The Impact of Medical Cost Inflation and Dynamic Policyholder Behavior on Market Consistent Embedded Value in Health Insurance

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Session Number: TBR6
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Motivation

Stochastic Environment

Insurance Company

Dynamic Policyholder Behavior

Results

Conclusion and Outlook
Motivation

▸ What is the shareholder value from long-term insurance contracts?
▸ How do the inflation and medical inflation affect the shareholders value and risk associated with the value?
▸ How is the value affected by dynamic policyholder behavior?

Analysis based on stochastic insurance company model for German private health insurance companies (introduced in Schmidt (2012)).
Framework

Stochastic Environment: (\(\Omega, \mathcal{F}, P\)) prob. space
X_1, \ldots, X_n r.v.
with \(X_i : \Omega \rightarrow \mathbb{R}^T\)
1 \(\leq i \leq n\)

Insurance Company: Cash flows
\(Y = f(X_1, \ldots, X_n)\)

Valuation: Value
e.g. \(\mathbb{E}(g(Y))\)
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Inflation and Medical Inflation in Germany

Analysis of data set from German supervisor (BaFin):

Claim increase: Average annual increase of claim reimbursement (policyholders aged 25-80) for outpatient benefits in all German private health insurance tariffs. Inflation rate: Increase in Consumer Price Index CPI (Germany)
Consider capital market model from Jarrow and Yildirim (2003) with risk factors nominal and real term structure and inflation.

- $\sigma_n$, $\sigma_r$, $\sigma_I$ volatility of processes, $a_n$, $a_r$ mean reversion speed
- $(W_n, W_r, W_I)$ Brownian motion for each risk factor
- Correlations of Brownian motion $\rho_{n,r}$, $\rho_{n,I}$ and $\rho_{r,I}$
- $\vartheta_n(t)$, $\vartheta_r(t)$ functions to fit term structure of interest rates

Medical inflation considered as an additive spread $\sigma$ on top of the change in the inflation process.

Analysis of impact of inflation and medical inflation by variation of . . .

- . . . medical inflation spread $\sigma$
- . . . volatility of inflation process $I(t)$
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Private Health Insurance in Germany

- Whole-life insurance guarantee
- Pricing and reserving similar to life insurance techniques (principle by equivalence, accumulation of actuarial reserve)
- Level premium at beginning of the contract linked to
  - gender
  - age at underwriting
  - risk classification at underwriting
- Insurance company renounces the right of contract cancellation
- Premium development over lifetime of a contract linked to claim and mortality experience in a tariff → Premium adjustment
- Safety loading factor of at least 5% of premium
- Policyholders pay 10% loading on premium until age 60 to accumulate additional reserve for limiting premium increases in case of premium adjustments
Premium Adjustments in German Private Health Insurance

- Annual check of first-order assumptions
  - Claim reimbursement
  - Mortality rates
- Deviation between first-order assumptions and observations above threshold (at least 5%) and deviation not temporarily:
  - Check of all first-order assumptions
  - If necessary: determination of new first-order assumptions
- Adjustment of first-order assumptions at the beginning of the following year based on independent trustee agreement:
  - Adjustment may result in new premium
  - If premium increases: company performs limiting measures (profit sharing)
Impact of Inflation and Medical Inflation on Shareholder Profits

- Premium adjustment allows adjustment of first-order assumptions and in particular adjustments of claim assumptions.
- Aggregation of different surpluses allows balancing of loss from claim development.

**Short-term effect:** Inflation and medical inflation disadvantageous for shareholders due to negative underwriting surplus (until next premium adjustment).

**Long-term effect:** Inflation and medical inflation in general advantageous for shareholders due to ‘increased’ insurance coverage.

Which effect dominates?
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Joint IACA, IAAHS and PBSS Colloquium in Hong Kong
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Dynamic Policyholder Behavior – Introduction

Policyholders’ propensity to exercise options in insurance contracts is influenced by external factors (Kent et al., 2009).

Options of policyholders in German health insurance, e.g.,

- lapse of contract and switch to other insurance company
- tariff switch or change of coverage (e.g. higher deductible)

Policyholder behavior may depend on several factors, e.g.

- age, gender and tariff of policyholder, . . .
- number of premium adjustments, development of premium, . . .
- contract duration, health status, sales channel, . . .
- development of capital market (e.g. term structure of interest rates), . . .
Dynamic Policyholder Behavior – Lapse

- **Policyholders**: Lapse in general disadvantageous in financial terms due to (partial) loss of actuarial reserve.
- **Shareholders**: Lapse rates are part of first-order assumptions in premium and reserve calculation. Impact of lapse is mainly based on those first-order assumptions.

**Short-term effect:**
- Increase in actual lapse rates: Annual surplus increases

**Long-term effect:**
- Increase in actual lapse rates: Loss of future profits

Which effect dominates?
Dynamic Policyholder Behavior – Modeling

Data set from German supervisor (BaFin) for male policyholders:

![Graph showing lapse rates](image-url)
Dynamic Policyholder Behavior – Modeling

Based on previous 5 years the lapse rates from the previous slide are adjusted based on the following rule:

Check 1: Number of adjustments?

- ≥ 3
- ≤ 2

Check 2: Premium increase?

- high
  - increase lapse rates by $1 + \ell$
- low
  - no change in lapse rates
  - low
  - decrease lapse rates by $1/(1 + \ell)$

Check 2 compares the premium increase with the change of inflation and medical inflation.
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Results – Medical Inflation (Spread)

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Results – Medical Inflation (Volatility of Inflation)

PVFP\(_{MC}\) in relation to assets

**volatility of inflation process**

- threshold 10 %
- threshold 5 %
- threshold 0 %
Results – Dynamic Policyholder Behavior

Parameter of lapse function $\ell$

PVFP\textsubscript{MC} in relation to assets

- Threshold 10%
- Threshold 5%
- Threshold 0%

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Conclusion and Outlook

- Inflation and medical inflation have a significant impact on shareholders value.
  - Long-term effect dominates: A high medical inflation (spread on top of CPI) may *increase the shareholders value*.
  - Impact of inflation volatility is non-linear.
- Dynamic policyholder behavior affects shareholders value.
  - Long-term effect dominates: A higher policyholder sensitivity decreases shareholders value slightly in our setting.
  - Policyholder behavior influenced by many more external and internal factors.
- Further *empirical studies* necessary to determine the importance of different factors on policyholder behavior in health insurance (work in progress).
Thank you very much for your attention.

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References

