n.a.	9%	0%	20%	10%
Listed equivalent + additional return	n.a.	0%	0%	40%	10%
Inflation + additional return	n.a.	0%	0%	0%	0%
Absolute Return	n.a.	18%	0%	0%	10%
No Benchmark	n.a.	0%	0%	0%	0%
Total	n.a.	100%	100%	100%	100%
# Pension Funds	0	11	5	5	21

Region	Europe	North America	Asia and ME	Oceania	Total
Opportunity cost / reference portfolio	14%	17%	0%	n.a.	14%
Listed equivalent	29%	17%	0%	n.a.	24%
Specific private assets benchmark	0%	50%	100%	n.a.	19%
Portfolio return	21%	0%	0%	n.a.	14%
Short rate + additional return	14%	0%	0%	n.a.	10%
Listed equivalent + additional return	7%	17%	0%	n.a.	10%
Inflation + additional return	0%	0%	0%	n.a.	0%
Absolute Return	14%	0%	0%	n.a.	10%
No Benchmark	0%	0%	0%	n.a.	0%
Total	100%	100%	100%	n.a.	100%
# Pension Funds	14	6	1	0	21

9.1.2. Infrastructure

Asset Size (billion USD)	0-20	20-50	50-100	>100	Total
Opportunity cost / reference portfolio	0%	8%	17%	13%	10%
Listed equivalent	0%	8%	0%	0%	3%
Specific private assets benchmark	0%	31%	17%	38%	28%
Portfolio return	0%	0%	33%	0%	7%
Short rate + additional return	50%	8%	17%	13%	14%
Listed equivalent + additional return	0%	8%	0%	0%	3%
Inflation + additional return	50%	23%	17%	38%	28%
Absolute Return	0%	15%	0%	0%	7%
No Benchmark	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%
# Pension Funds	2	13	6	8	29

Region	Europe	North America	Asia and ME	Oceania	Total
Opportunity cost / reference portfolio	21%	0%	0%	0%	10%
Listed equivalent	7%	0%	0%	0%	3%
Specific private assets benchmark	7%	46%	100%	0%	28%
Portfolio return	14%	0%	0%	0%	7%
Short rate + additional return	14%	15%	0%	0%	14%
Listed equivalent + additional return	7%	0%	0%	0%	3%
Inflation + additional return	14%	38%	0%	100%	28%
Absolute Return	14%	0%	0%	0%	7%
No Benchmark	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%
# Pension Funds	14	13	1	1	29

9.1.3. Real Estate

Asset Size (billion USD)	0-20	20-50	50-100	>100	Total
Opportunity cost / reference portfolio	0%	4%	5%	0%	4%
Listed equivalent	0%	4%	0%	0%	2%
Specific private assets benchmark	100%	58%	70%	90%	70%
Portfolio return	0%	13%	5%	0%	7%
Short rate + additional return	0%	0%	10%	0%	4%
Listed equivalent + additional return	0%	0%	5%	0%	2%
Inflation + additional return	0%	13%	0%	10%	7%
Absolute Return	0%	8%	5%	0%	5%
No Benchmark	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%
# Pension Funds	3	24	20	10	57

Region	Europe	North America	Asia and ME	Oceania	Total
Opportunity cost / reference portfolio	7%	0%	0%	0%	4%
Listed equivalent	4%	0%	0%	0%	2%
Specific private assets benchmark	59%	84%	50%	67%	70%
Portfolio return	11%	4%	0%	0%	7%
Short rate + additional return	4%	4%	0%	0%	4%
Listed equivalent + additional return	4%	0%	0%	0%	2%
Inflation + additional return	4%	4%	50%	33%	7%
Absolute Return	7%	4%	0%	0%	5%
No Benchmark	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%
# Pension Funds	27	25	2	3	57

9.1.4. Private Equity

Asset Size (billion USD)	0-20	20-50	50-100	>100	Total
Opportunity cost / reference portfolio	0%	6%	7%	9%	6%
Listed equivalent	50%	18%	7%	9%	15%
Specific private assets benchmark	0%	24%	33%	27%	26%
Portfolio return	25%	6%	13%	0%	9%
Short rate + additional return	0%	0%	0%	0%	0%
Listed equivalent + additional return	0%	29%	33%	45%	32%
Inflation + additional return	25%	12%	0%	9%	9%
Absolute Return	0%	6%	0%	0%	2%
No Benchmark	0%	0%	7%	0%	2%
Total	100%	100%	100%	100%	100%
# Pension Funds	4	17	15	11	47

Region	Europe	North America	Asia and ME	Oceania	Total
Opportunity cost / reference portfolio	11%	4%	0%	0%	6%
Listed equivalent	17%	12%	50%	0%	15%
Specific private assets benchmark	17%	32%	0%	50%	26%
Portfolio return	17%	4%	0%	0%	9%
Short rate + additional return	0%	0%	0%	0%	0%
Listed equivalent + additional return	28%	36%	50%	0%	32%
Inflation + additional return	6%	8%	0%	50%	9%
Absolute Return	6%	0%	0%	0%	2%
No Benchmark	0%	4%	0%	0%	2%
Total	100%	100%	100%	100%	100%
# Pension Funds	18	25	2	2	47

9.1.5. Hedge funds

Asset Size (billion USD)	0-20	20-50	50-100	>100	Total
Opportunity cost / reference portfolio	0%	14%	13%	0%	8%
Listed equivalent	0%	0%	0%	0%	0%
Specific hedge funds benchmark	60%	29%	63%	50%	50%
Portfolio return	0%	0%	25%	0%	8%
Short rate + additional return	40%	29%	0%	50%	25%
Listed equivalent + additional return	0%	0%	0%	0%	0%
Inflation + additional return	0%	0%	0%	0%	0%
Absolute Return	0%	14%	0%	0%	4%
No Benchmark	0%	14%	0%	0%	4%
Total	100%	100%	100%	100%	100%
# Pension Funds	5	7	8	4	24

Region	Europe	North America	Asia and ME	Oceania	Total
Opportunity cost / reference portfolio	8%	13%	0%	0%	8%
Listed equivalent	0%	0%	0%	0%	0%
Specific hedge funds benchmark	38%	75%	0%	100%	50%
Portfolio return	15%	0%	0%	0%	8%
Short rate + additional return	31%	13%	50%	0%	25%
Listed equivalent + additional return	0%	0%	0%	0%	0%
Inflation + additional return	0%	0%	0%	0%	0%
Absolute Return	8%	0%	0%	0%	4%
No Benchmark	0%	0%	50%	0%	4%
Total	100%	100%	100%	100%	100%
# Pension Funds	13	8	2	1	24

Rotterdam

Ortec Finance bv
Boompjes 40
3011 XB Rotterdam
The Netherlands
Tel. +31 10 700 50 00

Amsterdam

Ortec Finance bv
Naritaweg 51
1043 BP Amsterdam
The Netherlands
Tel. +31 20 700 97 00

London

Ortec Finance Ltd.
Bridge House
181 Queen Victoria Street
London, EC4V 4EG
United Kingdom
Tel. +44 20 3770 5780

Pfäffikon

Ortec Finance AG
Poststrasse 4
8808 Pfäffikon SZ
Switzerland
Tel. +41 55 410 38 38

Toronto

Ortec Finance Canada Inc.
250 University Ave. #200
Toronto, ON M5H 3E5
Canada
Tel. +1 416 736 4955

Hong Kong

Ortec Finance Asia Ltd.
Unit 211, 2/F, Building 12W
Phase 3, Hong Kong Science Park
Shatin, Hong Kong
Tel. +852 2477 9838

www.ortecfinance.com