The Risk-Shifting Behavior of Insurers under Different Guarantee Schemes

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Agenda

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1. Introduction

Insurance guaranty schemes (IGSs)

- An insurance guaranty fund is a scheme that has been established around the world to protect policyholders when insurers are unable to fulfill their contract commitments, i.e., in the event of insolvency of an insurance undertaking.

- Motivations for adopting IGSs
  - No matter how solvency regulation tries to reduce the default risk of insurance undertakings, it is not possible to eliminate altogether the possibility of failure;
  - Policyholders face high costs for diversifying insurers’ default risks;
  - IGSs can – depending on their premium principles – influence the risk behavior of insurance companies.
1. Introduction

The risk-shifting problem

- Capital endowment
  Shareholders reduce their equity capital towards minimum solvency requirements. (Cf. Schmeiser and Wagner (2010))

- Reinsurance
  Insurers decide not to purchase reinsurance or choose to sign reinsurance contracts with high-risk reinsurance companies. (Cf. Cummins (1988))

- Investment portfolio
  Shareholders cannot credibly commit to a specific investment strategy after receiving insurance premiums from policyholders. (Cf. Cummins (1988); Lee, Mayers and Smith (1997); Downs and Sommer (1999); Filipovic, Kremslehner and Muermann (2011))
1. Introduction

What we want to do

- contrast the flat-rate premium IGS with the risk-based premium IGS
- determine the insurer's optimal investment strategy under each scheme
- deduce which scheme maximizes policyholders' welfare

Main results

- The risk-based IGS does NOT necessarily induce a safe strategy of the insurer: the insurer might still find it optimal to take additional risk after collecting the insurance premium;

- The risk-based IGS must include a substantial loading in order to deter the insurer from risk shifting;

- For small markups on the IGS premium, the flat-rate IGS and the risk-based IGS do NOT differ in their influence on policyholders’ welfare.
2. Model & Methodology

We consider the arrangement of the guarantee fund’s shareholders in order to incorporate the costs of holding capital at the IGS level.

Policyholders

The insurer decides on asset allocation \( \alpha \)

The IGS determines guaranty fund premium

\( P^{GF} \)

\( P^{ins} \)

\( K^{GF} \)

\( K^{ins} \)

\( SH^{GF} \)

\( SH^{ins} \)

\( L^{ins} \)

\( A^{ins} \)

Insurer

Guarantee fund

Exogenous

\( K^{GF} \)

\( K^{ins} \)

Policyholders pay premiums

The insurer decides on asset allocation \( \alpha \)

The IGS determines guaranty fund premium

\( L^{ins} \)

\( A^{ins} \)

\( P^{ins} \)

\( \max \{ A_{i}^{GF} - L_{i}^{GF} ; 0 \} \)

\( \min \{ L_{i}^{ins} ; A_{i}^{ins} \} \)

\( \min \{ \max \{ L_{i}^{ins} - A_{i}^{ins} ; 0 \} ; A_{i}^{GF} \} \)

\( \max \{ A_{i}^{ins} - L_{i}^{ins} ; 0 \} \)

Payoffs to shareholders of the guarantee fund

Payment from the guarantee fund to policyholders

Payment from insurer to policyholders

Payoffs to shareholders of the insurance company

Payment from shareholders of the guarantee fund

\( t=0 \)

\( t=1 \)
2. Model & Methodology

**Insurer**

- Initial assets: \( A_0^{ins} = K^{ins} + P^{ins} - P^{GF} \)
- Final assets: \( A_1^{ins} = A_0^{ins} \cdot [\alpha \cdot e^{r_{risk}} + (1 - \alpha) \cdot e^{r_f}] \)
- Shareholder value: \( SHV^{ins} = \exp(-r_f) \cdot \mathbb{E}\left[ \max\{ A_1^{ins} - L_1^{ins} ; 0 \} \right] - K^{ins} \)

**Guarantee fund**

- Initial assets: \( A_0^{GF} = K^{GF} + P^{GF} \)
- Final assets: \( A_1^{GF} = A_0^{GF} \cdot e^{r_f} \)
- Shareholder value: \( SHV^{GF} = \exp(-r_f) \cdot \mathbb{E}\left[ \max\{ A_1^{GF}(\alpha) - L_1^{GF} ; 0 \} \right] - K^{GF} \)

\( L_1^{GF}(\alpha) = \max\{ L_1^{ins} - A_1^{ins}(\alpha) ; 0 \} \quad (\text{nominal claims}) \)
2. Model & Methodology

Regulatory perspective

Determine premium $P^{GF}(\alpha)$ that maximizes policyholders’ expected utility.

(1) The insurer decides on its asset allocation after premiums have been paid, and it cannot credibly commit on the original $\alpha$.

\[ \alpha \in \max \arg \max \text{SHV}^{ins}(\alpha) \]

\[ \text{SHV}^{ins}(\alpha) = 0 \] \[ \rightarrow \]

(2) Under perfect competition, policyholders anticipate the insurer’s risk-shifting, so the insurance premium is adjusted for the risk-shifting behavior.

\[ \text{SHV}^{GF}(\alpha) \geq 0 \] \[ \rightarrow \]

The participation constraint for the guarantee fund shareholders.

\[ EU(\min\{A_i^{ins}; L_i^{ins}\} + \min\{L_i^{GF}; A_i^{GF}\}) \rightarrow \max \]
2. Model & Methodology

Flat-rate IGS premium

\[ A_{0}^{ins} = K^{ins} + P^{ins} - P^{GF} \rightarrow \text{Premium is independent of } \alpha \]

Risk-based IGS premium

\[ A_{0}^{ins}(\alpha) = K^{ins} + P^{ins} - P^{GF}(\alpha) \]

\[ P^{GF}(\alpha) = (1 + \gamma) \cdot \exp(-r_{f}) \cdot \mathbb{E}[\min\{L_{i}^{GF}(\alpha), A_{i}^{GF}\}] \]

Premium loading \rightarrow Risk-based IGS premium
2. Model & Methodology

Welfare measures

- Insurer’s objective function

\[
\exp(-r_f) \cdot E[\max\{A_0^{\text{ins}} \cdot (\alpha \cdot e^{r_{\text{risky}}} + (1-\alpha) \cdot e^{r_f}) - L_1^{\text{ins}} ; 0\}] - K^{\text{ins}} \rightarrow \max_{a \in [0,1]}
\]

- Policyholders’ welfare

\[
w_1 = (w_0 - P^{\text{ins}}) \cdot \exp(r_f) - L_1^{\text{ins}} + I_1^{\text{ins}} + I_1^{\text{GF}}
\]

\[
EU(w_1) = -\exp(-a \cdot w_1)
\]

\[
CE_0 = \exp(-r_f) \cdot \left\{-\frac{1}{a} \cdot \ln[-EU(w_1)]\right\}
\]
2. Model & Methodology

Numerical analysis

- To model the asset and liability risks, we assume that both the risky asset and liability processes follow geometric Brownian motions.

- We calibrate the asset drift and volatility by using the historical data of Euro STOXX 50 price from 1997 to 2012; the risk-free rate of return is calibrated according to the QIS 5 by EIOPA (2010). The liability volatility is consistent with the calibration in Yow and Sherries (2008).

- The numerical results are derived by Monte Carlo simulation using 5,000,000 iterations.
3. Results: Insurer’s risk incentive under the flat-rate IGS with an insurance markup

Insurer’s risk-shifting behavior with different flat rates (when $\beta=1\%$ or $10\%$)
3. Results: Welfare under the flat-rate IGS with an insurance markup

If $\beta=5\%$ as an example:

The insurer exploits guarantee fund and policyholders and thus generates positive shareholder value (welfare transfer from policyholders and the guarantee fund’s shareholders to the insurer’s shareholders).
3. Results: Insurer’s risk incentive under the risk-based IGS with an insurance markup

Insurer’s risk-shifting behavior with different premium loadings (γ=0,1.5,2,4)
3. Results: Welfare under the risk-based IGS with an insurance markup

If $\gamma=0$ as an example:

The guarantee fund is protected by the risk-based guarantee fund premium, but the insurer can still exploit policyholders through the risk-shifting (welfare transfers from policyholders to insurer’s shareholders).
3. Results: Welfare under the flat-rate IGS with perfect competition

The guarantee fund exploits policyholders (welfare transfer from policyholders to the guarantee fund’s shareholders). However, total welfare improves as the increasing guarantee fund flat rate.
3. Results: Welfare under the risk-based IGS with perfect competition

For low guarantee fund premium loadings, the guarantee fund shareholders gain a positive net shareholder value through exploiting policyholders’ welfare. However, as the loading is raised further, risk mitigation effect takes place, leading to higher policyholder’ welfare as well as total welfare.
3. Results: Comparison of welfare between under the risk-based IGS and under the flat-rate IGS

For small markups on the IGS premium, the risk-based premium and the flat-rate premium do not differ in their influence on policyholders’ welfare, whereas higher loadings make the risk-based IGS superior to the flat-rate IGS in the sense of improving policyholders’ welfare.
4. Conclusion

- The insurer’s risk-shifting problem cannot be avoided through the risk-based IGS without an appropriate premium loading being imposed. In a non-competitive market, a higher guarantee fund premium loading is needed to activate the mitigating effect.

- Although the mitigating effect requires higher insurance premium from policyholder, the advantage of lowering the insurer’s risks outweighs its disadvantage; policyholders’ welfare improves.

- The risk-based IGS weakly dominates the flat-rate IGS in the sense of policyholder protection and generating potential Pareto-improvement.
Thank you for your attention!

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