Liability Driven Investment Strategies – For Prudent Pension Investing in Turbulent Capital Markets

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Abstract:

Deriving a prudent investment and risk management strategy for a pension fund is a complex task for the responsible plan trustees – given recent capital market turbulences and revisions in pension accounting and regulation, this challenge has become bigger than ever. The article will point out three components within the concept of liability driven investing (LDI) to provide a framework for managing this challenge. Beyond the general LDI concept of an integrated asset-liability view, a focus will be on key risk factors (such as interest rates, inflation, and credit spreads) and their impact on both sides of the pension plan, its assets and its liabilities. Active risk management as a key element of prudent pension management will be addressed with a focus on managing asset-liability mismatch risks also by using dynamic risk management strategies to efficiently control funding risk in changing market environments. The concluding component addresses the concept of a risk cockpit for effectively controlling pension funding risk in a forward looking way.

1 A Holistic Investment- and Risk-Framework for Pension Investing

Given its purpose, the primary goal of a pension fund is to ensure that the pension promises given to its plan members are honored at all times and under all circumstances. Practically speaking, this means that all future expected benefit payments are made to the entitled beneficiaries in due time and amount as specified in the individual pension deal. Prudent pension management, thus, requires an investment and risk management framework for its plans assets, which maximizes the chances that this will be achieved and is implemented in the most cost efficient way.

The various capital market crises Western economies experienced during the last decade however have highlighted repeatedly that most pension plans cannot cope very well with such financial market challenges. The guise of the individual crisis may look different and arise for example in form of the "burst of the dot com bubble", the "Lehman banking crisis" or the "Euro sovereign debt crisis" the effects on pension plans were always quite similar: they experienced substantial decline in plan asset values, reduction in funding level with consequently lower indexation of plan accruals, and in some cases the need for additional funding by its corporate sponsor or severe interventions of regulatory bodies to the pension plan's investment policy.

"Black Swan" is the metaphor Nassim Nicola Taleb uses in his book with the same title to describe economic shocks which occur only rarely and unexpectedly but have dramatic effects on market participants. And the fact that such Black Swans occur more often than traditional models take into account[1], in combination with the vulnerability of pension funds to financial risks suggests that it is prudent for pension boards and their corporate sponsors to apply investment policies which address these market risks explicitly to better cope with such challenges.

Among the lessons learnt from these turbulent financial markets is the insight that in stressed market situations "correlations between asset classes

1 Historical examples illustrate the shortcomings of traditional models assuming normally distributed returns: Those market events we have experienced in 2008, for example, in the equity or commodities markets should happen only every some 500.000 years under normal model assumptions. Having seen such movements within the last 10 years several times the "normal hypothesis" will not hold. More advanced models like Markov Switching models, therefore, consider such "fat tailed" return behavior.

break down". This expresses the phenomena that all asset classes show similar negative behavior, like equities crashed, credit spreads widened, interest rates dropped, and many assets have become illiquid – and at the same time, the corporate plan sponsors were financially in bad condition due to a worldwide economic downswing. Diversification is still a valuable investment principal, but being used as the only risk policy it failed poorly in turbulent markets. And moreover, the consequences of the sovereign credit crisis in Europe prompts another new challenge, namely the question what is a "risk free investment" at all in such market phases.

This high degree of interdependencies expresses a new quality of risk which caught many pension funds off guard and caused extreme financial distress for some pension funds[2]. Traditional "asset-only" approaches like simply holding a diversified investment portfolio seem not promising under such settings. Consequently, trustees and finance managers realize that to improve their pension management a more holistic and forward looking approach is needed which allows aligning the long-term liability oriented investment goals with short-term funding risk requirements of the funds.

Prudent pension management requires the board of the plan to define an investment and risk management strategy to reach the required funding goal safely and without surprises – even under turbulent financial market environments. Referring to a control cockpit of an airplane, Figure 1 illustrates such a holistic framework for this purpose outlining three major building blocks: firstly, a liability oriented asset allocation, which is also referred to as Liability Driven Investment (LDI) policy, secondly a dynamic surplus risk management concept addressing asset and liability risks jointly, and thirdly, a risk cockpit for an ongoing and forward looking LDI risk controlling process as the operative basis for an efficient implementation of the strategy.

2 As it was reported in IPE.com, big Dutch pension funds seem to have suffered a strong decline in their funding ratios at the end of 2008. For example, for one pension fund the funding ratio dropped from 148 % to 92 % in 2008. The decrease occurred mainly due to negative investment returns, increased pension liabilities and the hedging position of the interest-rate risk. [Source: "Funds blame bulk of decline on interest rates," IPE.com, 29 January 2009].

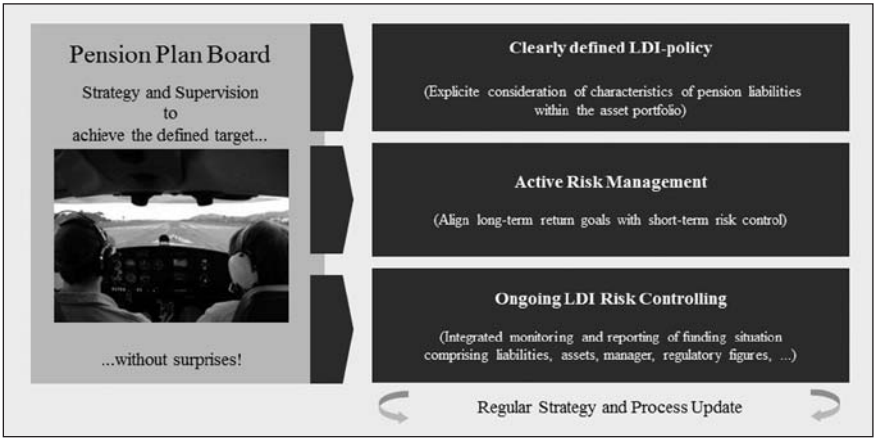

Figure 1: Holistic and forward looking perspective on investment and risk management for pension plans to better cope with turbulent financial markets

The following sections will shed more light onto these three components. Section 2 will address the LDI concept for pension funds in a first step. Beyond the general concept, a focus will be on key risk factors (such as interest rates, inflation and credit spreads) and their impact they have on both sides of the pension plan, its assets and its liabilities.

Section 3 addresses active risk management as a key element of prudent pension management. The focus will be on identifying and managing asset-liability mismatch risks and the use dynamic risk management strategies to control these risks in changing market environments.

The concluding Section 4 illustrates LDI risk controlling approaches to assess the current risk exposure situation in a forward looking way and provides a starting point for conscious risk exposure management.

2 Liability Driven Investing (LDI) reflects the Relevant Asset-Liability View

The liabilities are the starting point for deriving an investment and risk management policy for a pension plan. A thorough liability analysis provides the relevant information. Pension plans are typically quite complex legal contracts and are part of the employees compensation package. For an easier access to an assess-

ment of the plan's liabilities, the given pension promise for a defined benefit (DB) pension plan can be expressed in terms of its future benefit payments which need to be made to employees and retirees until the last beneficiary of the plan will die. Figure 2 illustrates a typical example of a cash-flow profile of a DB pension plan paying inflation-conditional benefit. The three curves underscore the significant effect future inflation levels can have on the amount of benefit payments to be made to beneficiaries. Thus for such a plan, inflation is a relevant risk factor. Considering the time horizon of these payments, the major part of benefits will be paid out e.g. in thirty to forty years, and payments will potentially reach out more than one hundred years into the future. The duration of pension plans therefore is typically high; active plans may have a duration of 15–23 years, mixed plans with active employees and some retirees may have a duration between 10–15 years, and plans with mostly retirees often show a duration of 5–10 years.

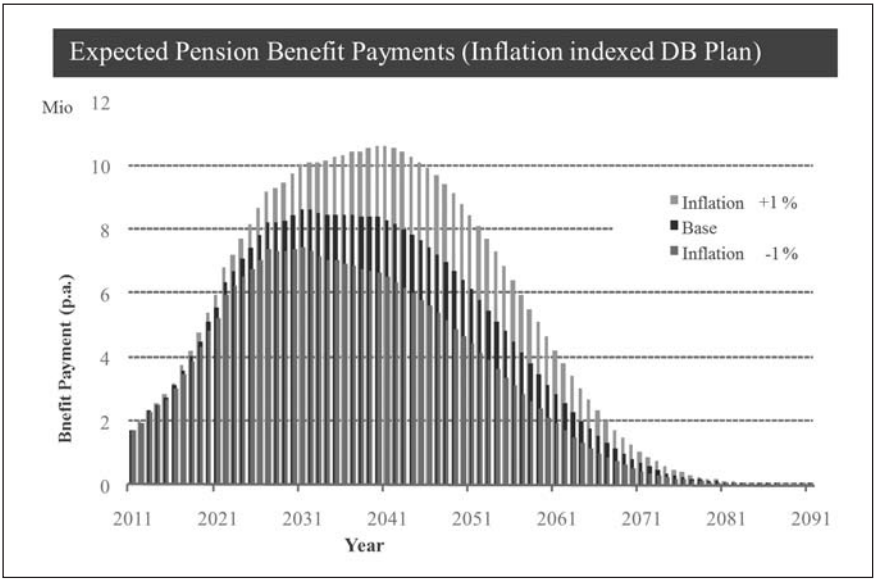

Figure 2: Illustration of an inflation-conditional profile of expected benefit payments of a hypothetical DB pension plan

The current value of these future benefit obligations represents the pension liability of the plan. This liability value and some of its risk characteristics depend on the method used for calculating the present values of these future benefit payments. Under IFRS (International Financial Reporting Standards) for example asset valuation is based on market values and liability valuation –

reported as the defined benefit obligations (DBO) – is based on "fair values" discounting future benefit payments using the yield of "high quality" corporate bonds. Other local accounting frameworks follow a different approach and allow or require smoothing of assets and/or liability values by using averaged discount factors over a period of e.g. 5 or 7 years (like the Pension Protection Act (PPA) in the USA or BilMoG in Germany). Furthermore, most country specific regulatory regimes require another view on how pension liabilities are to be measured, like the FTK framework of the DNB in the Netherlands requires the discounting of expected benefit payments based on EUR swap rates.

Given these quite different approaches to assess the liabilities of pension plans also investment strategy critical figures like the funded ratios (i.e. its value of assets divided by the value of liabilities) of a plan or its interest rate sensitivity can be quite different even for pension plans with the exact same pension promise[3]. Thus, a prudent investment policy of the plan's assets needs to explicitly consider the nature of its underlying liabilities to best possibly reach its funding goals.

This reconciliation between plan assets and liabilities is the general idea of a Liability Driven Investment (LDI) strategy. In practice we find LDI strategies in various forms. In its extreme version it is meant as a complete immunization or matching of all future liability cash-flows. Other, more common LDI approaches intend to hedge only major changes of the liability value which are triggered by risk factors such as interest rates or inflation. The latter type of LDI portfolio intends to outperform the liability growth rate on a mid-to-long term horizon and aims to avoid large deviations between asset and liability returns on a short term perspective to prevent critical funding level declines.

The individual design of a LDI strategy consequently depends on the specific characteristics of the underlying liabilities and the intention to what extent the differences between the asset and liability side can or should be reduced. The "can" aspect depends mainly on the availability of necessary financial in-

3 There exists an enormous variety of pension plans, such as final pay or career average ones, plans offering (conditional) indexation of benefits (in real or nominal terms) or even linking accruals to other public sources of pension income. For more detailed discussion on pension plans and the effect of regulatory or accounting driven measurement of liabilities on investment and risk management of plan assets see for example Blome, S. & Fachinger, K. & Franzen, D. & Scheuenstuhl, G. & Yermo, J. (2007): Pension Fund Regulation and Risk Management, OECD Private Pension Series, «Protecting Pensions: Policy Analysis and Examples from OECD Countries», No. 8, Chapter 4.

struments. For example, under accounting approaches with smoothing mechanisms it is practically impossible to find financial market instruments which go in tandem with the reported liabilities. Thus, a significant part of the mismatch risks between plan assets and pension liabilities can be attributed to accounting or regulatory rules. The "should" aspect refers to the explicit investment goals. Pension funds with a funded ratio of 100 % or more typically want to preserve their full funding level and therefore they may choose a LDI strategy which best possibly immunizes the funding status against capital market turbulences. Some plans take on explicitly certain mismatch risks in order to earn a systematic risk premium from exposure to asset classes like equities, commodities, or emerging market bonds. With the expected outperformance the plan intends for example to close a funding gap, or reduce the amount of contributions the corporate sponsor has to put up to finance the plan.

Interest rates or inflation are major capital market risk factors for most DB plans. The following Figure 3 illustrates the corresponding risk factor sensitivities of the above liability stream. Due to the long time horizon of the pension plan, the liability value will react quite sensitive to changes in the market factors of the longer maturities.

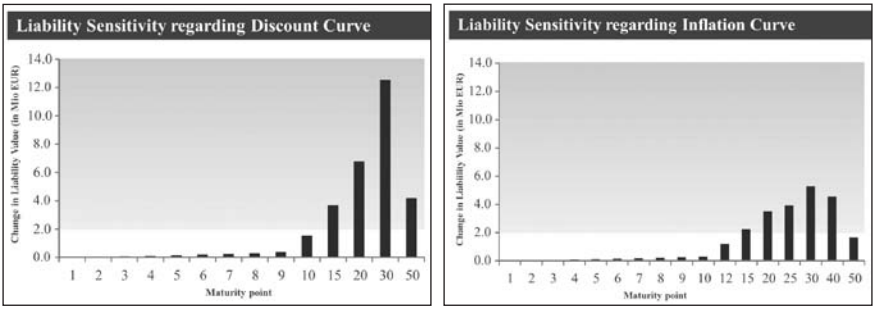

Figure 3: Risk factor sensitivities of liabilities to interest rates and inflation

The liability cash flow stream can be aggregated to a plan specific synthetic index, comparable to a bond index, which can be used as a customized liability benchmark. The following Figure 4 illustrates the development of the corresponding liability index over time under interest rate (EUR AAA Govt. bond yields) and inflation (EUSWI, Bloomberg data) movements in 2011.

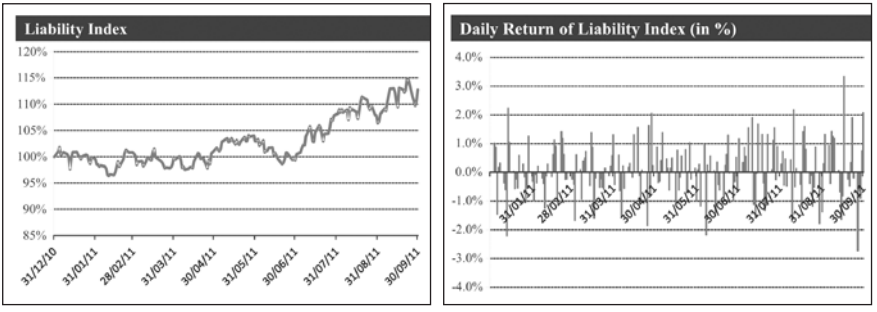

Figure 4: Development of the underlying Liability Index of a DB pension plan under inflation and interest rate changes in 2011

The graphs clearly underscore the risky nature of pension liabilities. Their market value can change dramatically over a short period of time: the realistic example shows +15 % increase only within the 3rd quarter of 2011 and the daily returns in 2011 show substantial volatility. This notion of liabilities is in contrast to the yearly pension valuation found in actuarial reports. To reduce and control funding level risks during the year, it is however essential to assess the effects of market risk factors on the asset side as well as on the liability side in a consistent way. Thus, only through an integrated asset-liability approach (in contrast to an asset only view) an effective pension investment strategy can be derived.

The LDI concept sets the outline for the investment and risk management solutions of the pension fund. For the optimization of the asset allocation strategy plan specific circumstances need to be considered. Typically many stakeholder such as plan members, trustees, the corporate sponsor, and regulators are involved and express preferences or constraints for the selection of the asset portfolio. This makes pension portfolio optimization in practice a rather complex challenge. Figure 5 illustrates the various aspects like liability risk characteristics, availability of asset classes, current funding situation, sponsor's contribution policy, funding goals, and regulatory requirements which all need to be considered simultaneously within the optimization process.

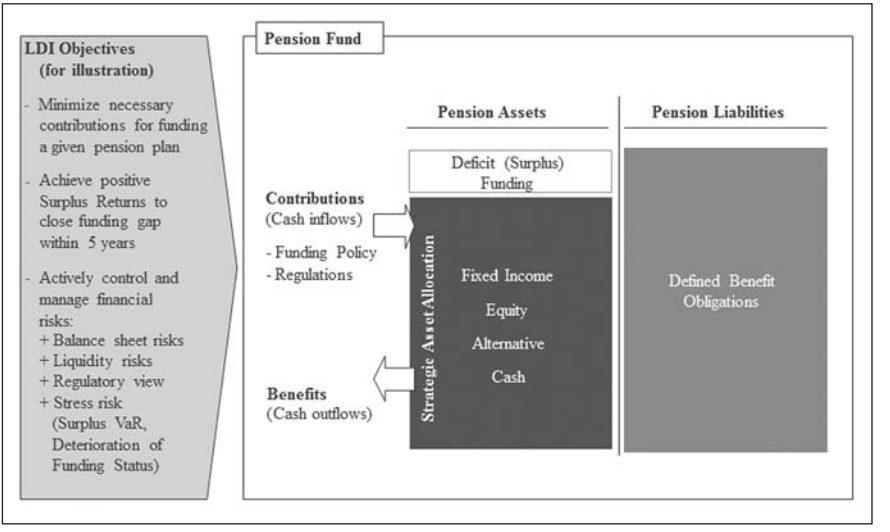

Figure 5: Illustration: Deriving a LDI Strategy under a holistic Asset-Liability view

This approach underscores that judging whether an asset allocation for a specific pension plan is appropriate or not will be done by looking at the direct or indirect consequences for the stakeholder – rather than by some abstract risk-return-characteristics of the asset portfolio itself, like its mean return or volatility. For this complex decision making it is important to translate the asset allocation characteristics into clear economic consequences on the business side. To include the various stakeholder aspects into a formal optimization process, it is thus necessary to quantify the effects a potential asset allocation will have on these target criteria or constraints. Additionally, the relative relevance of the criteria needs to be specified which can be done e.g. in form of a "goal pyramid".

The following Figure 6 illustrates a typical set of objectives and constraints. The figures for the current investment strategy can be used as a reference to show improvements of potential optimized investment strategies.

Objective	Decision variable	Current Investment Strategy
Optimization Target	Minimize Net Contributions over next 10 years	200 mln
1. Secure long term funding of pension liabilities	IFRS Funding Level 2022 (Median)	95.0%
	IFRS Funding Level 2022 (1% CVaR)	65.0%
	Yearly Change in IFRS Funding Level 2011 (Median)	3.0%
	Yearly Change in IFRS Funding Level 2011 (1% CVaR)	17.0%
2. Limit the losses of the plan sponsor under IFRS accounting	Effects on „Other Comprehensive Income" (OCI) position OCI Position 2020 (Median)	20 mln
	OCI Position 2020 (1% CVaR)	-150 mln
3. Limit the losses of the plan sponsor under HGB accounting	HGB Result 2011 (Median)	25 mln
	HGB Result 2011 (1% CVaR)	-80 mln

Figure 6: Example of a set of objectives and constraints for selecting a tailored pension investment strategy

Given this multi-dimensional optimization problem we need a comprehensive forward looking assessment covering also conditional interactions like funding level depending contribution policies or conditional indexation rules over a multi-period horizon. Closed form representations of the optimization task usually will not be feasible for this kind of complexity. For practical purposes, this can be achieved on the basis of a simulation framework using a set of consistent economic scenarios (e.g. 10.000 or more) to assess the effects on both sides assets and liabilities and consider their joint behavior under these multi-period scenarios to see how a given investment strategy effects the plan's decision variables over time. Applying a robust scenario optimization procedure allows to identify an efficient set of investment strategic asset allocations which fits best to the liabilities.

3 Active Surplus Exposure Management to Control Short-term Funding Risk

Depending on the type of pension plan the value of its liabilities will depend on many different risk factors. Figure 7 provides an overview on typical risk factors we find for DB pension plans assessed under an IFRS view. For the pension plan risk is not associated with the volatility of liability values but rather with potential losses of funding level, i.e. an adverse movement in the relative

values between plan asset and liabilities (or the surplus). Generally speaking, mismatch risks arise from a different value behavior of plan assets and liabilities with respect to changes in underlying risk factors. Figure 7 also summarizes some suggestions what risk factors can or should be hedged within an LDI strategy, i.e. align the behavior of assets and liabilities so their values move in tandem regarding this factor. The basic rational behind these suggestions is that risk exposure should be build up only for those factors which are expected to provide a systematic risk premium.

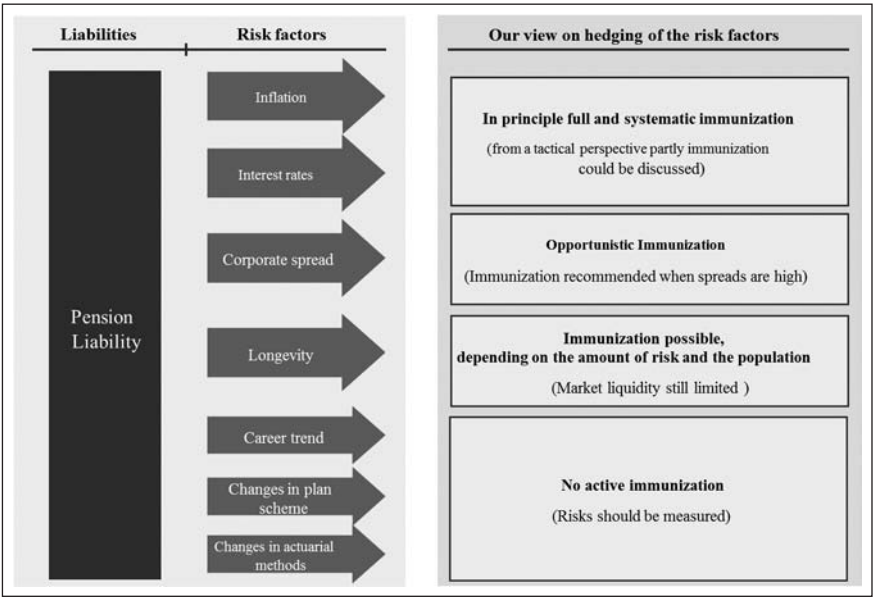

Figure 7: Liability risk factors under IFRS perspective and LDI hedging approaches

From a strategic view, changes in inflation and interest rate curves will not provide such a systematic risk premium. The net-exposure to these factors should therefore be minimized within the LDI strategy. This may be different under a tactical view. Discounting benefit payments under IFRS with AA corporate bond yields makes corporate spreads an additional risk factor. Given the typically long duration of the liabilities and illiquid corporate bond market for very long maturities make it hardly possible to fully hedge against this risk factor. Lately, credit spreads have widened dramatically and spread development has impacted the pension funds' surplus stronger than previously experienced.

Widening spreads in turbulent market phases reduces the value of the liabilities and improves funding status. Should credit spreads revert to lower levels, for example, in the context of an economic recovery, the liability value may increase much stronger than plan assets resulting in potential funding level deteriorations. Therefore, immunization is recommended when spreads are far above their average level.

Longevity risks, also called mortality or biometric risks stem from increased life-expectations of pension scheme beneficiaries. They are less in the headlines these days compared to other financial risk drivers. However, they become quite visible every time the mortality tables applied by the plan are updated. Historically, we see a systematic under estimation of increase in life expectancy. For future funding stability they play a significant role and influence the total long-term risk exposure of the funds. Only recently we see a more active but still rather illiquid market for bespoke longevity swaps as one way to actively manage this risk through capital market instruments[4].

No active immunization through the LDI strategy can be provided for pension specific risk factors such as salary growth rates (career trends) or adjustments within the plan design or actuarial valuation methods which are for example introduced by regulatory changes. Such risk should be assessed and monitored.

From a risk management perspective, the objective must be to create transparency, and to control and fine tune or – in extreme cases – completely match these financial risks.

The optimal risk exposure is individual and depends on the pension fund's and its sponsor's risk bearing capabilities and preferences. These are typically not static but change with market conditions. Specifically designed derivative LDI risk-overlay strategies aim to manage the surplus risk of a pension fund dynamically: the overall risk position can be either widely reduced – except for some basis risks – or extended to try to earn further expected risk premium as illustrated in Figure 8.

4 For a detailed description and comparison of approaches to hedge this risk factor see e.g., Brunner et.al "Capital Market Solutions for Longevity Risk", risklab working paper, 2011.

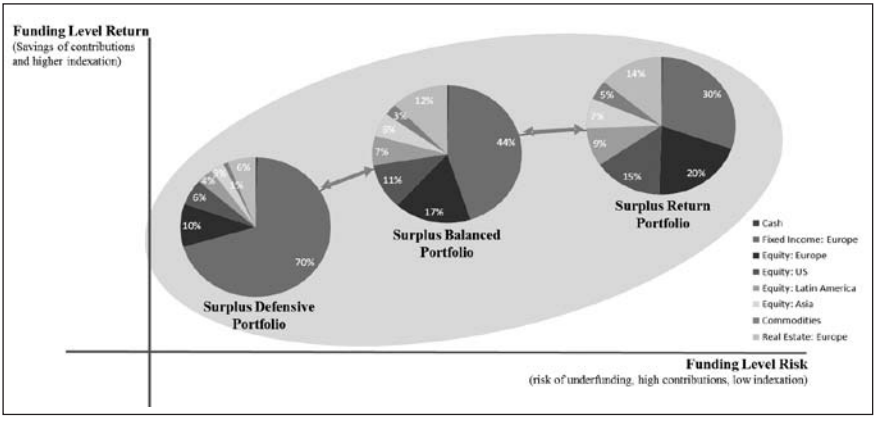

Figure 8: Illustration of a Dynamic LDI Risk Management Strategy

For long-term oriented pension investors risk transparency over a longer horizon is an important aspect. LDI overlay strategies adjust the surplus risk exposures in a rule-based way. They are part of the strategic positioning and are therefore quite different than a forecast driven tactical asset allocation procedure. The dynamics allows an efficient use of available risk budgets and can provide an effective downside protection – similar to synthetic put protection strategy on the funding level position. Such rule based risk management strategies offer an ex-ante transparent risk profile in combination with their ability to align long-term funding goals with short term risk restrictions better than compared to a static rebalancing of the plan-asset portfolio.

4 Risk Cockpit for Effective Pension Controlling

In times of severe economic and capital market crisis, being in effective control of your risk exposure is of real value to pension trustees, or corporate treasurers. Not to be taken off guard by specific financial risks inherent to sponsored pension schemes requires not only up-to-date market information but rather its immediate translation into potential consequences for the pension funds solvency situation, like: What is the potential net effect of a credit spread widening in combination with a real interest rate decline for the year end reporting of the funding status? Like in an airplane, a set of control instrument (risk cockpit) is needed to assess the current situation and indicate how to quickly

react to market turbulences in accordance with the defined long-term investment strategy. A forward looking assessment is a key for an effective risk control. It is not sufficient to know what has happened since the last reporting date. More important is to assess what possibly could happen in the future, e.g. one quarter ahead, or till the end of the year, and prepare in time to avoid critical funding situations.

An essential ingredient of defining a forward looking controlling tool is a sound assessment about potential future behavior of capital markets. For assessing risk it is not about perfect foresight but about economically realistic and consistent scenarios for all risk factors driving assets and liabilities. Applying the same projection logic also for the short term analysis repeats on an ongoing basis the strategy analysis only for a shorter horizon and with updated market data. Risk analysis and controlling then goes consistently together with the longer term LDI strategy focus.

Based on a scenario risk exposure assessment, we can identify the net risk contributions of the various risk factors to the overall surplus risk exposure. The following Figure 9 illustrates a "surplus value at risk" breakdown and reveals those risk factors that are most critical for potential funding level losses.

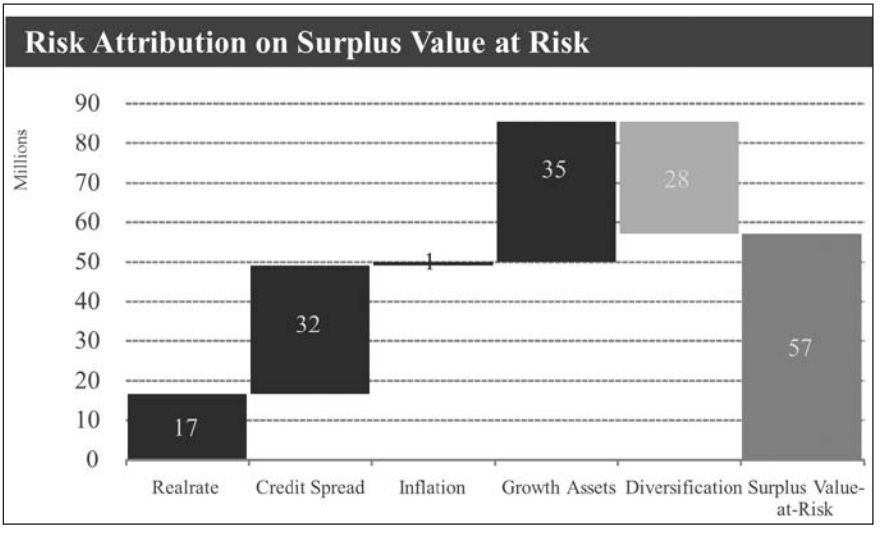

Figure 9: Example for quarterly report on risk exposure decomposition and surplus risk assessment

The illustrated risk metric "surplus value at risk" estimates the maximum negative change of the surplus, e.g., over a one year horizon, within a certain probability level, e.g., 95 % of all cases. The example shows a surplus value at risk of EUR 57mn providing a direct information what could possibly happen under extreme market conditions (whatever the individual economic event might be that triggers such a development) with the plan's funding situation. A comprehensive risk cockpit will comprise many other instruments (like shown in Figures 4 and 5) translating economic events into plan specific information – for consistent and prudent pension investment decision making.

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