Solvency requirements for Swiss pension funds and how to ensure the guarantee of benefit payments at any time.

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Abstract

We develop an approach for practitioners for setting up the target value of investment fluctuation reserves for autonomous Swiss pension funds and determine a desirable level for them to better ensure benefits payments during times of volatile financial markets. The Swiss pension legislation does not stipulate any methodology and requirements for setting up such reserves. We give an overview of methods used and suggest some improvements based on our experience as many pension funds are underfunded after 2008. A suggested approach will help trustees to better comply with funding and solvency requirements for Swiss pension funds.

1   Introduction
1.1   Experience from the financial crisis 2007-2008

According to the Swiss supervisory authority (Federal Office for Social Insurance, FOSI) at least 57% of Swiss pension funds might be underfunded per 31.12.2008 as they posted on average a negative return of 13% [1] for the calendar year 2008. This performance is well below the previous worst which was a negative return of almost 8% in 2002. Due to this there are several large pension funds which have been underfunded since the former crisis in 2001 and 2002[2]. According to the last two annual surveys by Watson Wyatt Worldwide ("2009 Global Pension Asset Study" [3] and "2008 Global Pension Asset Study" [4]), Switzerland's pension assets in the

second pillar fell from USD 600bn (year-end 2007) to USD 514bn (year-end 2008) or from 145% to 104% of GDP (Gross Domestic Product).

Pension funds with enduring deficits cannot credit sufficient interest (in excess of inflation) to members' account balances and have no funds for indexing pensions. If an underfunded pension fund situation is accompanied by a restructuring of the employer then the situation gets even worse for the insured members. Employees dismissed as part of a restructuring programme could expect, in addition to the loss of their jobs, a reduction in their vested benefits which could be reduced proportionally to the pension fund deficit if some conditions are fulfilled.

In Switzerland plan sponsors have no direct obligation to eliminate the whole deficit immediately (see section 1.3 for more details) so plan members can be significantly affected by any deficit in the pension fund. Dismissed employees could lose a portion of their savings and the remaining employees could be forced to pay additional contributions.

Changes in the Swiss pension legislation (BVG/ LPP) in 2004-2006 (see sections 1.2 and 1.3) have for the first time allowed pension funds in an underfunded situation to distribute their deficit to members' accounts in the case of partial liquidations which would take place if the sponsoring employer has to dismiss employees due to restructuring. Some underfunded pension funds in Switzerland at the end of 2008 made use of this opportunity and provisionally reduced vested benefits by 10% to 20% for members who were going to be terminated in view of an expected restructuring exercise and the consequential partial liquidation [5].

1.2   Swiss pension legislation (BVG/ LPP) and occupational provisions

Switzerland has a large and well-established three pillar pension system which is designed to provide a minimum income for all its citizens and a decent replacement[1] ratio for individuals with a full working career. Swiss occupational pension provision was made compulsory in 1985 and this has contributed to a substantial accumulation of second pillar financial resources. Twenty years later in 2004-2006 the 1st revision of the legal framework BVG/LPP was carried out. This revision introduced the Swiss GAAP FER 26, the Swiss accounting standards for Swiss pension funds, and prescribed more clearly the necessity to set up additional actuarial provisions and investment fluctuation reserves. Moreover the definition of the funding ratio was stipulated in the law and the conditions for the disclosure of surplus ("free reserves") and their distribution (contribution holiday) were formulated.

Swiss pension legislation (BVG/LPP) stipulates only the so-called mandatory level of pension provisions which should be financed by both employer and employees with the only requirement that the plan sponsor (employer) contributes no less than employees as a whole. Mandatory provisions are set up as cash balance (CB) arrangements with two guaranteed parameters defined by the Federal Office: BVG minimum interest credits and BVG minimum conversion rate applicable on the mandatory savings for calculating retirement pensions [6]. The savings process for retirement managed as DB (defined benefit) or CB arrangements is accompanied by death and disability benefits (mostly in form of DB arrangements) including survivor and disability pensions and capital payments. The mandatory level of risk benefits depends on the mandatory

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[1] One can reach at retirement a pension of up to 85% of the last salary for pensions from the first and second pillar together if a savings plan was set up correspondingly.

account balance. Each employer is free to grant higher benefits than the mandatory level and many make use of this opportunity.

The second pillar has three types of providers:
- Company specific pension funds
- Independent collective foundations with multi-employer plans (either for employees in a specific industry sector or open for different small firms)
- Insurance companies offering group life insurance contracts[2] with full guarantees for separate employers (such contracts are mostly chosen by very small and/ or risk-averse employers)

Pension funds are non-profit trusts or foundations run by a board of trustees made up of both employer and employee representatives. Pension trustees are in charge of all pension fund decisions and cannot transfer their fiduciary responsibility to an external third party. Within the limits of the Swiss pension legislation pension funds may adopt their own benefit design, financing system and organisation and their boards bear the responsibility for the funding (or financing) strategy which should ensure benefit payments can be met at any time and should deliver an investment return in line with the development of capital markets.

According to Swiss pension legislation a pension fund funding strategy[3] should be set out in the plan rules and investment guidelines and approved by the board of trustees.
The funding strategy is a long term policy taking into account the expected human resource and benefit policies of the employer and the macroeconomic development of the Swiss and global market environments. Ideally the funding strategy should be based on an ALM[4] study and updated every three to five years and in cases of major plan changes. Unfortunately there are no explicit requirements on the scope of such studies or on their eligible providers (see [7]). Annual actuarial valuations should be conducted and signed by a certified pension actuary, but an ALM study could be conducted by any investment or actuarial consulting firm working in the pension market. Very often it is difficult for the board to verify the approach and the underlying model used. The objectives of an ALM study vary across pension funds, but in general an ALM study helps to define a strategic asset allocation which
- corresponds to pension fund's risk tolerance and risk capacity,
- minimises the expected total contributions to be paid into the fund by the plan sponsor and its employees, and
- avoids a possible deficit with a pre-specified level of probability,

where the underfunding and surplus policies are taken into account. We are not going to discuss ALM studies in detail but it should be noted that the results could be different depending on the investment return model used, the level of detail in the modelling of the pension fund liabilities and the software tool used.

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[2] We will not cover group life insurance contracts in this publication as they are supervised separately in the framework of Swiss Solvency Test for Swiss insurers.
[3] Where we refer to a funding (or financing) strategy we mean a contribution policy together with strategic and tactical asset allocations and surplus & underfunding policy defining how any possible surplus could be used/ distributed and how any possible deficit is going to be eliminated and by whom.
[4] ALM stands for Asset Liability Management.

Investment returns in Switzerland have historically been low as there are maximum legal limits on the equity allocation[5], and as most pension funds have to maintain their funding level from their own resources. There are some exceptions to this, mostly among pension funds of US multinationals. Those pension funds can pursue a more aggressive asset strategy because they have an employer guarantee to meet the balance of costs.

On average the typical asset allocation of a Swiss pension fund consisted per year-end 2007 of about 33% equities, 38% bonds and 29% in other assets like real estate and alternative investments. A year later it was only 21% in equities, and 44% in bonds mainly due to the significant drop in equity markets and the common decision to not rebalance portfolios back to the strategic weights. About half of equity investments are invested in domestic equities [3,4] showing that Swiss pension funds are subject to home bias and exposed to some concentration risk.

Switzerland has one of the lowest inflation levels in Europe and a very stable economy. The long-term rate of inflation in Switzerland used for actuarial valuations under IFRS/ US GAAP is around 1.5%. Indeed the trend in the Swiss market is not to promise any indexation in plan rules but to decide annually based on current financial results.

1.3 Solvency Requirements

A steady decrease in market interest rates and a rapid decline in the value of equities in the years from 2001 to 2002 led to a sharp decrease in funding ratios, which were very often calculated without any allowances for fluctuations in actuarial risks. Additionally, the definition for available pension assets was ambiguous. Taking into account this experience, the formula for the funding ratio was stipulated in the framework of the 1st revision (2004-2006) of the Swiss pension legislation as follows: available pension assets divided by total actuarial liabilities. The available pension assets no longer include employer contribution reserves and short term liabilities, and the total actuarial liability consists of a net actuarial liability and additional actuarial provisions. Additional actuarial provisions should be defined in the plan rules of each pension fund and are calculated annually by the certified pension fund actuary. Depending on the actuarial risks borne by a pension fund, the risk perception of the pension actuary and the structure of the pensioner population, the additional actuarial provisions were observed between 3% and 30% of the net liability.

A pension fund is underfunded if available pension assets cannot cover the total actuarial liabilities; therefore the funding ratio is below 100%. Investment fluctuation reserves can be disclosed only if the funding ratio is at least 100%.

According to Swiss pension legislation, pension funds are independent in setting up their strategies and should formulate their financing strategies in such a way that benefits could be paid at any time and the funding ratio of 100% could be maintain. Temporary underfunding is possible if the pension fund can pay benefits due and takes measures to eliminate the deficit over a predefined period of time. The legislation accepts a 5 (to 7) year period for eliminating a deficit, and in some cases this may be extended to 10 years but not beyond. Possible measures should be set out in the plan rules in advance and could include a temporary reduction of benefits (like

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[5] Although maximum limits on different asset classes are stated in Swiss legislation, the pension trustees have to possibility to extend them provided that the security of the pension fund is not impaired.

lower or even zero interest credit to account balances); additional contributions to be paid by employer and employees, a reduction of voluntary pensions in payment if some conditions are fulfilled.

The necessity to set up investment fluctuation reserves (IFR) and formulate their target value was also stipulated in the revised accounting standards (Swiss GAAP FER 26). The IFR provide protection to the pension fund against adverse movements in financial markets. They have to be set up according to market-specific investment risks and should cover the required minimum interest on the liabilities with adequate security. There are no precise requirements and regulations on how to calculate their target value and with which level of accuracy. No set period is defined to fully fund these reserves. Pension assets in excess of the net liability including additional actuarial provisions and the target value of IFR are called free reserves (surplus). Free reserves can be distributed among the members of a pension fund in the form of additional interest credits, pension indexation or contribution holidays. Employers can use a maximum of 50% of free reserves for the reduction of their contributions.

Any additional interests granted to retirement savings accounts of active members following a better asset performance than the BVG minimum interest rate are restricted by some legal requirements such that IFR are fully funded to their target value first, or at least funded to a certain level. Unfortunately there are pension funds whose trustees still decide on ad hoc indexations or additional interest credits while their IFR are not fully funded.

The last financial crisis in 2007-2008 shows clearly that many Swiss pension funds had underestimated their target value for IFR. Even pension funds with nearly fully funded IFR at the end of 2007 were underfunded at the end of 2008. In general, the higher the equity allocation is, the larger the resulting deficit.

In this article we analyse the reasons for this underestimation and suggest an approach for how trustees can understand and manage this issue.

2   Contemporary requirements on additional capital
2.1   Risk based supervision

The necessity to set up a comprehensive and objective approach for assessing the financial position of pension funds and so to evaluate pension fund solvency is now urgent. This should be an integral part of contemporary risk management for each pension fund. Concerns about the capacity of new CB plans (with flexible interest credits to account balances depending on the achieved performance and determined by the board of trustees) to produce an adequate level of retirement income lead to a need for better risk management.

A risk-based solvency system comprises three fundamental issues: the valuation of assets and liabilities, the risk margin for uncertainty in assets and liabilities, the risk measures and their modelling (risk categories, risk mitigation, diversification, etc.)[8].
The risk-based approach to the solvency rules was implemented in the framework of Basel II[6] and Solvency II (Swiss Solvency Test, SST, in Switzerland) and is very important as an early

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[6] Basel II was developed based on Basel I and is a framework designed to encourage good risk management by tying regulatory capital requirements to the results of internal systems and processes assessments, thereby creating

warning system. One of the main objectives of this approach in banking and insurance is to ensure that institutions adopt sound risk management procedures and hold appropriate level of capital. For pension funds this is also important to strengthen financial stability and to ensure more efficient outcomes for pensioners and the active membership.

Solvency requirements for pension funds should be risk-based and the proper choice of the risk measures and the modelling plays a very important role.

The approach for calculating additional actuarial provisions was formulated several years ago by the Swiss Chamber of independent consulting actuaries and is well understood and accepted by trustees. We find it reasonable and are not going to review or propose revisions to this approach in this publication. However, in our view the calculation of IFR should be more precisely defined.

In this publication we try to develop an intuitive approach to help trustees verify and set up more accurate target values for IFR based on a historical return analysis of common indices used by Swiss pension funds: the BVG/LPP indices published by the Bank Pictet [9].

2.2   Definition of target value of IFR

There are no exact requirements or regulations in Switzerland that state which methods should be used to set up a target value for IFR. Nevertheless the target value should be disclosed in the financial statements of each Swiss pension fund. Parameters needed for calculating a target value of IFR are:

- A basis variable for calculating the target value – available assets or pension liabilities
- A necessary minimum expected return on investment to fund pension fund liabilities
- A time period
- A desirable confidence interval

Based on the strategic asset allocation of a pension fund several models for setting the target value of IFR could be suggested. Many pension funds now use a Value-at-Risk[7] (VaR)-approach, but there are still enough pension funds using a so called "practical"-method. In this approach a target value is defined as a weighted average of coefficients assigned to different asset classes (equities, bonds, real estate etc.). Coefficients are proportional to the perceived risk of the asset class, with equities for example having the highest coefficient. Conditional Value-at Risk (CVaR)[8] could also be used and is accepted by SST for insurance companies but we have not yet met a pension fund using this methodology for setting up the target value of its IFR.

Any practical or other approaches which are based on any "rules of thumb" underestimate as a rule (according to our experience) the target value because they have no relation to liabilities and

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incentives for improvements in risk management. In addition to making the calculation of regulatory capital more risk sensitive and recognising the quality of internal risk management systems, the framework added two pillars to the model: the supervisory review process and the market discipline.

[7] The Value-at-Risk of a portfolio is defined to be the loss that is expected to be exceeding only α x 100% of the time over a fixed time interval. The α-Value of 0.05 corresponds to the confidence interval of 95%.

[8] The Conditional Value-at-Risk, also called Expected Shortfall, at α% level is the expected loss in the worst α% of the cases.

no definition of a confidence interval. Correlations between different asset classes are not taken into account either.

The VaR approach used by many Swiss pension funds is a so called Delta-Normal VaR (or standard or traditional VaR) implying a normal distribution for a portfolio return. A common level of confidence interval is 95% and some pension funds even use 97.5%. In this approach the target value can be calculated analytically without an ALM-study or Monte Carlo simulations; only the expected investment return and the standard deviation of the investment portfolio are needed.

The biggest drawback of this approach is the normality assumption for the portfolio return. Observations over the last 40 years confirm that financial markets can be much more extreme than implied by a normal distribution. Here are some examples: October 1987, Asian crisis 1997, Russian crisis 1998, Dot-Com crisis 2001-2003, and the financial crisis 2007-2008 (where the last crisis in particular has had dramatic impacts on pension industry in many countries). According to the Watson Wyatt survey on pension assets [4] at the end of 2008, pension assets for the 11 biggest pension markets

- Had a 19% fall compared to the 2007 year-end value
- Are now below their 2005 level and
- In terms of pension assets to GDP ratio are back to their 1996 levels.

It is well known that the probability of high losses is underestimated by a normal distribution but it is very difficult to perceive this in practice. Another drawback of the traditional VaR approach is the assumption that the expected values, standard deviations and correlations between asset classes do not change during the time period. In the past it was observed that correlations between asset classes tend to increase during bear markets and even more significantly during crises. For risk management purposes it is crucial to recognise that extreme losses can take place in reality more often than could be predicted by a normal distribution.

3. Cornish-Fisher VaR and IFR based on Pictet BVG/LPP Indices
3.1 Pictet BVG/ LPP Indices

The Pictet BVG/LPP 2005 Indices [9] reflect common asset allocations used by Swiss pension funds. Based on monthly observations for Pictet BVG/LPP 2005 Indices from January 1990 to February 2009 it is possible to calculate delta-gamma-VaR (hereafter "traditional" VaR) annual values.[9] In order to account for the non-normality in asset returns, the third and fourth moments (skewness and kurtosis) are computed as well and inputted into a non-normal VaR-based on the Cornish-Fisher approximation[10]. The Bank Pictet publishes three indices denoted 25, 40 and 60 where the number represents the sum of the allocations to equities, hedge funds and private equity. A real pension portfolio may not correspond to any of the BVG/LPP 2005 Pictet indices but it is still possible to find some similarities for comparison purposes. Table 1 shows the asset allocations for the three BVG/LPP 2005 Pictet Indices and Figure 1 represents the development of the indices over the last 20 years.

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[9] For the sake of simplicity, we assume in this illustrative example that expected values are equal to historical means and standard deviation.

|	LPP-25	LPP-40	LPP-60
Bonds	65.0%	50.0%	30.0%
Swiss	40.0%	30.0%	15.0%
Foreign	25.0%	20.0%	15.0%
Equities	20.0%	30.0%	45.0%
Swiss	7.5%	10.0%	15.0%
Foreign	12.5%	20.0%	30.0%
Real Estate	10.0%	10.0%	10.0%
Swiss	7.5%	5.0%	2.5%
Foreign	2.5%	5.0%	7.5%
Hedge funds	2.5%	5.0%	7.5%
Private equity	2.5%	5.0%	7.5%
Total	100.0%	100.0%	100.0%
Historical annual average return	5.17%	5.20%	5.29%
Annual standard deviation	5.13%	7.45%	10.72%

Table 1 Asset allocations of Pictet Indices
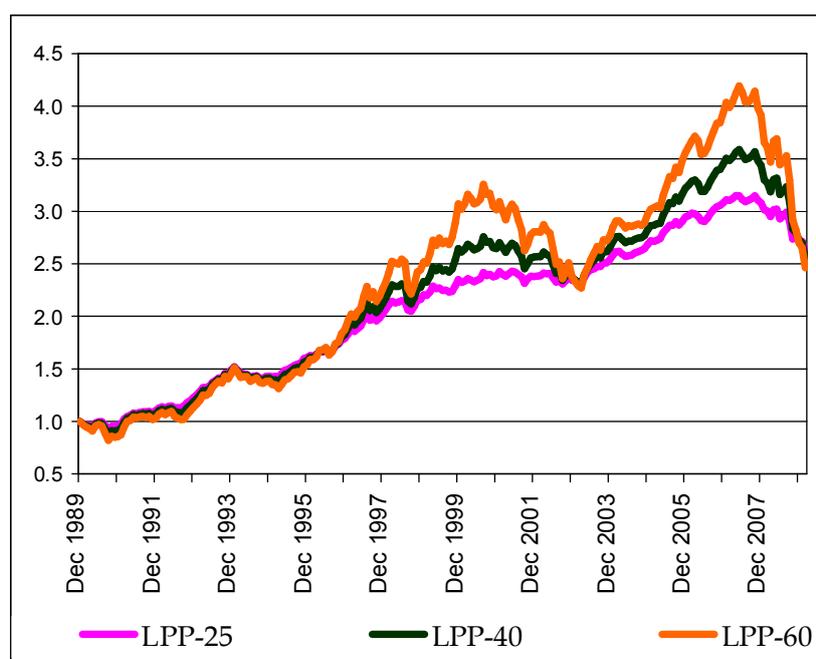
Figure 1 BVG/LPP 2005 Pictet Indices and their development since December 1989

3.2 Target values for Investment fluctuation reserves with different measures

The table below summarises our calculations for VaR in traditional (Delta-Normal) approach (here shown as VaR) and Cornish-Fisher approach (CF VaR) for different confidence intervals (95%, 97.5% and 99%). Based on these VaR values we calculated target values for IFR with the traditional approach, which we name IFR (VaR), and with the Cornish-Fisher approach, IFR (CF VaR), assuming a minimum necessary return of 3.5% for funding plan liabilities.

Additionally we have calculated CVaR using the traditional (delta-gamma) approach [11] to show the expected loss below the VaR value. Target values determined based on the traditional VaR approach do not take into account the expected loss below the VaR boundary due to the definition of VaR. With a growing proportion of equities and alternative investments in a portfolio it is very important to be able to make some estimates to quantify additional risk taken if IFR are set up based only on traditional VaR. CVaR according to its definition estimates the expected loss if the realised return is already lower than VaR. CVaR for a normal distribution can be calculated analytically based on the expected values, the standard deviation, the confidence interval and the VaR corresponding to the chosen confidence interval [11]. The target value for IFR based on the CVaR is labelled as IFR (CVaR).

	Minimum Return 3.5%	LPP-25	LPP-40	LPP-60		LPP-25	LPP-40	LPP-60		LPP-25	LPP-40	LPP-60
	Confidence interval	95.0%				97.5%				99.0%		
1	Traditional VaR (VaR) %	-3.26	-7.06	-12.35		-4.87	-9.41	-15.73		-6.75	-12.14	-19.65
2	Cornish-Fisher VaR (CF VaR) %	-3.93	-8.27	-14.24		-6.41	-11.89	-19.32		-9.65	-16.53	-25.74
3	Traditional CVaR (CVaR) %	-5.40	-10.18	-16.83		-6.81	-12.23	-19.78		-8.49	-14.67	-23.29
4	IFR(VaR) %	6.99	11.36	18.08		8.80	14.25	22.81		10.99	17.80	28.82
5	IFR (CF VaR) %	7.73	12.84	20.68		10.59	17.46	28.28		14.55	23.99	39.37
6	IFR(CVaR) %	9.41	15.22	24.44		11.06	17.92	29.02		13.10	21.29	34.92
7	IFR (CF VaR) - IFR (VaR), %	0.75	1.47	2.60		1.79	3.21	5.46		3.56	6.19	10.55
8	IFR(CVaR) - IFR(VaR), %	2.42	3.86	6.36		2.26	3.67	6.20		2.11	3.49	6.10
9	IFR (CVaR) - IFR (CF VaR), %	1.67	2.39	3.76		0.47	0.46	0.74		-1.45	-2.70	-4.45

Table 2 Target values for IFR calculated with different risk measures (VaR, CF VaR and CVaR) as a % of pension assets under management with an assumption of minimum necessary return of 3.5% for funding plan liabilities

The results show that target values for IFR calculated with traditional VaR are lower than those calculated based on historical observations with the Cornish-Fisher approach. These differences are explained by the negative skewness and positive excess kurtosis found in the historical returns, meaning that extreme negative returns happen more often than predicted by the normal distribution hypothesis. Comparison between values for the 97.5% confidence level shows that IFR(VaR) should be multiplied by 1.20-1.24 to reach the level of IFR(CF VaR) depending on index. The higher the confidence interval is, the higher the multiplier for target values calculated by traditional VaR are (multipliers are around 1.12 for 95% and 1.35 for 99%).

If we compare values calculated with both Delta-Normal (traditional) CVaR (row 3 in the table) and VaR (row 1 in the table) we notice that

- The higher the equity proportion in the index, the bigger the difference between CVaR and VaR. The absolute difference between CVaR and VaR is around 2% for LPP-25 and around 4% for LPP-60

- the higher the confidence interval, the lower the absolute difference between CVaR and VaR for each index but the absolute value for CVaR is larger with a higher confidence interval
- This could be intuitively understood as: the lower the confidence interval, the bigger the possible loss underestimation even with the normal distribution assumption.

CVaR with Cornish-Fisher approximation is expected to have the same or even bigger deviation from CF VaR.

With the 97.5% confidence interval we have the smallest differences between target values for IFR with the Cornish-Fisher approach and with traditional CVaR (see row 9). This means that possible losses below traditional VaR can be taken into account by calculating target values with the Cornish-Fisher approach for this confidence interval. For the 99% confidence interval target values calculated with Cornish-Fisher approach are even bigger than target values with CVaR.

For higher risk portfolios like the Pictet BVG 2005 LPP-40 and LPP-60 (with a substantial proportion of equity and alternative investment) it will be worth calculating expected losses over the traditional and Cornish-Fisher VaR to estimate the possible risk taken with such investments.

All these results show clearly that calculating IFR based on the traditional VaR approach with an underlying assumption of normally distributed returns can substantially underestimate their target value. Comparing funding ratios for Swiss pension funds per year-end 2007 and 2008 revealed and proved this drawback of the traditional VaR approach for the calculation of target values of IFR.

3.3 What target value for investment fluctuation reserves should be funded?

Here we assume that the employer gives no special guarantee to its pension fund and the underfunding policy aims to avoid any additional contributions being paid into the pension fund to eliminate a possible deficit due to a bear market. On the other hand, the emergence of free reserves (money in excess of a total liability and a target value of IFR) should be avoided. Many pension funds and their sponsors now prefer
- To keep contributions at a reasonably low level allowing them not to pay additional contributions in case of possible underfunding.
- to avoid the emergence of any free reserves in the pension fund with a high probability

Such a contribution policy should be set up and verified with the use of an ALM-study.

Pension funds with a moderate level of risky investments can have IFR funded to the level of a target value calculated with traditional VaR. They could indeed be underfunded after a market fall like in 2008 but the underfunding would be at a lower level and the fund should recover from its own resources based on (cyclical) mean reversion behaviour of investment returns. Pension funds with a substantial proportion of risky investments like LPP-40 or more could fund the target value of IFR calculated with traditional VaR but should choose a higher level of confidence interval (97.5% or even higher) and verify additionally with other risk measures (like CVaR) and stress testing/ sensitivity analysis the risk taken.

Pension funds which have underfunding policies without any employer guarantee or with an option of a temporary reduction in benefit levels should be very careful in setting up investment strategies not compliant with their risk tolerance. Backtesting[10] of the used VaR approach for setting up target values for IFR would be very useful in checking if the capital requirement could be justifiable for a long term. If a desirable and secure level of the target value for IFR is substantially higher than the one accepted by the fund based on an ALM-study, the funding strategy and its strategic asset allocation should be verified and possible losses should be quantified via stress testing and sensitivity analysis.

4.   Conclusion

Pension fund trustees now have a very intuitive qualitative approach for checking target values of their IFR as Pictet BVG 2005 Indices reflect real observations for the Swiss pension investments and can provide such reference values. Nevertheless it is necessary to complement such calculations with stress testing and sensitivity analysis for portfolios with a growing proportion of equity and alternative investment and to increase the confidence interval.

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[10] Backtesting is a statistical procedure where actual profits and losses are systematically compared to corresponding VaR estimates