

# Pricing investment risk

Alfred Bühler and Lukas Riesen analyse the costs that arise by taking investment risk and the way they are shared

## Funding

The financing of Swiss pension schemes' savings is based on three sources of income: employer and employee contributions and capital market returns. The pension schemes have wide freedom to decide on the extent to which they rely on each of these sources of income and on the consequential investment risks. The funds can decide autonomously on how to define and apply their investment strategy. In practice, the possibilities range from dynamic investment strategies based on a risk hedging philosophy to investing in an index with occasional rebalancing. This means the burden on the risk bearers varies and can lead to significant distribution effects between employers and the insured. The fund's demographic structure, the design of the pension scheme and any recovery or distribution plan can reinforce the redistribution effects. That means the risk costs and the way they are shared out between the bearers must be set out transparently at the

establishment of the scheme's investment policy. Only in this way can employers and employee representatives, who are both represented in the boards of trustees of Swiss pension schemes, take an informed decision about their investment policy and risk management. In the following discussion we will show how costs are calculated and how the redistribution effects can be revealed.

### Risk and costs

The only way of earning a premium above the zero risk return rate on the capital markets is by taking on investment risk. By investing in risky securities, such as equities, the investor can earn a risk premium. But as the term 'risk premium' makes abundantly clear, there is no certainty that any premium will actually be earned or that the investor will not suffer a loss. Because of the possibility of losing money, any risky investment always burdens an investor with costs. The costs

reflect the value of the option that would be needed to hedge the investment risk.

In order to determine the cost of the risk and thus the value of this option for a pension fund, the extent of the benefits that need to be hedged has to be defined. To do this it is necessary to define a target return, which is composed of factors such as the contributions paid in, the interest on the savings accounts or the conversion rate applied when a member goes into retirement. The second step is to establish how the costs of hedging the target benefits will be divided up between the various risk bearers. The employer may, for example, pay a recovery charge if the investment return is insufficient, or the employee may be forced to accept a lower interest on the savings accounts. It is possible to do without such measures, of course: but in this case the costs of supplementary contributions or benefit cuts will be passed on to future risk bearers. If we take the risk costs over a period of, say, 10 years, then it is necessary to quantify on the one hand the risk costs for this period of time, and, on the other, the unshared risks that apply beyond this time horizon.

### Asymmetrically shared opportunities and risks

The risk costs must also be offset against the possibility of improved benefits if capital markets move in a favourable direction. The investment risk bearers nonetheless often benefit only partially from distributions of profits. De facto, employers have limited options for participating in positive investment performance. Distribution of profits primarily benefit the active insured and, to some extent, pensioners, who, because of legal return guarantees, bear no investment risk. The opportunities for improved benefits that are likely to result from a given investment strategy can be reckoned up to the risk costs.

## 1. Stabilisation measures

Coverage ratio	Interest credited to savings accounts	Recovery contributions		Additional pension payments
		Employer	Employee	
CR > 115% + FR	LTR +10%			1 month's pension
110% + FR < CR < 115% + FR	LTR +6%			1 month's pension
105% + FR < CR < 110% + FR	LTR +3%			1 month's pension
100% + FR < CR < 105% + FR	LTR +1%			1 month's pension
100% < CR < 100% + FR	LTR			
95% < CR < 100%	1%	2%	0%	
90% < CR < 95%	0%	2%	0%	
CR < 90%	0%	4%	2%	

## 2. Distribution of risk costs (% of total pension liabilities)

Equity allocation of investment strategy	Employer recovery contribution	Employee recovery contribution	Employee reduced interest on savings	Employee total costs	Pension scheme (future risk costs)
20%	-2.5%	-0.1%	-4.6%	-4.7%	-2.2%
30%	-3.0%	-0.4%	-5.1%	-5.4%	-3.1%
40%	-3.4%	-0.7%	-5.4%	-6.1%	-4.2%

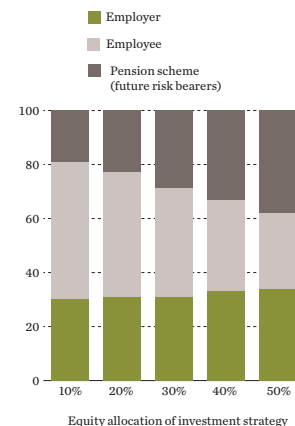
## 3. Distribution of risk benefits (% of total pension liabilities)

Equity allocation of investment strategy	Pensioner pension payments	Employee increased interest on savings	Pension scheme (future risk benefits)
20%	0.2%	0.9%	0.3%
30%	0.3%	1.6%	0.5%
40%	0.3%	2.6%	0.8%

Key for all tables: CR = coverage ratio; FR = fluctuation reserve; LTR = long-term interest rate  
Source for all tables: PPCmetrics

## 4. Distribution of net risk costs (%)

Monte Carlo simulations allow us not only to determine the level of the risk costs but also how they are shared out between risk bearers. To this end, realistic recovery measures and distribution rules that help stabilise the scheme are elaborated in collaboration with the board of trustees. A special role is played in this by the reduction in the interest credited on savings accounts, since experience shows that this measure is normally adopted as a first priority and is one which unilaterally burdens the insured. It is precisely this unilateral burdening of the active



Source: PPCmetrics

insured that can be demonstrated clearly by the method presented here. Each simulated change in asset return leads to a resultant change in the coverage ratio and triggers certain measures outlined in the stabilisation mechanism that has already been agreed upon. For example, if the cover ratio falls below 100%, the employer has to make recovery contributions and the interest credited on savings accounts will be cut by 1%. These measures, which are set up to be dependent of investment performance, can be valued precisely, in a fashion analogous to the appraisal of a structured investment product.

Beyond the stabilisation measures, a target is established for the desired financial situation that should be reached at the end of the period of time in question. Establishing such a goal makes it possible to prevent a recovery process from being postponed after the simulated period, which could lead to risk costs being underestimated. In general, the target is to have a coverage ratio of at least 100% at the end of a given 10-year simulation period.

Depending on the situation in which the fund finds itself, the management board can set other targets, such as building up fluctuation reserves or, in the case of public schemes that are partly capitalised to hit a target coverage ratio of, say, 80%. The likelihood of achieving a high coverage ratio at the end of the simulation period is also linked to investment risk and this can lead to improved benefits in the future. The likelihood that the required level will be exceeded can be priced as an option as well and accounted toward risk costs.

One important characteristic of risk costs defined in this fashion is that they are independent of the expected returns of the investment strategy. The result is not linked to uncertain assumptions relating to the risk premiums for various asset classes, as the price of an equity option is not dependent on the expected return of its underlying. Risk (volatility) does nonetheless play a central role, as it does with all approaches to option valuation. As the price of an insurance policy rises with growing risk, higher investment risks lead to a rise in risk costs.

### Quantifying costs

We will illustrate this approach to quantifying risk costs using a simplified example based on a cash balance plan with a coverage ratio of 102% and a technical interest rate of 3.5%. The savings accounts make up 70%, and pensioners' liabilities make up 30% of total liabilities. Risk contributions and the pension conversion rate have been set in such a way that no technical profits or losses need be planned for.

The interest credited on savings accounts is intended to match the long-term interest rate. With equity allocations of 20%, 30% or 40%, the fluctuation reserve required by the investment strategy will constitute respectively 10%, 12.5% and 15% of total pension liabilities.

The pension fund's board of trustees chooses to adopt the stabilisation measures depicted in figure 1. These include agreed measures that are dependent on the coverage ratio, while the cover ratio's upper and lower limits also depend on the fluctuation reserve that has been agreed for the investment strategy in question.

Figure 2 depicts the risk costs for employers and employees as a percentage of total pension liabilities over a 10-year time horizon. Further, the risk costs remaining in the fund at the end of the simulation period are listed in the final column. Regardless of the risk of the investment strategy itself, receiving interest on retirement savings below the long-term interest rate is among the highest risk costs. If one includes the recovery contributions, the employee bears

almost twice the risk cost of the employer. With an equity allocation of 30%, the risk costs of the employee amount to 5.4% of the pension liabilities and those of the employer only 3%. On the other hand, the employee may benefit from any excess interest credited on the savings accounts, an effect whose impact grows strongly in importance as the risk level of the investment strategy increases (see figure 3).

Part of the risks and opportunities remain in the pension scheme and are shared among future risk bearers after the 10-year horizon of the simulation has passed. As figure 4 shows, this share grows continuously if investment risk is increased. The only way of reducing this risk is by taking larger recovery contributions as the equity allocation rises.

This example shows that, for a given pattern of stabilisation measures, the higher the investment risk, the lower the net risk costs for current employees.

However, a higher level of investment risk will lead to a greater portion of the risk costs being passed on to future risk bearers.

### Transparency regarding investment risks

Using this methodology, it is possible to determine the opportunities and risks of an investment strategy and the way these are shared between risk bearers both during the time period in question and after it. It becomes possible to modify the investment strategy as well as recovery and distribution rules in such a way that risk costs are shared as the board of trustees agrees. Transparency regarding risk costs and their sharing allows decision takers to make an informed choice concerning investment strategy and risk management.

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