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Portfolio Insurance Strategies for Pension Funds

Master's Thesis

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Executive Summary

Problem Setting

Pension funds belong to a group of long-term investors who are subjected to short-term constraints and periodically transfer an amount of money to beneficiaries. Most developed countries demand that pension funds respect a minimum funding ratio, i.e. it is periodically assessed if the funding ratio, defined as the ratio between the total asset value and the market value of the liabilities, is above a predefined threshold value (Martellini and Milhau (2009)). The sponsor company could be obligated to contribute additional funds to the pension plan if this constraint is violated (Martellini and Milhau (2009)). From an academical perspective, the presence of the liabilities require the application of a sound Asset-Liability Management (ALM). However, this is not always the case in practice. The results of a survey conducted by Badaoui et al. (2014) indicate that a significant number of pension funds does not hedge the liabilities and, therefore, does not implement a sound ALM approach. On the one hand, the aim of this thesis is to provide an overview of the most relevant portfolio insurance strategies for pension funds. A portfolio insurance strategy is designed to ensure that the total (or partial) value of the initial investment is above some floor level at some specified time horizon, while the strategy gives access to the upside potential of some reference portfolio (Basak (2002) and Grossman and Vila (1989)). These strategies are effective instruments for pension funds to limit adverse impacts of market downturns and can take into account short-term constraints and pension obligations. On the other hand, this thesis shows how different variations of the simple Constant Proportion Portfolio Insurance (CPPI) strategy perform under various market conditions when real world liability data of a representative Swiss pension fund is used.

Procedure

Foremost, the theoretical concept of each presented portfolio insurance strategy is discussed. More concretely, the Dynamic Liability-Driven Investing (DLDI) strategies are first introduced. The focus lies on the conceptual challenges and on the adequacy of this paradigm for pension funds. Afterwards, the standard CPPI model is explained and set in relation to an ALM context. Furthermore, the Time-Invariant Portfolio Protection (TIPP) and the Option Based Portfolio Insurance (OBPI) models are presented. A discussion about what the optimal strategy for a pension fund could be and a comparison, based on empirical results from the literature, between the CPPI approach and the DLDI strategies in terms of expected utility conclude the theoretical part.

The empirical part starts with the definition of some general implementation settings and continues with the description of the base case strategy and the implemented variations of the CPPI model in an ALM context. All strategy variations include a minimum funding ratio constraint, while the second and third variation are additionally characterized by the introduction of a maximum funding ratio constraint and a dynamic multiplier, respectively. In the last variation, the Liability-Hedging Portfolio (LHP), in which the pension fund should invest in along with a

Performance-Seeking Portfolio (PSP), is designed with two Swiss government bonds such that the duration and the convexity of the liabilities are matched. All other variations just assume that the risk-free rate is earned on the funds allocated to the LHP without explicitly specifying how the liabilities are hedged.

In order to analyze the performance of the strategies under different market conditions, a variety of scenarios for a number of risky assets and interest rates is generated by applying the Filtered Historical Simulation (FHS) technique. In a nutshell, the FHS approach is designed to consider certain stylized patterns such as volatility clustering, fat tails and other non-normality features in the simulation process and it makes very few assumptions about the statistical properties of future returns (Adcock et al. (2012) and Grigoriu et al. (2015)). Since the FHS technique requires first to fit a conditional mean and variance model to each risk factor, the process of finding the most appropriate time series model is illustrated. The outcome of the FHS is validated using realized prices and used afterwards to implement the different CPPI variations.

Results

The empirical analysis shows that under a simplified setting, i.e. transaction costs, contributions, credit and inflation risks are neglected, but by the use of real world liability data of a representative Swiss pension fund, the implemented CPPI strategy variations yield in general better results than a simple constant mix strategy if short-term constraints are imposed by regulatory authorities. Assuming that the funds allocated to the LHP yield the risk-free rate, the probability that the pension plan has a funding ratio below the imposed minimum level at a certain point in time during implementation period is close to zero if the pension plan is sufficiently funded at the beginning. If the difference between the initial funding ratio and the minimum funding ratio is not sufficient, the shortfall probabilities can significantly increase. It should be noted that the choice of the risk-free rate is crucial for the performance, especially when negative interest rates are possible. This influence can be reduced by explicitly stating how the LHP is constructed to hedge the liabilities. Applying a duration/convexity hedge with two Swiss government bonds leads to a significantly improved overall performance, even if the difference between the initial funding ratio and the minimum funding ratio is smaller. Furthermore, it is shown that introducing a maximum funding ratio constraint can be of interest for a pension fund although under the given implementation settings such a constraint cannot be met with almost certainty. Assuming that a pension fund has no utility of exceedingly large funding ratios, the study shows that a maximum funding ratio constraint can often reduce the cost of downside protection by giving up some of the upside potential. Finally, a dynamic multiplier as introduced by Lee et al. (2008) cannot sufficiently improve the results, especially with regard to the higher ex post calculated total transaction costs. In fact, it turns out that using a more sophisticated designed LHP does not only lead to the most promising results but can also be implemented at the lowest costs.