

Summary of the Paper Awarded the SCOR Prize in Actuarial Science 2012 in Germany (2nd Prize)

Title: Market-Consistent Valuation of Long-Term Insurance Contracts – Valuation Framework and Application to German Private Health Insurance

Author: Jan-Philipp Schmidt

Motivation

In times of volatile stock markets and very low interest rates from government bonds, the valuation and risk analysis of private health insurance companies become more and more important. Insurance contracts from German private health insurance companies (substituting for statutory health insurance coverage) are long-term insurance contracts with a short-term guarantee of interest crediting to accumulated reserves of the policyholders. Moreover, those health insurance contracts provide life-long claim reimbursement in case of health care utilization. The interest rate guarantee (which is, at the moment, predominantly 3.5% in the industry) is short term, because private health insurance companies have to check annually their actuarial assumptions for pricing and reserving, and they have to adjust the actuarial assumptions with respect to many regulatory rules.

The model introduced in this paper (Schmidt 2012) allows for a valuation of the profitability and of the risk of private health insurance companies with the market-consistent embedded value (MCEV) methodology (CFO Forum 2009). This methodology provides values consistent with the values quoted in the financial market; the methodology is mainly used for

the valuation of long-term insurance contracts. The valuation process requires a stochastic insurance company model that properly covers the effects resulting from adjustments of the actuarial assumptions and covers specifics of the surplus distribution between shareholders and policyholders. In the literature, this model is the first stochastic insurance company model that accounts for the many characteristics of the calculation and accounting of German private health insurance portfolios. The MCEV methodology allows us to answer the following questions: How profitable is German private health insurance for the shareholders of the company? What are the value drivers in German private health insurance? How great is the risk for the shareholders, considering the options and guarantees attached to health insurance contracts? How great is the influence of the interest rate? Adjustments of the actuarial assumptions (usually resulting in premium adjustments) are of fundamental importance for the valuation of health insurance portfolios; how do premium adjustments change the risk situation of the shareholders?

The private health insurance industry is essential in the German health care system. In 2010, health expenditures of about 8.9 million persons was covered by private health insurance contracts (substituting the statutory health insurance coverage).

Modeling Approach

Two distinct mathematical models are required for a market-consistent valuation; one model is used for the projection of insurance portfolios in a balance sheet perspective. Another model considers the external parameters influencing the accounts of the insurance company (e.g. the

development of interest rates or the development of health expenditures).

For the stochastic modeling of the term structure of interest rates, inflation, and health expenditures, we apply the capital market model introduced by Jarrow and Yildirim (2003). Thereby, the interdependence of nominal interest and inflation is economically appropriate captured. The health expenditure of the insurance company is linked to the development of inflation, because we observed a high correlation between health expenditure and inflation during the last decade. Following this modeling approach, we perform a risk-neutral valuation of the inflation risk of the private health insurance company.

Furthermore, we introduce a model for the projection of the insurance company in a balance sheet setup similar to those of Gerstner et al. (2008) and Kling et al. (2007). In particular, we consider the characteristics of premium adjustments (check of claim assumptions and adjustments of the interest rate in analogy to the mechanism proposed by the German actuarial association), and we consider the characteristics of the surplus distribution (i.e. the most important regulatory rules). In contrast to the life insurance industry, German private health insurance companies adjust their actuarial assumptions, resulting in premium adjustments (thus, actuarial assumptions in private health insurance usually include less safety margins as in life insurance). A premium adjustment is performed if not enough capital is available (or is used) in order to limit premium increases. The surplus distribution is performed to limit premium increases in the case of premium adjustments.

In this paper, we present a decomposition of the gross surplus of the shareholders in dependence of the origin of the surplus. This decomposition allows for a quantification of the influence of the surplus resulting from investments in the financial market or of the safety margin on the gross surplus and thus on the situation of the shareholders. This decomposition also allows for a detailed analysis of the time value of financial options and guarantees.

Results

Insurance contracts from German private health insurance companies (substituting statutory health insurance) exhibit very different effects on the value and risk for the shareholders in comparison to those of life insurance contracts (even if they are very similar in pricing and reserving techniques). The financial risk of the guaranteed interest rate is significantly lower due to the premium adjustment mechanism and the offsetting in the course of the surplus distribution. However, situations with high risk for the shareholders emerged; if adjustments are performed only with delays, then the guaranteed interest crediting may notably diminish the profit and substantially boost the risk for the shareholders of the company.

The stochastic insurance company model is required to accurately model the interactions between the premium adjustment frequencies, the guarantee of the short-term interest crediting, and the surplus distribution. The stochastic valuation may result in higher shareholder value compared to the results indicated by an average (best-estimate) deterministic scenario. This is a fundamental difference to computations for life insurance portfolios. In life insurance, the stochastic valuation

commonly results in substantially lower values, mainly due to the long-term interest rate guarantee.

The time and therefore the frequency of premium adjustments are of high importance in the analysis of German private health insurance.

If premium adjustments are performed less frequently, then the risk resulting from investments in the financial market or the risk resulting from increasing health expenditure is significantly higher (i.e. lower dividends and raise of capital in the case of losses). In particular, the influence of health expenditure is only inadequately captured in a deterministic scenario with premium adjustments rhythm “every second year.” The decomposition of the surplus shows that the deterministic scenario (in our parameterization of the model) even underestimates the advantages for shareholders of the premium adjustment mechanism.

Outlook

The results are relevant not only for the valuation and risk analysis of private health insurance, but also for the determination of the solvency capital requirement in the course of Solvency II. The results indicate that, in certain situations, the risk of the investment in the financial market is not of major importance for the shareholders.

This model is suitable for further research on German private health insurance. Deterministic projections already exist to address the question of whether the current mechanisms are feasible to guarantee stable premiums of old policyholders. The introduced model may provide further insights, for example, with the determination of confidence intervals.

Literature

CFO Forum (2009) Market Consistent Embedded Value Principles. http://www.cfoforum.eu/downloads/MCEV_Principles_and_Guidance_October_2009.pdf.

Gerstner, T., Griebel, M., Holtz, M., Goschnick, R., Haep, M. (2008) A General Asset- Liability Management Model for the Efficient Simulation of Portfolios of Life Insurance Policies, *Insurance: Mathematics and Economics*, 42(2):704-716.

Jarrow, R., Yildirim, Y. (2003) Pricing Treasury Inflation Protected Securities and Related Derivatives using an HJM Model, *Journal of Financial and Quantitative Analysis*, 38(2):337-358.

Kling, A., Richter, A., Ruß, J. (2007) The Interaction of Guarantees, Surplus Distribution, and Asset Allocation in With-Profit Life Insurance Policies, *Insurance: Mathematics and Economics*, 40(1):164-178.

Schmidt, J.-P. (2012) Market-Consistent Valuation of Long-Term Insurance Contracts – Valuation Framework and Application to German Private Health Insurance, *Working Paper University of Ulm*.