

Pension accounting: forecasts for the company's own balance sheet and profit and loss statement based on nested stochastic modelling

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Under the International Accounting Standard, IFRS, employers have to account for a Defined Benefit (DB) plan by recognising a gap between their plan liabilities (DBO) and assets on the company's own balance sheet and a loss or gain in the company's profit and loss statement (P&L).

DBO liability of Swiss cash balance plans is very volatile due to discount rate assumptions based on high quality corporate bond yields that were even negative in August 2019. That is why the employer balance sheet and P&L are extremely affected by this yield curve level.

To support companies in planning for the financial year-end and preparing budgets for next years, it is worth estimating positions of the company's own balance sheet and the P&L over the next 2-3 years using Monte Carlo simulation. Our approach is based on a nested stochastic valuation engine for the pension fund membership and their liabilities implemented with company specific HR policies. Discount rate and interest credit assumptions are based on a stochastic neural network autoregression approach for yield curve forecasts. The pension fund asset value simulation is implemented with our regime-switching model for forecasting portfolio return.

Keywords: International Accounting Standard; IFRS; IAS19; nested stochastic modelling; NNAR (neural network autoregression); regime-switching model portfolio return.

1 Introduction

Fluctuations in the obligation in the IFRS financial statements are recognized either in the income statement or in other comprehensive income, depending on the cause. Forecasts of this variability in the obligation could be made realistically and in line with the market using stochastic modeling based on historical experience. Results support financial corporate teams.

Listed companies use international accounting standards for the valuation of their pension fund obligations, which must be reported in their annual financial statements. Because international accounting standards such as the International Financial Reporting Standards (IFRS) require a dynamic valuation of pension liabilities using the market-based discount rate, pension liabilities valued in this way are considerably higher and more volatile than according to the local standards (Swiss GAAP FER 26) with which the pension plans' financial statements (for local accounting) must be prepared.

Due to the low interest rate environment over the last year as well as very volatile yield curve levels, the balance sheet position net liability and positions in income statement (P&L) and other comprehensive income (OCI) worsened during the last years, which has a significant impact on the overall valuation of the company.

In recent years, various products and services in the area of administration and payment transactions for pension funds have been significantly digitized. Now the second phase of digitization is starting, implementing actuarially advanced and market-based methods for various types of forecasts and making their results available on-line on an ongoing basis.

The aim of this publication is to realistically forecast future IFRS financial statements based on advanced stochastic modeling and to illustrate the added value of such analyses. Chapter 2 provides insight into the specifics of this forecasting method. The results for a sample pension fund are presented in chapter 3.

2 Forecasting method for IFRS financial results

2.1 Approaches

In the IFRS financial statements, the variability of the pension fund specific benefits is to be perceived in the calculation of the pension obligation per measurement date.

The following important key metrics for forecasting international accounting results (IFRS/ US GAAP/ IPSAS) should be realistically implemented:

- Discount Rate:
 - The level of the discount rate and its potential future development have the greatest impact on the defined benefit obligation (DBO) at the measurement date and on the gross service cost (GSC) for the coming fiscal year.
- Portfolio return:
 - In IAS19 valuation it has a strong impact on the net-liability (= DBO – plan assets) of the pension fund.
 - Additionally in Switzerland the high level of portfolio return could help increase the interest credits for saving accounts and it will have an additional impact on the DBO (but still lower compared to the discount rate impact)
- Mutations of the pension fund membership:
 - The development of the active membership and pensioners population which does not corresponds to their expected development has an impact on the OCI position;
 - Stochastic forecasting of pension fund membership development helps to evaluate it and understand the impact of different kinds of mutations

In Switzerland some firms have to build up reserves in the financial statements of the employer company based on the net-liability value if it is positive (i.e. DBO is higher compared to the plan asset value). At the same time if the net-liability value is negative (i.e. the plan asset value is higher than the DBO), in Switzerland it cannot be accepted on the IAS19 balance sheet, because Swiss pension funds are fully independent from the employer firm and the employer firm has no profit from this level of the net-liability value. It means the “asset ceiling” should be implemented correctly.

2.2 Additional assumption factors which affect international accounting results

The following assumption factors have substantial influences as well on the value of the DBO and the GSC:

- Salary growth depending on the group of persons and the level of pension fund specific interest credits compared to the corresponding IFRS assumptions;
- Level of termination rates as well as early retirements in the IFRS assumptions compared to the company's HR policy;
- Cash-specific capital withdrawal rate compared to the corresponding IFRS assumption and the level of the conversion rate;
- Due to the employer firm business development, the restructuring measures could be implemented in the pension fund and it could take place on the P&L position

In general, at first the forecasting of the local occupational provision benefits based on the local guidelines Swiss GAAP FER 26 should be implemented and then based on the forecasted results for the local benefits on measurement date the international accounting results should be forecasted (like in reality).

2.3 Forecasting yield curve

For the forecasting of the discount rate it is necessary to prepare forecasting of the high-quality market corporate bond yield curve of AA level and determine the discount rate based on the liability duration. The liability duration depends on the level of the discount rate, on the structure of the pension fund

membership, their kind of benefits as well as some assumptions like pension indexation and interest credits, because such assumptions impact future benefit payments.

As a rule, durations of Swiss pension fund liabilities in international accounting (IFRS & US GAAP) are between 16 and 19 years. Jubilee plans have much smaller duration, ca. 3-4 years, because no annuity payments are included in Switzerland in such kind of plans. The Jubilee plan impact on total IAS19 results is very small compared to the pension plan benefits.

The level of the following liability development assumption – age and gender dependent turnover rates – has a strong impact on the liability duration level as well. The higher the turnover rate, the lower the liability duration, i.e. it could be even 10 years. Based on this assumption and the level and shape of the yield curve the DBO could be smaller and the net-liability value even negative.

The Swiss AA yield curve forecast depends on the Swiss government bond yield curve forecast as well. Figure 1 shows the historical development of AA yield curves over the period from December 2015 to March 2022 vs. Swiss government bond (GB) yield curves and the difference their yield values (based on the same maturity).

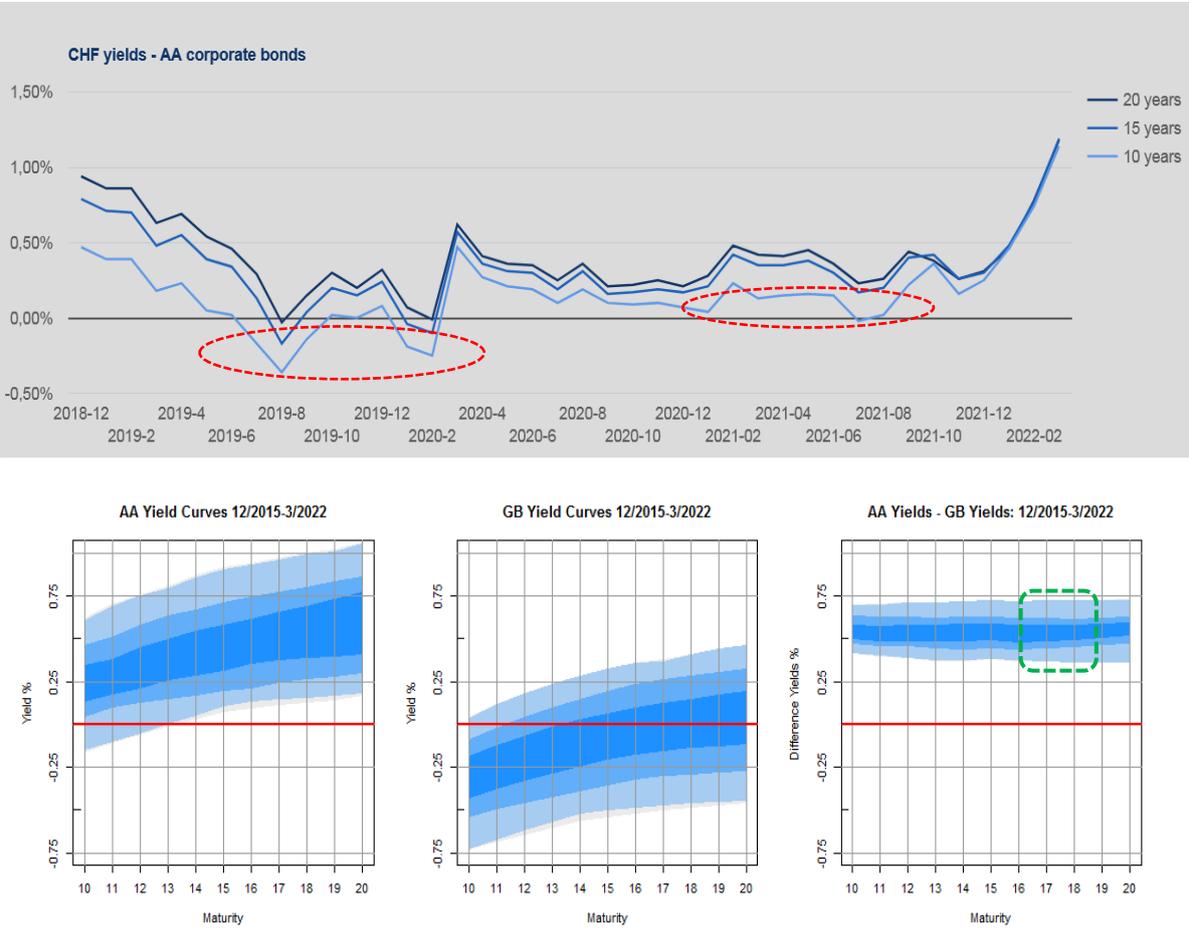


Figure 1. The upper level of Figure 1 shows the historical monthly values of 10-year, 15-year and 20-year bond yields: over some periods the AA yield curve was quite flat or had negative values. The lower level of Figure 1 shows AA Yield Curves vs. GB Yield Curves over period: December 2015 to March 2022. Historical Swiss AA Yield Curves are practically parallel to Swiss GB Yield Curves. The typical liability duration is in the bandwidth between 16 and 19 maturity year but the duration could be lower as well at the level of 10 years. The colour intensity corresponds to the confidence interval 30%, 60% and 90%. The red line shows the zero level of yields.

The approach used for the forecast of the AA year curve is based on the forecast of the government bond yield curve with NNAR (neural network autoregression) approach. Figure 2 shows the comparison of forecasted AA Yield Curves (NNAR approach) with their historical values per end of 2020, end of 2021 as well per end of March 2022.

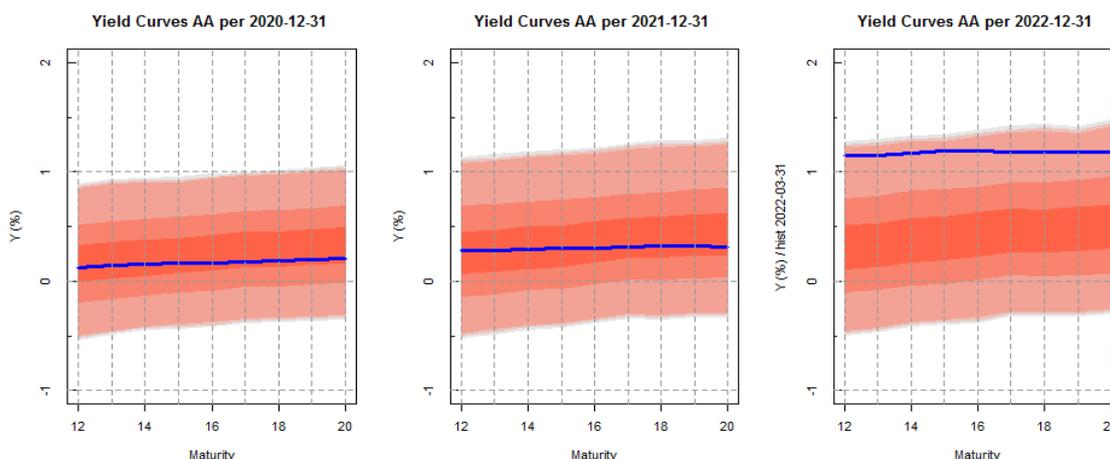


Figure 2. The historical Yield Curves AA per 2020-12-31 (Dec 31, 2020) and per 2021-12-31 (Dec 31, 2021) are a bit flatter compared to the forecasted ones – but they are within the bandwidth 30% (between 35% and 65% percentiles) of the forecasted results. The AA Yield Curve per March 31, 2022 increased in February-March 2022 due to the very strong increase of the Government Bonds Yield Curve and the inflation in Switzerland (like in other countries as well).

The forecast of IAS19 disclosure was prepared starting from December 31, 2019 as a measurement date with real data. The historical values of IAS19 disclosure results per December 31, 2020 and December 31, 2021 prepared for the sample pension fund are compared with the forecasted results.

3 Forecast IAS19 disclosure for a sample pension fund

3.1 Nested simulation engine

We used the approach described in the book „Stochastic Modeling: Theory and Reality from an Actuarial Perspective“, ISBN 978-0-9813968-2-8, www.actuaries.org (Milliman), excerpted from “The Future of Capital Modeling.” by Pat Renzi, Milliman Insight, Issue 2, 2006.

The implementation of this approach is made by us for each person (active membership and pensioners in the sample pension fund) and the results are aggregated. The total number of scenarios is 80'000 realistically implemented for mutations and turnovers.

To understand the impact of different parameters on stochastic simulated membership and their local as well as according to the international accounting IAS19 liabilities at the first step only the mutations in the pension fund population will be implemented, i.e. leaving with transferred vested benefits to an external pension fund; death and disability cases with corresponding benefits based on the plan rules; retirement with annuity and capital payments depending on decisions. The pension fund leavers will be exchanged with new entrants based on scenarios for head counts of employees (it depends on the firm's specific HR-policy).

3.2 Sample Pension Fund

The sample pension fund is a medium pension fund in Switzerland and has a relatively small pensioner population (24% of active membership) with substantial level of their reserves (65.4% of the total local active membership vested benefits) due to the technical interest rate 1.5% for local reserving based on Swiss GAAP FER 26.

December 31, 2019	Membership	Average Age	Local Liabilities CHF Mio.	Average Insured Salary Average Annuity (in CHF)
Active membership	814	44.3	332.4	110'750
Pensioners	195	69.1	217.9	52'780

The sample pension fund is a cash balance plan. Each active member has an individual saving account with a guaranteed interest credit (there is a mandatory level, now 1%, for the mandatory saving capital).

As a rule, all individual saving accounts have more money compared to the mandatory level and pension funds try to guarantee the mandatory interest credit for the whole saving account. In this sample pension fund the interest credit is 1% and the technical interest rate for reserving pensioner liabilities is 1.5%. The local liability for pensions in payment is valued as a DBO for pensions in payment but with the local technical interest rate compared to the discount rate for IAS19 disclosure. In this case is the DBO for pensions in payment in IAS19 disclosure is much higher compared to the local liability value for pensions in payment (based on the technical interest rate 1.5% vs. the discount rate 0.28% per December 31, 2019). The pension annuity is long-life and its value corresponds to the saving capital at retirement multiplied by the conversion ratio (here 5.8%). Normally, depending on the technical interest rate and actuarial basis used for reserving the so-called pension losses could arise. They have a very strong impact on the DBO values as well.

The forecasting over the next three years starts on December 31, 2019. The HR-policy planed that the active membership would be increasing by ca. 1.6% and the insured salary on average per person would be growing by ca. 3.0% per annum. Due to restructuring of business, many employees over the year 2018 left the employer firm and new hired employees were younger and with lower vested benefits. At the end of 2019 the HR-Department did not perceive the situation due to COVID-19.

3.3 DBO Duration vs. AA Yield Curve and discount rate per measurement date

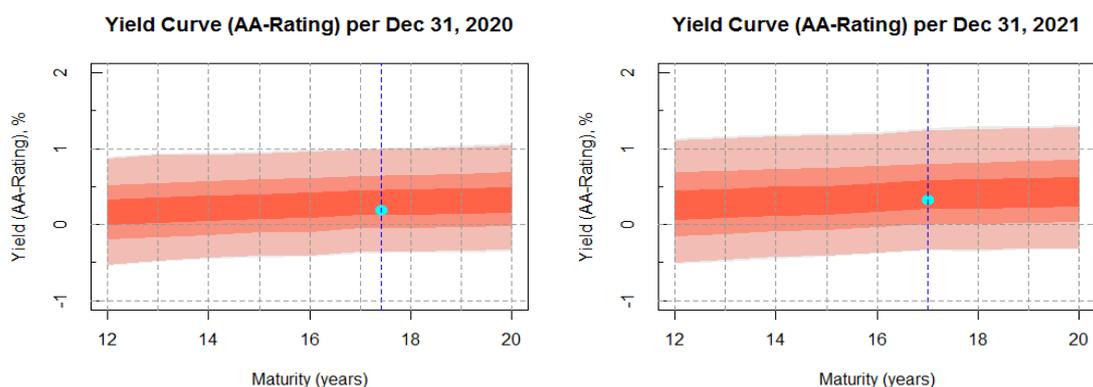


Figure 3. Discount Rate level depends on the liability duration (DBO duration). Historical AA Yield Curves per Dec 31, 2020 and per Dec 31, 2021 were a bit flatter compared to the forecasted yield curves. That is why the historical position of the discount rate based on the liability duration (*x-axis Maturity*) is in the bandwidth 30% and slightly higher level than 35% percentile. The total liability duration depends on the share of DBO pensions vs. DBO active membership. Normally the liability duration of DBO active membership is higher than the liability duration of DBO pensions. The discount rate in IAS19 disclosure per December 31, 2020 was 0.19% and per December 31, 2021 amounted to 0.32%.

The forecast period (December 2019 – December 2022) is shown on the grey background and the historical value over the period 2017-2018 on the white background. The total bandwidth of simulated results is 90% (between 5- and 95- percentiles) with the step 15%, i.e. the widths depending on the colour intensity are 30%, 60% and 90%, the median is shown with the line in the bandwidth between percentiles 48%-52%. The forecasts for discount rates, interest credits and DBO-duration are compared with their historical values per end of years 2020 and 2021 on Figure 4.

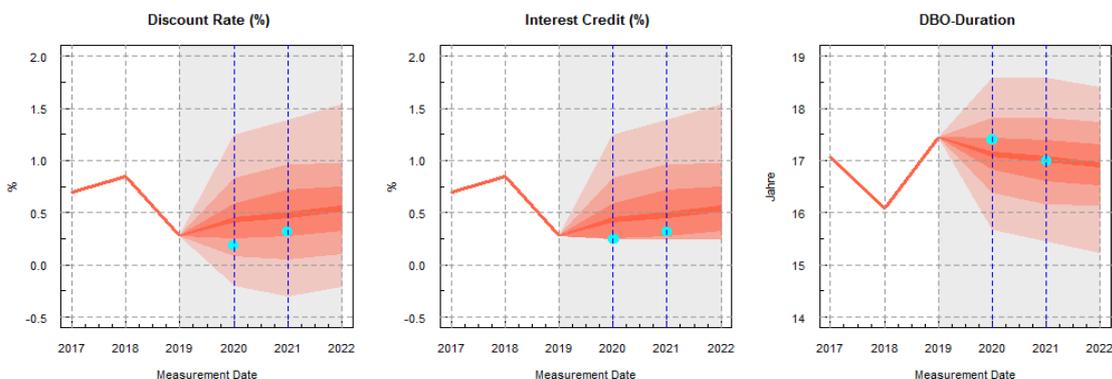


Figure 4. Discount Rates and DBO-Durations are determined based on the forecasted AA Yield Curves per measurement date. The historical positions of these factors from IAS19 Disclosures per December 31, 2020 and per December 31, 2021 are shown with cyan colour point. The forecast of discount rates, DBO-durations and interest credits depends on the Model for AA yield curve forecasting. The forecast approach used now is NNAR (Neural Network Autoregression)

Assumptions for interest credits for International Pension Accounting were set out as the maximum value of the discount rate vs. the mandatory interest credit. The mandatory interest credit amounts to 1% (so called the BVG interest credit) applied to the mandatory saving capital.

The sample pension fund has the total mandatory saving capital (BVG mandatory saving capital) 25% of the total saving capital. In this case the minimum level of the interest credit assumptions for international accounting IAS19 is 0.25% (=1% * 25%), i.e. if the simulated discount rate is below 0.25% the interest credit assumptions should be 0.25%, and if the discount rate higher than 0.25%, the interest credit assumptions will be the same as the discount rate assumption.

At the end of the year 2020 the discount rate was 0.19% (i.e. smaller than 0.25%) that is why the interest credit assumptions was 0.25%. At the end of the year 2021 the discount rate was 0.32% and, in this case, the interest credit assumption was 0.32%.

Due to the very low Swiss AA Yield Curve level over last years the assumptions for interest credit were substantially lower than real interest credit values, because portfolio returns over the same period (like 2019) were very high and many pension funds in Switzerland offered over 2017-2021 interest credits on the level of 3.0%-5.0%.

Since May 2022 auditors request the forecasting of this interest credit assumption based on the local reserving parameters (Swiss GAAP FER 26), portfolio returns and potential development of the local funding ratio, because these factors strongly affect the local interest credit level.

To implement this approach for the new definition of interest credit assumptions in international accounting such kind of forecasting (based on the nested stochastic modelling and NNAR approach for yield curves) will be more important than up to now.

3.4 Forecast of total DBO, Net-Liability, plan assets and portfolio return

The forecast of the DBO and net-liability needs the forecast of the plan assets

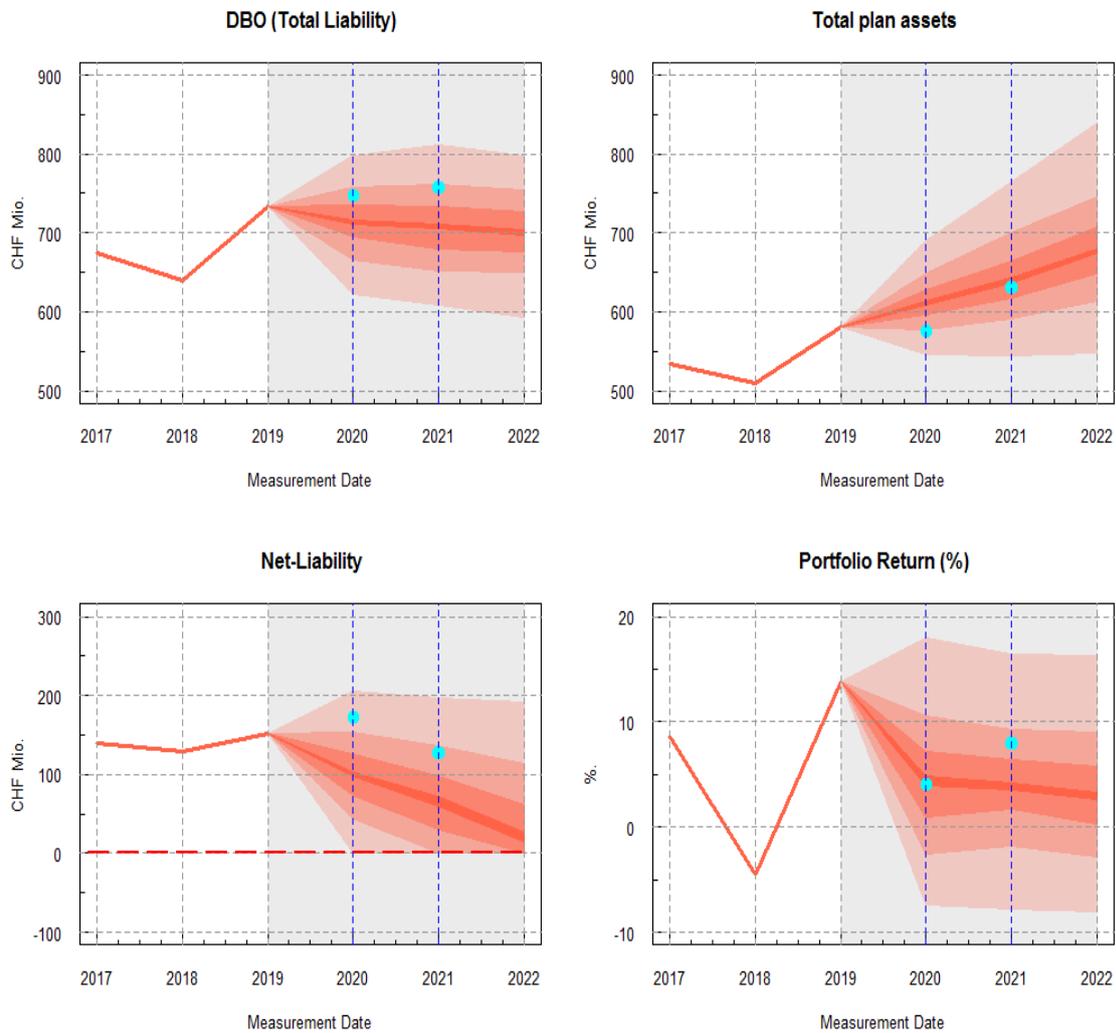


Figure 5. The historical data (shown with cyan colour points) are from the IAS19 disclosure per Dec 31, 2020 and per Dec 31, 2021. The forecast of plan assets is implemented with the regime-switching approach for the portfolio return forecast. The “asset ceiling” is implemented (i.e. the negative value of net-liability with be recorded in OCI-position, i.e. net-liability values below the zero level, here shown with the red dashed line).

“Asset ceiling” means that the plan assets not profitably available to Company. In Switzerland the employer cannot use money from the pension fund (if plan assets are higher than the DBO).

3.5 Total Defined Benefits Costs: P&L and OCI

Below Figure 6 shows the total defined benefit costs and its components (with asset ceiling).

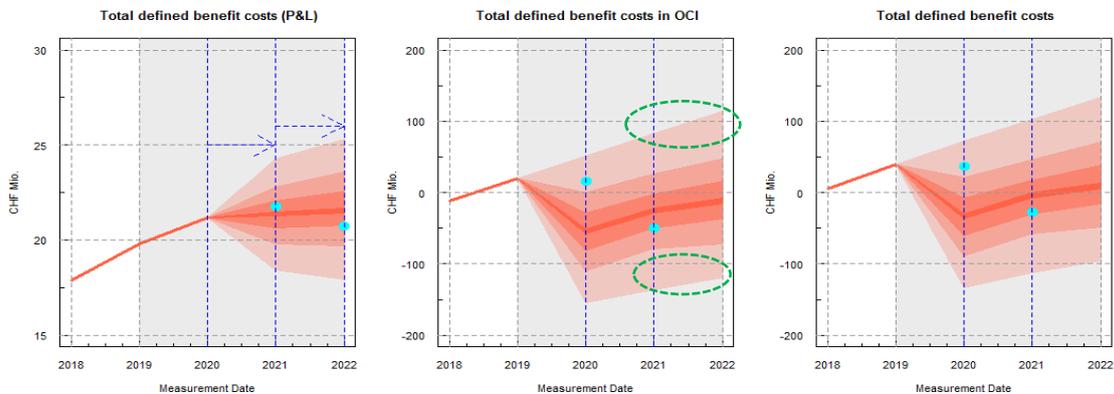


Figure 6. Total defined benefit costs (P&L and OCI) and its total value. The asset ceiling is implemented and is recorded into the OCI position. The P&L-position per Dec 31, 2020 is calculated based on assumptions per Dec 31, 2019 (P&L per Dec 31, 2021 on assumptions per Dec 31, 2020 etc.). This is shown with the blue vertical line and the arrow. Due to higher discount rate per December 31, 2021 (0.32%) vs. discount rate per December 31, 2020 (0.19%) the Employer Service Cost is lower and the total position DB Costs P&L is getting lower as well. The asset ceiling is added to OCI-Position and its impact is shown with green ellipses on OCI position.

The components of the P&L defined benefit costs are shown in Figure 7.

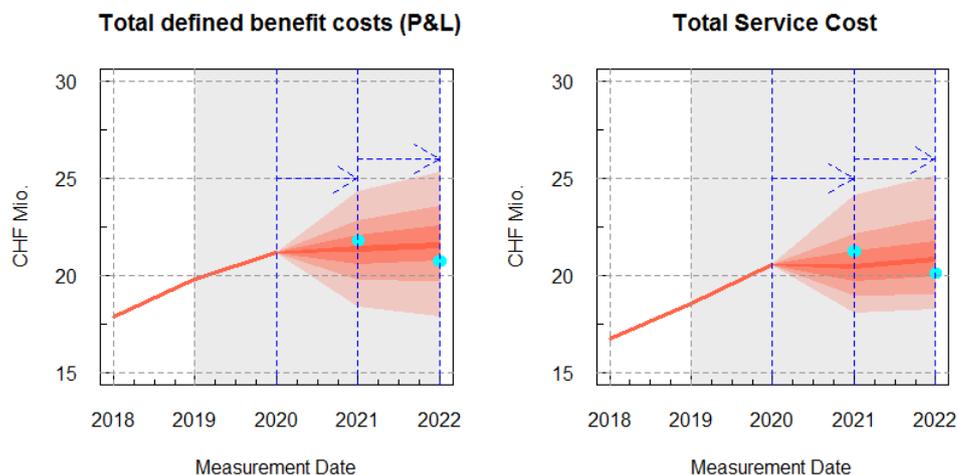


Figure 7. Defined Benefit Costs P&L components are service cost and net interest (based on the discount rate) as well as the administration costs. The net interest position is very small compared to the total service cost. The level of net interest and administration costs over the last 3 years was between 0.5-1.2 CHF Mio. Here: The services cost corresponds to the employer service cost (i.e. in Switzerland the employee contributions are subtracted from the gross service cost). Total service cost = current service cost + past service cost + gain & losses on plan settlement. Neither plan changes no settlement were implemented over the forecast period (i.e. past service cost = 0, G/L settlement = 0). If such events are expected they should be implemented over the forecast period.

The components of the OCI defined benefit costs are shown in Figure 8.

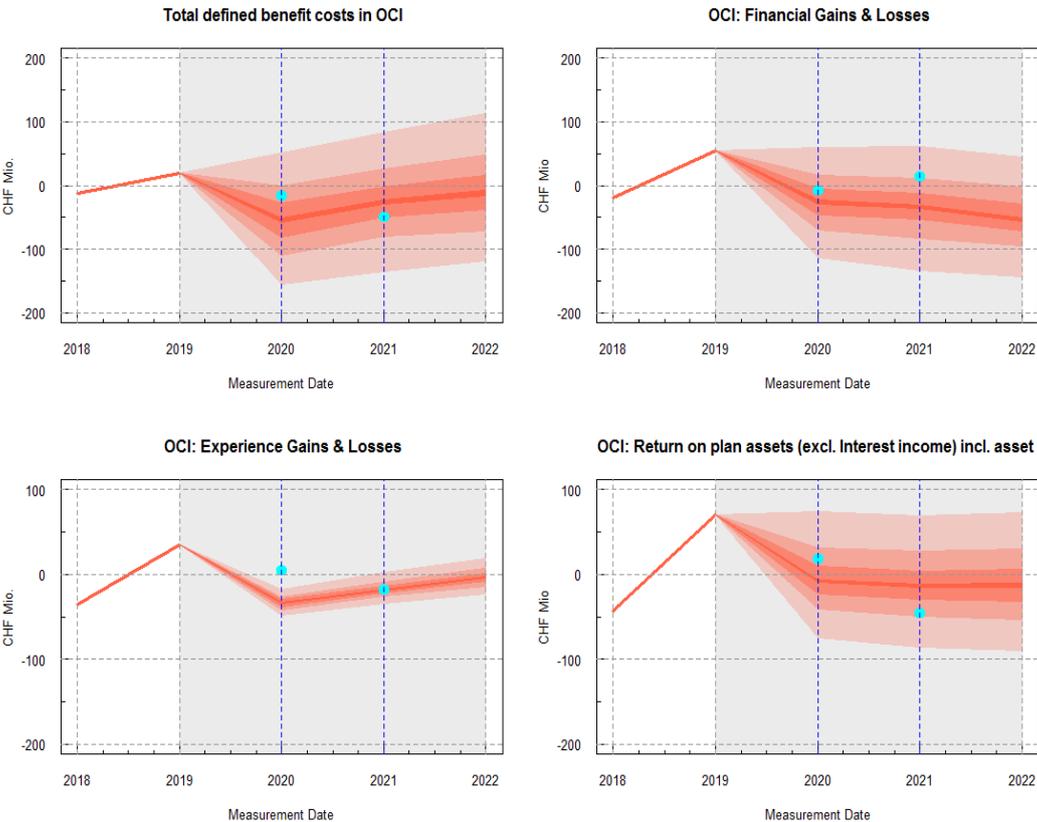


Figure 8. OCI Position and its components. OCI: Financial Gains & Losses shows the assumption change impact. In this analysis only the impact of financial assumption changes is shown because no changes of demographic assumptions were implemented. Changes of implemented financial assumptions were done for the discount rate, interest credit and salary increase because they are adjusted practically with each valuation per measurement date – other assumptions were not changed. For example: discount rate 0.28% (2019), 0.19% (2020) and 0.32% (2021). OCI: Experience Gains & Losses: it has an impact of COVID-19 in 2020. The cyan colour points correspond to IAS19-Disclosure results per December 31, 2020 and per December 31, 2021. The total defined benefit costs in OCI corresponds to the sum of positions OCI: Financial Gains & Losses, OCI: Experience Gains & Losses and OCI: negative Net-Liability (not shown here separately but included into the total DB costs in OCI). The position OCI: Return on plan assets is subtracted.

5 Summary results

The nested stochastic projections of liabilities produce more realistic forecast of different key metrics for the local (Swiss GAAP FER 26) and international accounting standards (IAS19, US GAAP, IPSAS). Here only membership mutations were implemented. Based on the very special COVID-19 experience it is worth realising similar scenarios with other potential pandemics and estimate their impact on financial markets. Due to very low (earlier even negative) discount rates it is worth making forecasts of the IFRS/ US GAAP important key metrics (P&L, OCI and other booking entities) for the next 1-2 year (on a half year or quarterly basis) to explain employer financial teams potential costs and their bandwidths. The discount rate has the strongest impact on DBO liabilities. The presented forecasted results compared to the historical values of IAS19 disclosures based on the NNAR approach for the yield curve forecast were realistic.

The results are always pension fund specific and depend on the size of active membership and pensioner population, on development scenarios as well as on the benefit plan scope. That is why such pension fund specific results cannot be simply used for other pension funds.