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Strategic Interest Rate Hedges Or How Derivatives Can Help Solve the Pension Fund Crisis Part II

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Strategic Interest Rate Hedges

Or How Derivatives Can Help Solve the Pension Fund Crisis Part II

Abstract

In this paper we use a scenario-based ALM model to study the impact of different interest rate derivatives strategies on the risk-return profile of a defined benefit pension fund. The results show that properly constructed hedging strategies using swaps and swaptions can add substantial value. Increased risk perception due to fair value accounting and regulation can be dealt with effectively via these techniques. The results are robust with respect to the assumed interest rate mean reversion level. An expected rise in interest rates is therefore no reason to refrain from hedging.

1. Introduction

Given the typical composition of their asset portfolios and the nature of their liabilities, most pension funds are currently exposed to a very substantial degree of interest rate risk. A distinct feature of pension funds, when compared to other financial institutions such as banks for example, is the very long maturity of their liabilities. Although over time the aging of the average population will gradually reduce the average duration in many Western countries, the typical duration of pension fund liabilities currently lies between 10 and 20 years.

Pension fund investments tend to have a much lower duration. Liquid bond portfolios for example, usually have a duration of 5-7 years. Longer maturity bonds are available, but in such limited quantities that liquidity is poor and active (alpha generating) management impossible. Apart from the severe mismatch in terms of duration and the accompanying non-perfect correlation between medium-term and long-term interest rates, it is important to note that most non-bond asset classes, such as equity and real estate, typically do not exhibit a very pronounced and stable correlation with pension fund liabilities[1]. This means that the interest rate risk embedded in the long-term liabilities of pension funds is not meaningfully reduced by investing in these asset classes.

In a way, pension funds are in the reverse position of that of banks. The latter fund themselves with relatively short-dated instruments, such as savings deposits and short-dated loans, while investing in longer dated products, such as mortgages and medium-term loans. In the long run, pension funds therefore run risks similar to banks except that the positive risk premium banks extract in the long run from the (on average) upward sloping yield curve is negative for pension funds. Not an enviable position to be in.

[1] It is sometimes argued that, when considering the present value of future dividends, the duration of equity is fairly long. By some this is interpreted as implying that therefore equity provides a good hedge for long-dated liabilities. This argument, however, is seriously flawed since for a good hedge the (in the short and medium term) limited correlation between interest rates and equity and the volatility of this correlation cannot be ignored.

Following recent changes in most Western countries, accounting and solvency rules now require pension funds to assess their long-dated liabilities in terms of fair value, with discounting usually based on a nominal yield curve. This has lead to increased awareness of interest rate risks within pension funds, which in turn is dramatically increasing hedging activity. It has also sparked debate on the necessity and the effectiveness of hedging, with arguments against hedging including the mismatch risk between nominal and real interest rates and the fact that current interest rate levels are far below historical levels.

In this paper we study the use of derivatives in pension fund interest rate hedging. We investigate the nominal interest rate hedging possibilities, mean reversion aspects, as well as the robustness of the various strategies in the context of parameter uncertainty. Our model is based on the real-life case of an average pension fund, seen from a going-concern perspective. Its liability structure reflects most (average) pension fund structures in the Western world, except for the level of indexation, which may differ significantly between countries. In technical terms, we apply the same ALM modelling techniques as used previously in Capelleveen et al. (2004).

2. The Asset & Liability Management Model

Although a full description of the details of the scenario-based ALM model is outside the scope of this paper and would distract from the main discussion, the model itself is key to the analysis of the various hedging strategies. A brief description is therefore unavoidable.[2] In sum, the model consists of five separate building blocks:

(1) **Economic market variables –** Generates the returns on the various asset classes, yield curves (nominal and real), inflation, etc.

(2) **The asset structure** – Generates the asset portfolio value as a function of the external economy, while taking into account investment and rebalancing rules related to contributions, payouts, dividends, coupon reinvestment aspects, etc.

(3) **The liability structure –** Generates future obligations in a going-concern context, partly as a function of inflation and in combination with the funded ratio as a

[2] An introduction to this type of models can be found in Ziemba and Mulvey (1998) for example.

conditioning variable for indexation, taking into account mortality, career and civil status.

(4) **The policy instruments** – Instruments available in the model are among others the contribution rate policy, the indexation policies for active and inactive members, the pension policies (pension age, final wage versus average wage, etc.), asset allocation decisions and derivatives strategies. Some instruments can be deployed as a function of the funded ratio and/or other state variables.

(5) **Objectives and constraints** – Includes the various risk and return variables of interest, characterized by type (contribution rate, funded ratio, etc.), level and horizon.

We discuss the above five building blocks in some more detail below.

The External Economy

Generating realistic scenarios for the external economy is crucial to optimising the decision-making process. The scenario-generating model used in this study is a co-integrated Vector Autoregressive (VAR) model, estimated on end-of-year data over the period 1970 – 2003[3]. The model generates annual returns for global stock indices as well as price and wage inflation. The model also generates stochastic paths for various long-term and short-term interest rates, with the yield curve subsequently determined using the Nelson-Siegel curve fitting technique.[4] The model allows for mean-reversion and (auto-)correlation in and between all relevant variables.[5]

In principle, the model is capable of handling any number of asset classes. However, to avoid unnecessary complication the basic asset mix is constrained to a combination of global equities (taken to be the MSCI equities world index) and global bonds (MSCI bond world index).

Option prices are based on arbitrage-free models consistent with the stochastics embedded in the ALM model, using the underlying index values and relevant risk-free interest rates as inputs. The necessary 'smile' and term structure of implied

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[3] See for example Judge et al. (1985) for a theoretical introduction to VAR-models.
[4] See Nelson (1987).
[5] See for example Campbell et al. (1997) for a further explanation of mean reversion models.

volatilities are embedded in a 'volatility surface', which is modelled as a spread over the cash market volatilities of the underlying reference indices generated by the model.[6]

All model parameters are based on historical estimates. The parameter values for the average short-term and long-term interest rates, equity risk premium, and inflation rate, however, are subjective inputs in line with a number of recent publications on this subject. Table 1 provides an overview of the means and volatilities of some of the key variables in the model. Of course, different parameter values may produce different results. In a later section we will therefore submit our conclusions to a thorough robustness test.

The mean reversion in interest rates is key in this research. At initiation, the long end of the yield curve (30-years) is 0.8% and the short end (1-year) 1.7% below its assumed long-term mean.

Table 1: Key model parameters VAR model

	Geometric mean return	Volatility
Wage inflation rate	2.2%	1.5%
Short term interest	4.0%	1.5%
Long term interest	4.9%	0.9%
MSCI World	7.7%	17.0%

The Asset Structure

In line with the way the external economy is modeled, the fund's assets are invested in global bond and equity indices only and, for the derivatives part, in OTC derivatives as defined in the next sections. At every point in time all assets and derivatives (including non-expired options) are valued at market prices. Annually, the strategies are fully rebalanced to their target levels. Rebalancing takes place after contributions are collected and pensions paid. The basic benchmark case is the case of 60% bonds, 40% equity and no derivatives.

[6] See for example Taleb (1997) for an explanation of volatility surfaces, skews, etc.

The Liability Structure

All analyses are carried out from a going-concern perspective as, over 5-year and 10-year horizons, we simulate a pension fund with not only existing participants making annual contributions in return for future pension rights, but also existing employees exiting and new employees entering the fund, based on an empirically estimated Markov-chain process. The Markov process determines how from one year to the next a participant stochastically moves from one state to another (for example from active employee to retiree or from retiree to deceased participant) and with what probability. The going-concern approach simulates the long-term process in a real-life pension fund. The alternative is to evaluate pension funds from a so-called ‘liquidation perspective’, which assumes no new entrants and contributions. This only applies in a limited number of cases, however, for example when a fund is closed due to default of the parent company.

We make the following assumptions. Initially, 75% of the members are inactive (of which 30% retirees), representing 50% of the liabilities. The initial duration of the liabilities is approximately 17 years. The going-concern structure is such that these parameters do not change very much over the period of analysis. After 10 years for example, the duration of the fund liabilities is still 15.5 years. The slight reduction in duration over time reflects the process of gradual aging (less active members, more retirees) in the pension fund, which is in line with current demographics in Europe.

Although the various regulatory authorities around Europe and in the US prescribe somewhat different methodologies, they all require a nominal yield curve for the valuation of pension fund liabilities.[7] In our simulations the value of all pension fund liabilities is therefore calculated using the nominal swap curve. Some countries still rely on a fixed discount curve, but it is only a matter of time until they will converge to actual yield curve based discounting as well.

[7] The main difference between different methodologies lies in the credit quality of the curve used, ranging from AAA government to AA corporate. The swap curve in Europe is currently very close to the AAA government curve.

The Policy Instruments

A pension fund has a variety of policy instruments at its disposal. In principle, these can all be incorporated in the current ALM model. In this study, however, more structural aspects such as pension design, contribution rate policy and indexation policy are taken to be exogenously fixed, i.e. not part of the dynamic rules that determine the optimal allocation and derivatives strategy.

The pension and asset allocation policy are independent of any state variables. However, we do assume that the pension fund in question grants indexation only conditionally with the amount of indexation determined by the health of the pension fund, as measured by the funded ratio. The latter is defined as the ratio of the asset value at time *t*, including the (positive or negative) value of all derivatives, and the market value of the liabilities at time *t*. Accounting reserves are absent on asset and liability balance sheet items. Indexation is postponed as long as the funded ratio is below 110%. If the funded ratio exceeds 120% pensions are fully indexed to wage inflation. If the funded ratio is between 110% and 120% wage inflation is linearly interpolated. Finally, if the funded ratio exceeds 130% previous indexation shortages are compensated as well.[8]

The Objective Function

In order to incorporate risk and return preferences, academic research often uses utility functions. However, since pension fund decision-making processes are based on multiple horizons, multiple criteria, etc., this is not a viable option here. We therefore refrain from using explicit utility functions. Instead, we take the probability of one or more years of low funded ratios as the prime risk variable of interest.

One could argue that the risk of a severe indexation shortage (for example the risk of indexation levels below 25% of full indexation) is a valid measure of risk as well, especially from the point of view of the employee. However, pension fund dynamics are such that low indexation only exists at low funding levels and vice versa. In practice, this implies that reducing funding shortfall risk also reduces indexation risk. We therefore refrain from this risk measure to avoid further complexity.

[8] See Kocken et al. (2005) for a further elaboration on the impact of these indexation policies on pension fund risk management.

Risk should of course always be looked at in conjunction with expected return as different risk reduction strategies may have a different impact on expected return. In a pension fund ALM context this is quite a complex concept since the return impact of risk management strategies is translated into different funding ratios and different contribution rates. By fixing the contribution rate, however, the dominant return impact is channeled to the funding ratio, which means that in our case the relevant risk-return tradeoff consists of the risk of underfunding versus the expected funded ratio. The time horizon of the analysis will be 5 and 10 years. The reason for looking at different horizons is to be able to evaluate the stability of the various solutions over time.

We will present our results in two different formats. First, we present risk-return type graphs showing the probability of underfunding (funded ratio falling short of 100%) versus the expected end-of-horizon funded ratio. These graphs provide a clear graphical view on the overall efficiency of the various strategies. Second, we present tables concentrating on the probabilities of falling short of certain specific funded ratio levels and investigate how these probabilities differ between the various strategies. To set a benchmark, we selected those funded ratio levels, which in the case without any interest rate hedging have a shortfall probability of 5%, 10% and 15%. In this way, changes in these shortfall probabilities due to the inclusion of derivatives can directly be interpreted as indicators of the effectiveness of these strategies.

3. Nominal Interest Rate Hedges

In this section we investigate the effectiveness of several interest rate hedging strategies, using linear (swaps) as well as non-linear (swaptions) products. The basic case is a pension fund with an initial funded ratio of 110% and an indexation policy as described earlier.

Swaps and Swaptions

Derivatives are very well suited to efficiently minimize risk as these products can easily be tailored to optimally fit into an ALM context. More specifically, derivatives can have non-linear payoffs, which allows a much better fit to non-linear preferences than is possible with only linear products. Another benefit is that the use of derivatives does not require (material) changes in the existing asset allocation. This is an important feature since, while hedging their interest rate position, pension funds will prefer to retain their allocations to asset classes offering a significant risk premium, such as (private) equity and real estate for example. In this way pension funds can optimize their risk-return profile in line with their objectives and risk constraints.

Over the years, interest rate derivatives, such as swaps and swaptions, have gained tremendous popularity in practical applications. Liquidity in these instruments has surpassed liquidity in the underlying securities and credit risk can easily be eliminated by means of proper collateral management.

A *swap* is a contract under which two counterparties agree to exchange cash flows at a number of future dates. In a standard interest rate swap one counterparty pays fixed amounts while the other counterparty's payments are explicitly linked to a short-term interest rate, such as 6-month Euribor for example. If the interest rate goes up, the latter pays more and vice versa. It is a linear product in the sense that what is lost in case of a rise in interest rates is gained in case of a fall. Apart from convexity effects due to discounting, this makes the value of the contract also a linear function of the interest rate.

A *swaption* is an option on a swap, i.e. the right to enter into a swap. Since options represent a right and not a strict commitment, they offer non-linear payoffs and option values are non-linear functions of the value of the underlying variable(s). Swaptions are specifically applied in cases where the risk of a certain interest rate movement has to be reduced but it is expected that interest rates will move favourably (for example because interest rates are below expected long term mean reversion levels).

The Impact of Interest Rate Swaps

As described above, in case of a funded ratio below 120 pensions are not (fully) indexed with inflation. In this region the liabilities therefore behave in a 'nominal' fashion.

The first step in the search for the optimal derivatives overlay is therefore to investigate hedging strategies with interest rate swaps. We work with three different swap maturities of 20, 25 and 30 years. Shorter maturities are not adding much value since this risk is naturally hedged with the bond portfolio. Maturities exceeding 30 years are typically not sufficiently liquid. Using a greater variety of maturities (for example to match future cash flows on a one-to-one basis) hardly adds any value to the strategy's efficiency, but is operationally much more intensive.

Together with the shorter-term bond allocation, the maturity mix of the swaps is determined in such a way that the mismatch risk is minimised efficiently.[9] The result is an initial swap portfolio consisting of 10% 20-year swaps, 20% 25-year swaps and 70% 30-year swaps.

The interest rate sensitivity (also called 'basis point value') of the optimal swap hedge plus that of the bonds equals 85% of the interest rate sensitivity of the liabilities. A 100% interest rate hedge would be sub-optimal. There are a number of reasons for this. One is that the liabilities which the (nominal) interest rate swaps aim to hedge are not 100% nominal in nature, but partially inflation-linked.[10] A 100% nominal hedge could therefore be overhedging the interest rate risk. Secondly, the correlation between equity and (nominal and real) interest rates, although not particularly high over a 5 or 10-year horizon, plays some role in the risk minimization as well.

For different equity/bond allocations, figure 1 shows the risk of underfunding, i.e. the probability that the funded ratio falls short of 100%, versus the expected funded ratio. The results are depicted over both a 5-year and a 10-year horizon.

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[9] All swaps are receiver swaps (fund receives a fixed rate and pays a floating rate). Risk is minimized by minimizing the probability of underfunding over a 5-years horizon. Some further risk reduction could be achieved by applying payer swaps (fund pays a fixed rate and receives a floating rate) as well. This is, however, primarily a practical implementation issue, which does not add any new insights.

[10] Resulting from the indexation of pensions with inflation if the funded level is sufficiently high.

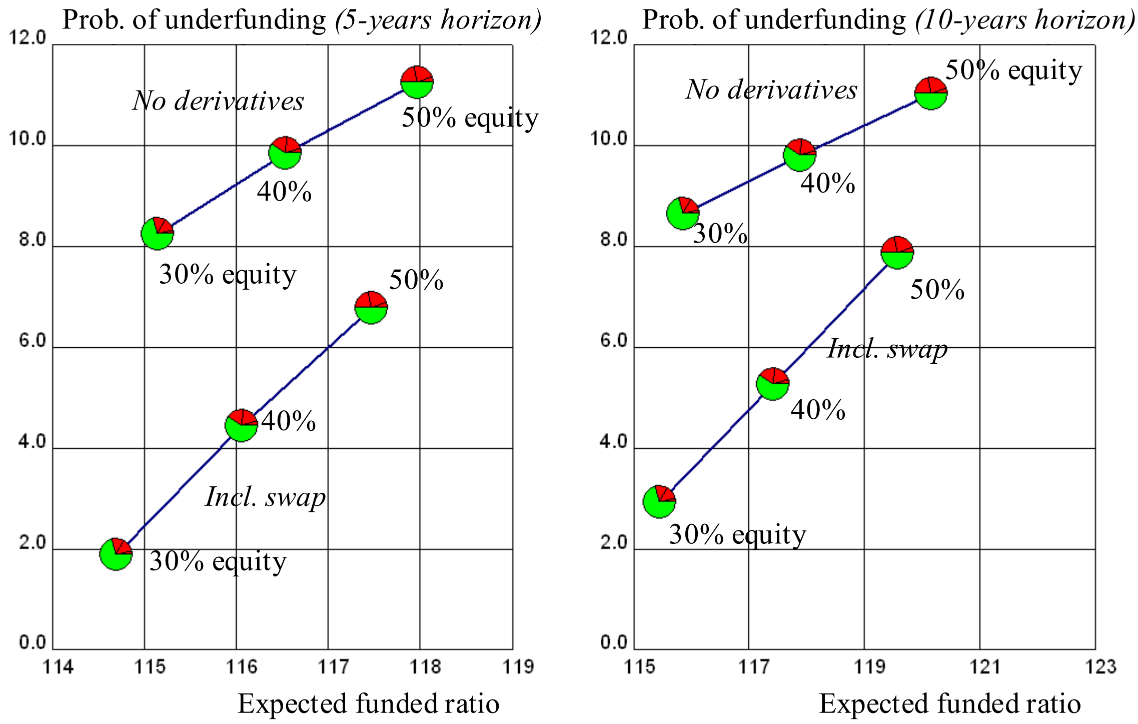

Figure 1: Impact interest rate swap on probability of underfunding and expected funded ratio

Figure 1 clearly shows that the introduction of swaps significantly reduces the risk of underfunding but, when leaving the equity/bond allocation unchanged, at the cost of a slightly lower expected funding ratio. From the graph, however, we see that this can easily be corrected by slightly increasing the equity allocation. Doing so allows one to maintain the same expected funded ratio as without swaps but at a much lower risk level.

Next, we zoom in on the lower tail of the distribution of the funded ratio by looking at the probability of experiencing a funded ratio lower than the ratio that in the benchmark case of 40% equity, 60% bonds and no derivatives has a probability of occurrence of either 5%, 10% or 15%. We do so on a ‘funded ratio neutral’ basis. When a strategy leads to a lower (higher) expected funded ratio, the equity allocation is increased (reduced) to such a level that the expected funded ratio equals the expected funded ratio of the basic strategy without derivatives overlay. Table 2 shows how this works out for the swap strategy. Between brackets are the funded ratios that correspond with a 5%, 10% and 15% probability that the pension fund will fall short of these levels in the benchmark case without derivatives.

Table 2: Impact swaps on probabilities of low funded ratio

Horizon	Strategy	Pr(FR < 95.2)	Pr(FR < 100.3)	Pr(FR < 103.5)
5y	40% eq., no derivatives	5.0%	10.0%	15.0%
	43% eq., incl. swap	1.6%	5.4%	10.3%
		Pr(FR < 94.7)	Pr(FR < 100.3)	Pr(FR < 103.8)
10y	40% eq., no derivatives	5.0%	10.0%	15.0%
	43% eq., incl. swap	2.3%	6.5%	11.2%

Table 2 shows that the swap strategy works very well for all three percentiles and both horizons under investigation. From the table we see that, for example, over a 5-year horizon the funded ratio in the case without swaps will fall short of 95.2 with a 5% probability. The probability of experiencing a funded ratio lower than 95.2 can, however, be reduced from 5% to 1.6% by adding the swap strategy while at the same time increasing in equity allocation from 40% to 43%. By construction, the expected funded ratio of course remains unchanged.

It is important to note that the cost of the swaps strategy is state dependent. In the underlying case of extremely low initial interest rates, swaps have a negative impact on the expected funded ratio as initially interest rates are more likely to drift upwards than downwards. In case initial interest rates are closer to their mean reversion levels, the hedging process will generate more risk premium (positive differential between the long and short end of the yield curve) and thereby reduce risk while raising the expected funded ratio. In such a case there is no real risk-return trade-off as hedging will improve risk as well as expected return.

Adding Asymmetry to the Strategy

As shown in Capelleveen et al. (2004), proper use of simple equity option strategies can lead to significant efficiency gains in pension fund management. Do we observe a similar phenomenon with swaptions? To increase efficiency, options should not only reduce risk (this can also be achieved with linear derivatives such as swaps) but they should also retain some upside potential with a positive expected return.[11] If the cost of the option exceeds the market value of the risk reduction, the net efficiency effect of incorporating options will be negative. Buying a swaption will reduce risk. In general, however, the long duration liability structure combined with an, on average, upward sloping yield curve does not provide expected return in the long run. In general, this favours swaps over swaptions. There are situations, however, especially when interest rates are far below their long-term mean reversion levels, where the expected payoff is positive. In those cases, swaptions are preferred over swaps. Obviously, this calls for an interest rate dependent hedging strategy, which uses swaptions in case of low interest rates and converts to swaps at higher interest rate levels and vice versa. Figure 2 shows how the various strategies (swaps-only, swaptions-only and dynamic swap-swaption[12]) work out in our case.

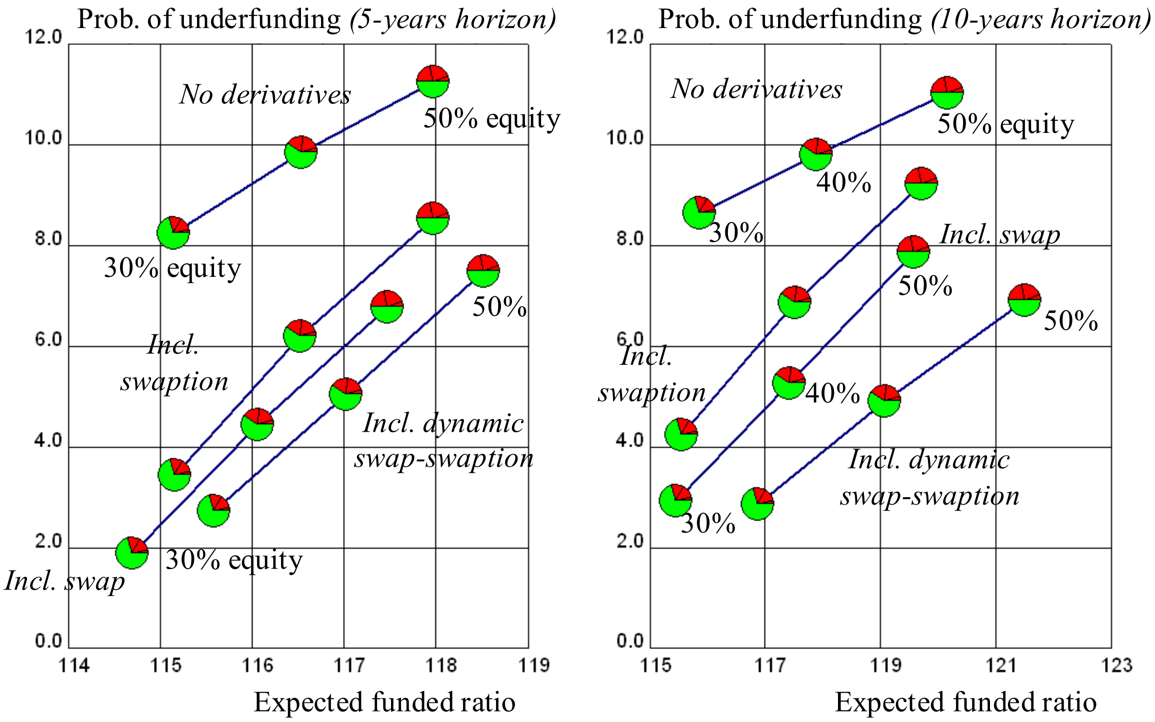

Figure 2: Impact swap, swaption and dynamic swap-swaption strategies on probability of underfunding and expected funded ratio

[11] For example, foreign exchange positions with no expected return should not be hedged using options, but should be hedged with linear products such as currency swaps and FX Forwards. Equity positions on the other hand do provide expected return and option strategies therefore make much more sense, as discussed in Capelleveen et al. (2004).

[12] If the long-term interest rate is below 4% a swaption is used, while if the interest rate is above 5% a swap is chosen. Between an interest rate of 4% and 5% a linear combination of both swap and swaption is used.

Figure 2 illustrates that, although both are able to reduce the probability of underfunding quite substantially, due to the low initial interest rate environment, swaptions perform worse than swaps. The dynamic swap-swaption strategy clearly outperforms the swaps-only strategy. The probability of underfunding is reduced in a similar way as with swaps-only, but with an improved expected funding ratio. This is because in the dynamic strategy swaps are only applied in situations where they have a positive expected value (via the positive cost of carry). In case of low interest rates the use of swaptions reduces the expected loss that would otherwise occur on swaps.

Table 3 reports the same 5%, 10% and 15% tail probabilities as in table 2, but now with the dynamic swap-swaption strategy added. From the table we see that in all cases the dynamic swap-swaption strategy performs better than the swaps-only strategy.

Table 3: Impact swaps and swaptions on probabilities of low funded ratio

Horizon	Strategy	Pr(FR < 95.2)	Pr(FR < 100.3)	Pr(FR < 103.5)
	40% eq., no derivatives	5.0%	10.0%	15.0%
5y	43% eq., incl. swap	1.6%	5.4%	10.3%
	35% eq., incl. dyn. swaption	1.0%	4.0%	8.6%
		Pr(FR < 94.7)	Pr(FR < 100.3)	Pr(FR < 103.8)
	40% eq., no derivatives	5.0%	10.0%	15.0%
10y	43% eq., incl. swap	2.3%	6.5%	11.2%
	35% eq., incl. dyn. swaption	1.2%	4.1%	8.1%

Robustness Analysis

Any optimization study should include a thorough analysis of the robustness of the results, as a small change in parameter assumptions may have serious implications for the final choice of products and their exact specifications. This is especially true when dealing with long time horizons.

In the current low interest rate environment investors often find it hard to believe that the benefits of risk reduction outweigh the negative expected return due to the expected mean reversion in interest rates. Below we therefore focus on the sensitivity of our results to the long-term mean reversion level of interest rates. Apart from the basic set-up, we study two alternative parameter sets created by shifting long-term interest rate levels by plus and minus 0.75%. One alternative set of scenarios therefore evolves around relatively low interest rate levels, while the other set evolves around relatively high interest rate levels.

Tables 4a-c show the tail probability results of the swaps-only and dynamic swap-swaption strategies under the 3 different parameters sets. As before, under all scenarios, we determine the equity allocation for both strategies such that the resulting expected funding level is the same as in the case of the 40% equity, 60% bond and no derivatives. The other parameters of the strategies, such as the switching levels of the dynamic swap-swaption strategy for example, remain unchanged.

Table 4a: Probability low funded ratio under base assumptions

Horizon	Strategy	Pr(FR < 95.2)	Pr(FR < 100.3)	Pr(FR < 103.5)
	40% eq., no derivatives	5.0%	10.0%	15.0%
5y	43% eq., incl. swap	1.6%	5.4%	10.3%
	35% eq., incl. dyn. swaption	1.0%	4.0%	8.6%
		Pr(FR < 94.7)	Pr(FR < 100.3)	Pr(FR < 103.8)
	40% eq., no derivatives	5.0%	10.0%	15.0%
10y	43% eq., incl. swap	2.3%	6.5%	11.2%
	35% eq., incl. dyn. swaption	1.2%	4.1%	8.1%

Table 4b: Probability low funded ratio under lower mean reversion assumption

Horizon	Strategy	Pr(FR < 91.8)	Pr(FR < 96.8)	Pr(FR < 100.0)
	40% eq., no derivatives	5.0%	10.0%	15.0%
5y	29% eq., incl. swap	0.0%	1.0%	2.9%
	27% eq., incl. dyn. swaption	0.2%	1.3%	4.1%
		Pr(FR < 90.1)	Pr(FR < 95.5)	Pr(FR < 99.0)
	40% eq., no derivatives	5.0%	10.0%	15.0%
10y	29% eq., incl. swap	0.5%	1.5%	3.6%
	27% eq., incl. dyn. swaption	0.3%	1.8%	3.9%

Table 4c: Probability low funded ratio under higher mean reversion assumption

Horizon	Strategy	Pr(FR < 98.7)	Pr(FR < 103.5)	Pr(FR < 106.6)
	40% eq., no derivatives	5.0%	10.0%	15.0%
5y	52% eq., incl. swap	4.9%	10.9%	15.8%
	41% eq., incl. dyn. swaption	2.7%	7.0%	12.2%
		Pr(FR < 99.0)	Pr(FR < 104.5)	Pr(FR < 107.9)
	40% eq., no derivatives	5.0%	10.0%	15.0%
10y	52% eq., incl. swap	5.7%	11.8%	17.2%
	41% eq., incl. dyn. swaption	2.6%	7.1%	11.8%

Comparing the entries in the three subtables we see that both strategies work better with lower mean reversion levels than with higher mean reversion levels. This is not surprising since in the lower mean reversion environment the derivatives used will have a higher and in the higher mean reversion scenario a lower expected value. What is interesting though, is that, at least in these alternative states of the world, the dynamic swap-swaption strategy is much more robust than the swaps-only strategy. Under the assumption of a high mean reversion level the swaps-only strategy does not reduce risk anymore. In fact it increases slightly. Note that due to the high mean reversion level (and, starting with very low interest rates, therefore the high expected loss on the swaps-only strategy), the equity allocation in case of the swaps-only strategy has to be increased significantly to keep the expected funded ratio unchanged. This is partly the reason for the high observed risk levels.

Inflation-Linked Hedging Strategies

The above analysis illustrates how nominal interest rate related products can efficiently improve the risk-return profile of a conditionally indexed defined benefit pension fund. However, given the presence of indexation, a link with inflation-linked assets could make for an even more effective hedge. Further discussion of inflation-linked hedging strategies is beyond the scope of this paper. In a follow-up paper, however, we will discuss the case of inflation hedges in a fully inflation-linked pension fund.[13]

[13] See also Kocken et al. (2005) for an extensive discussion on inflation risk in pension funds.

More Advanced Solutions

The analysis in this paper has been limited to only the most straightforward hedging strategies. Swaps and swaptions are of course not the only interest rate dependent contracts available in today's derivatives markets. Further research (not reported) has shown, however, that widely popular products such as caps, floors and constant maturity swaps for example, are less effective in a defined benefit pension fund set up such as the one used in this study. That does not mean that these products have no place in pension fund management at all though, as there are countries, such as Austria and Switzerland, where pension funds (and the way they are regulated) are structured significantly different. In those cases the above products may prove quite helpful in hedging interest rate risk.

Furthermore, many dynamic combinations are possible. More complex options and combinations allow for more tailored, slightly more efficient solutions. On the other hand, this may come at the cost of reduced transparency and liquidity. In addition, more dynamic solutions require dedicated execution over time, which may present its own organizational problems. It therefore depends very much on the organization (its size, balance sheet, derivatives experience, structure of the board, etc.) which degree of complexity is acceptable for reducing market risk without incurring too much operational risk.

4. Conclusion

In this paper we have used a scenario-based ALM model to study the impact of different interest rate hedges on the risk-return profile of a typical defined benefit pension fund. The results show that properly constructed hedging strategies can add substantial value to pension funds. More specifically,

1. **The use of interest rate swaps**. In general, much of the interest rate risk faced by a pension fund can be eliminated by the proper use of swaps. When interest rates are well below their long-term mean, however, the risk premium on swaps will be negative in the short term, which makes swaps less effective as a hedging tool.

2. **The added value of swaptions.** When interest rates are far below their long-term mean reversion levels, swaptions are to be preferred over swaps as the former avoid the loss on swaps, which can be expected to occur in that case.

3. **The optimal hedging strategy.** The optimal hedge is interest rate dependent. It uses swaptions in case of low interest rates and converts to swaps at higher interest rate levels and vice versa.

4. **Robustness.** The dynamic swap-swaption strategy appears quite robust with respect to the mean reversion parameters of long-term interest rates.

It should be noted that in practice pension funds may vary quite considerably with respect to structure and policies. Differences in liability characteristics, contribution rate policy, indexation policy and asset structure can lead to optimal hedging strategies that are significantly different from the ones discussed here. Unfortunately, in the pension fund risk management game there is no one size fits all solution.

Advanced fine-tuning with complex products or dynamic strategies can add a few percent in additional efficiency. Unfortunately, for most pension funds this is only of secundary importance as many of them have yet to start thinking about strategic hedging at all. Interest in proper risk management, however, is on the rise and will prove to be irreversible. Unlike what many trustees, as well as their consultants, like to believe, derivatives are not dangerous. When used correctly, they can make a tremendous contribution to pension fund risk management. Over years to come more and more pension funds will realize this and derivatives will become one of the most important strategic tools for pension fund risk management.

Finally, it is important to realize that the argument that interest rates are expected to rise does not imply that interest rate positions should not be hedged. Hedging these positions, even with a negative expected return in the short and medium term, can substantially reduce risk and thereby make room for investment in other asset classes that offer a higher expected return per unit of risk. The simple rule of optimizing the ratio of marginal return and marginal risk over all risk groups is well known from the finance literature but hardly ever applied in practice on a strategic level.

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