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## 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

# Agenda

Motivation

Stochastic Environment

Insurance Company

Dynamic Policyholder Behavior

Results

Conclusion and Outlook

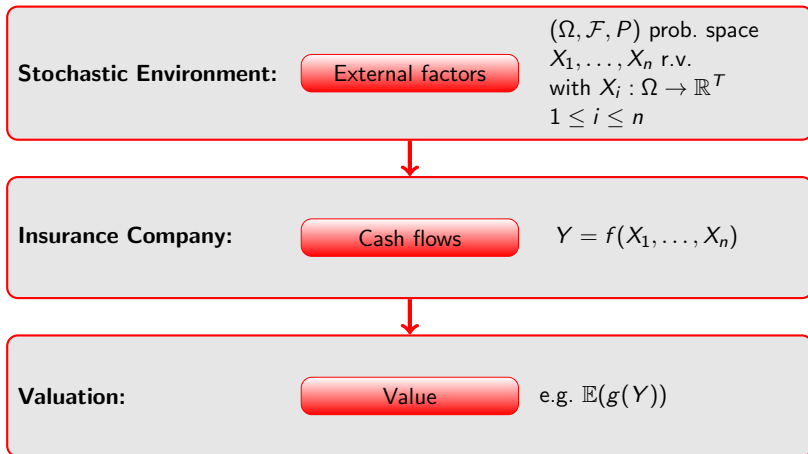


# Motivation

- ▶ 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



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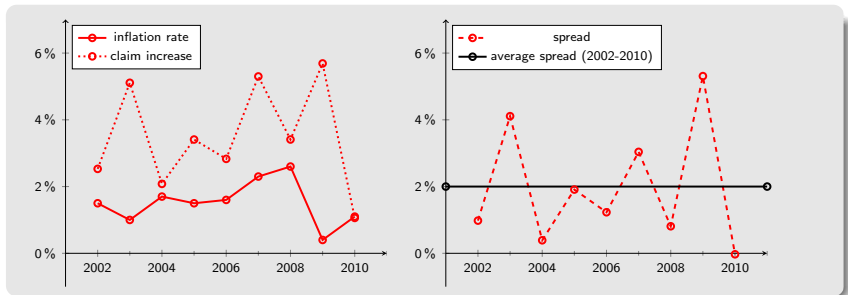
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# Inflation and Medical Inflation in Germany

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)

# Stochastic Environment

- ▶ 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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## 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

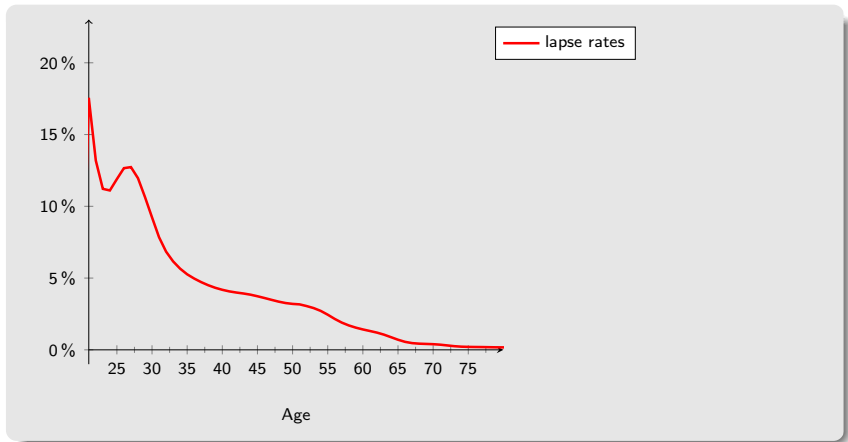
### Long-term effect:

- ▶ Increase in actual lapse rates: Loss of future profits

Which effect dominates?

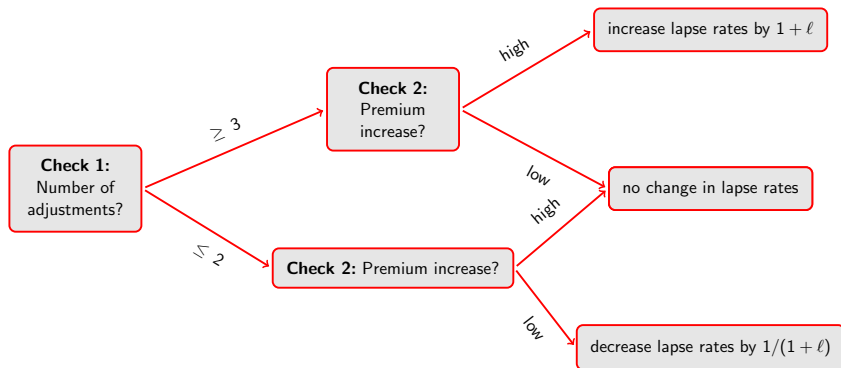
# Dynamic Policyholder Behavior – Modeling

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



## Dynamic Policyholder Behavior – Modeling

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



**Check 2** compares the premium increase with the change of inflation and medical inflation.



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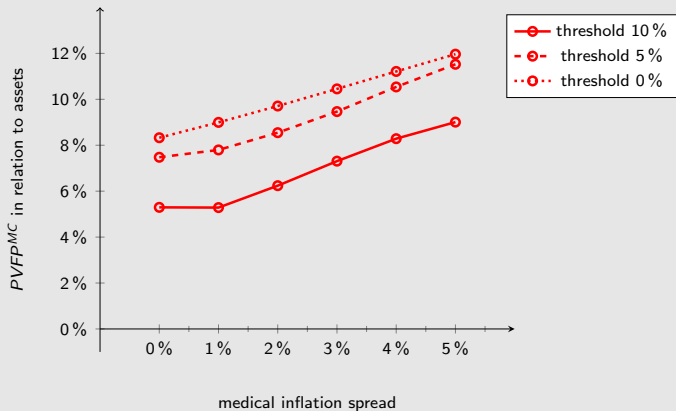
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Results

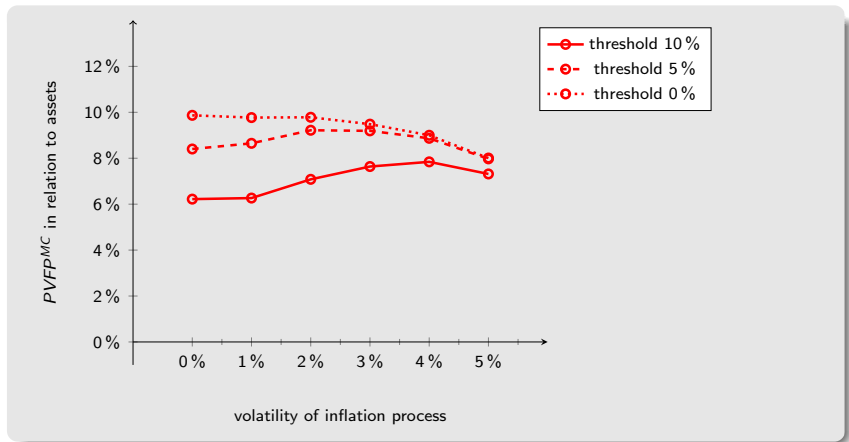
Conclusion and Outlook



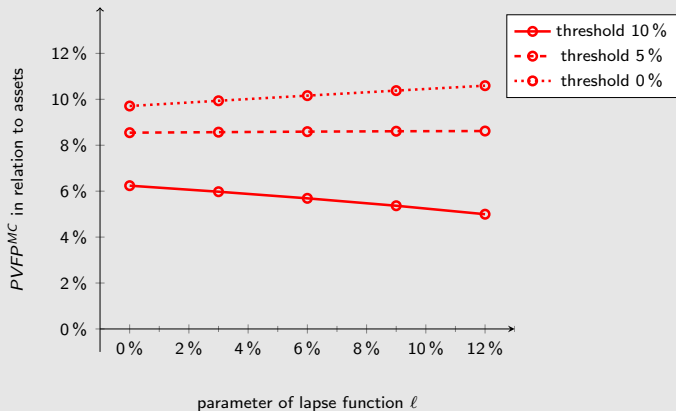
## Results – Medical Inflation (Spread)



## Results – Medical Inflation (Volatility of Inflation)



## Results – Dynamic Policyholder Behavior



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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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