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Stock vs. Mutual Insurers: Who Should and Who Does Charge More?

Abstract

We contribute to the literature by developing a normative theory of the relationship between stock and mutual insurers based on a contingent claims framework. To consistently price policies provided by firms in these two legal forms of organization, we extend the work of Doherty and Garven (1986) to the mutual case, thus ensuring that the formulae for the stock insurer are nested in our more general model. This set-up allows us to separately consider the ownership and policyholder stakes included in the mutual insurance premium and explicitly takes into account the right to charge additional premiums in times of financial distress, restrictions on the ability of members to realize the value of their equity stake, as well as relevant market frictions. Based on a numerical implementation of our model, we are able to show that, for the premiums of stock and mutuals insurers to be equal, the latter would need to hold comparatively less equity capital. We then evaluate panel data for the German motor liability insurance sector and demonstrate that observed premiums are not consistent with our normative findings. The combination of theory and empirical evidence is not compatible with full competition in insurance markets and suggests that policies offered by stock insurers are overpriced relative to policies of mutuals. Consequently, we suspect considerable wealth transfers between the stakeholder groups.

Key words: Insurance Company · Insurance Pricing · Legal Form of Organization · Contingent Claims Framework · Hausman-Taylor Estimator

JEL Classification: G13 · G22

1 Introduction

Private insurance firms in many insurance markets can be organized either as mutuals or corporations (stock insurance companies). Similar to the policyholders of a stock insurance company, those of a mutual insurer are obliged to pay the insurance premium, which, in turn, entitles them to an indemnity payment contingent on the occurrence of a loss. Apart from that, however, several important differences between these two legal forms of organization exist. First of all, in contrast to stock insurers, mutuals are in fact owned by their policyholders. By paying the respective premium, the buyer of a mutual policy becomes a so-called member, which is economically equivalent to simultaneously acquiring a policyholder and an equityholder stake in the firm. As a result, those insured by a mutual are usually granted direct or indirect participation in the administrative bodies and should thus be able to exert influence on business

decisions. To establish a similar position, policyholders of stock insurance companies would need to acquire additional ownership rights by purchasing the company's common stock. Unlike the shareholders of a stock insurer, however, members of a mutual cannot simply sell their equity stake. This is due to the fact that, in practice, it is not explicitly differentiated from the policyholder stake and a secondary market for such ownership claims does not exist. Hence, the only way to fully realize the value of the equity are liquidation or demutualization of the company, which would need to be enacted collectively by a majority of the members.¹ A further difference to stock insurers is the occasional premium refund that mutual members can expect if the company is profitable. Finally, stock insurance companies cannot draw on their policyholders to recover financial deficits, whereas the membership in a mutual insurer might be associated with the obligation to make additional premium payments contingent on the firm being in financial distress, also termed "member assessment".² Since the legal form determines these rights and obligations associated with the purchase of an insurance contract, it should *ceteris paribus* result in different prices for policies, covering identical claims.

In this paper, we contribute to the literature by developing a normative theory of the relationship between stock and mutual insurance premiums based on a contingent claims framework. To consistently price policies provided by these two types of organizations, we extend the work of Doherty and Garven (1986) to the mutual case, thus ensuring that the formulae for the stock insurer are nested in our more general model. This set-up allows us to separately consider the ownership and policyholder stakes included in the mutual insurance premium, taking into account the restricted ability of members to extract the value of their equity stake as well as the mutuals' right to charge additional premiums, which, in the following, will be called "recovery option". In addition, we explicitly incorporate relevant market frictions. By means of our model, we are able to derive certain conditions under which the premiums of stock and mutual insurance companies should be equal. In order to examine whether observed market prices are consistent with the normative results, in a last step, we run an analysis of panel data for the German motor liability insurance sector and provide empirical evidence for the impact of the organizational form on premium size. Finally, integrating our theoretical and empirical findings, we discuss selected economic implications for the stakeholders.

The remainder of this paper is organized as follows. In the next section, we provide an overview of previous literature on issues surrounding stock and mutual insurance companies and point out the gap that we would like to address with our contribution. Our model framework is then developed in the third section, beginning with the simple and well-established case of the stock insurance company in a perfect market. Subsequently, we introduce frictions and then consider a mutual insurer with recovery option and partial participation in future equity payoffs. Furthermore, the fourth section comprises a

¹In the course of a demutualization, the insurer changes its legal form and is transformed into a stock company.

²According to industry professionals, there are quite a few example cases in which mutuals actually had to draw on this option. In the years 2005 and 2008, the Bermuda-based company Oil Insurance Limited struggled with significant hurricane losses that ultimately resulted in a member assessment to speed up recovery. Furthermore, anecdotal evidence indicates that Mutuelle Assurance des Instituteurs (MAIF) and various other French mutuals needed to make premium calls due to exceptionally high claims costs in the wake of cyclone Lothar in 1999.

numerical analysis that illustrates the interaction of the main model components and allows us to derive normative results. The fifth section is the empirical part, in which we apply panel data methodology to a sample from the German motor liability insurance sector. Finally, in the sixth section, we discuss selected economic implications of our findings, and in the last section, we state our conclusion.

2 Literature Review

The literature comparing stock and mutual insurance companies has predominantly dealt with agency issues of the organizational form. Extending the fundamental work of Jensen and Meckling (1976), Mayers and Smith (1981, 1988, 1994) develop a theory of insurance contracting. On the one hand, asymmetric information and the call-option-like payoff profile associated with the equity position in a stock insurer imply that the shareholders will want to prompt the company's management to pursue riskier strategies. This, however, is detrimental to the position of the policyholders.³ Since owners and policyholders within a mutual insurance company coincide, agency costs due to this owner-policyholder conflict can be avoided (see Garven, 1987). On the other hand, through their organizational bodies and direct market discipline, stock insurers provide more efficient sanction mechanisms to tackle the so-called owner-manager conflict that results from diverging interests between shareholders and company executives. Hence, the choice of legal form must somehow depend on the trade-off between frictional costs arising from these agency problems. Ultimately, stock firms should dominate activities that involve significant managerial discretion, whereas mutuals should prevail in long-term lines of business that are usually encumbered with a more significant owner-policyholder conflict potential, such as the life insurance sector (see, e.g., Hansmann, 1985; Mayers and Smith, 1988).

The previously discussed agency-theoretic considerations are supported by a number of empirical articles. Through a survey on policyholder awareness of the rights resulting from their insurance contracts, Greene and Johnson (1980) illustrate the greater potential for the owner-manager conflict associated with mutuals. Compared to the holders of publicly traded shares, members of the considered mutual insurers were less aware of their voting rights and appeared to exercise less control. Lamm-Tennant and Starks (1993) provide evidence for the owner-policyholder conflict by showing that stock insurers are generally riskier than mutual insurance companies. This is coherent with the results of Lee et al. (1997), who analyze both legal forms in the context of insurance guarantee funds. In addition, Wells et al. (1995) find that, in contrast to managers of stock insurance companies, those of mutuals have a higher free cash flow at their disposal, implying a greater opportunity to waste cash on unprofitable investments. The managerial discretion hypothesis is also supported by the results of Pottier and Sommer (1997). Based on testable hypotheses for both principal-agent conflicts, they reveal systematic differences in the business activities of stock and mutual firms from the life insurance sector. Further evidence for the owner-manager conflict is provided by Mayers and Smith (2005), who show that mutual company charters are more likely to contain provisions which limit the range of operating policies of the firm. Zou et al. (2009) observe

³The notion that the equity stake in a company can be interpreted as a call option on its assets, struck at the face value of the liabilities, was introduced by Merton (1974).

that, probably owing to their inferior management control mechanisms, mutuals tend to pay significantly lower dividends than stock insurers. Finally, analyzing data from the property-liability insurance sector, He and Sommer (2010) document a larger fraction of outside directors in the board of mutuals. They argue that additional monitoring through outside directors is necessary since ownership and control in mutual insurance companies are separated to a greater extent, thus increasing agency costs arising from the owner-manager conflict.

Another major strand of literature deals with changes in the organizational form of an insurer. Fletcher (1966) as well as Mayers and Smith (1986) focus on the mutualization of life insurance companies. Yet, much more research has been conducted on the demutualization process. A survey by Fitzgerald (1973) reveals economic pressure as a main reason for the conversion of small property-liability insurers into stock companies. Furthermore, Carson et al. (1998) find the size of the available free cash flow to be significantly related to the probability of demutualization. In contrast to that, Viswanathan and Cummins (2003) suggest that improvements in the access to capital are a major driver for the abandoning of the mutual form. Evidence for a significant underpricing of initial public offerings following demutualizations is provided by Viswanathan (2006) as well as Lai et al. (2008). Zanjani (2007) analyzes macroeconomic and regulatory conditions under which mutual insurance companies have been formed in order to explain the evolution of the whole U.S. life insurance industry toward the stock insurer form. Similarly, Erhemjamts and Leverty (2010) as well as Erhemjamts and Phillips (2012) examine U.S. life insurers and argue that their incentive to demutualize differs by the type of conversion. Companies that fully demutualize seem to be driven by the desire to increase operational efficiency and the improved access to external capital, whereas partial demutualizations, involving mutual holding companies, are mainly conducted to achieve tax savings.

Extant research has also focused on differences in efficiency between stock and mutual insurance firms. Spiller (1972), for example, provides evidence that ownership structure is a determinant of performance. Moreover, in their empirical study of U.S. life insurers, McNamara and Rhee (1992) conclude that increased efficiency is an important reason for and result of the transformation of mutuals into stock firms. Their view is confirmed by Cummins et al. (1999), who find mutuals to be less cost-efficient. Examining Spanish data, in contrast, Cummins et al. (2004) identify differences in efficiency between stocks and mutuals only for small mutual insurance companies. Jeng et al. (2007) also present mixed results with regard to efficiency improvements through demutualization. Finally, drawing on a large international data set, Biener and Eling (2012) find no evidence for the notion that stock insurers are more cost-efficient than mutual insurers.

Apart from agency-theoretic considerations, (de)mutualization, and differences in efficiency, various other topics related to the organizational type have been explored in the literature. The contractual structures of policies offered by mutual and stock insurers are examined by Smith and Stutzer (1990, 1995). Moreover, Cass et al. (1996) consider how a Pareto-optimal risk allocation can be achieved through mutual insurance in the presence of individual risk, Harrington and Niehaus (2002) focus on dissimilarities

concerning capital structure, which may result from the costs of raising new capital, and Ligon and Thistle (2005) point out that issues arising from asymmetric information can restrict the size of mutual institutions. In addition, using an equilibrium model in which mutuals are assumed to exclusively offer fully participating policies, Friesen (2007) shows that stock companies can only provide partially participating insurance when their premiums need to ensure a fair return on equity. Finally, Laux and Muermann (2010) demonstrate that, by linking policies to the provision of capital, mutuals can resolve free-rider and commitment issues faced by stock insurers.

Despite this large body of literature on various aspects of mutual and stock companies, to the best of our knowledge, a rigorous theory of the relationship between their premiums and safety levels has not been proposed yet. In addition, empirical evidence for the impact of the organization type on insurance pricing is still outstanding. Hence, in this paper, we aim to address this gap in the literature by means of a contingent claims model framework, an empirical analysis, and a comparison of the respective results. In doing so, we are able to establish major economic implications for equity- and policyholders. While we derive our results within the insurance context, most insights could be transferred to other industries where mutual companies are an established legal form, such as credit unions and pension funds.

3 Model Framework

In this section, we present a general model framework for insurance companies based on the seminal work of Merton (1974) as well as Doherty and Garven (1986). The economy is characterized by rational expectations, the absence of arbitrage opportunities, and complete capital markets, i.e., all contingent claims can be replicated with available financial instruments. There are no bid-ask spreads, broker commissions, and short-selling constraints. Furthermore, we assume asymmetric information and account for relevant frictions such as agency conflicts and financial distress. Risk sharing takes place through an insurance company that can adopt the legal form of a corporation (stock insurer) or a mutual. The firm runs for one initial period, at the end of which it is either liquidated or continues to do business into the future, thereby accumulating capital over time. Managers and shareholders are risk-neutral. The insurer issues policies to n risk-averse policyholders or mutual members, each of whom may suffer a loss of magnitude $\mathcal{L}_i > 0$ ($i = 1, \dots, n$) with some positive probability.⁴ For the sake of simplicity, individuals exhibit a single-period decision horizon, implying that, at time $t = 1$, the insurance contracts of the first policyholder generation mature and the value of the equity capital is realized through repayment or sale in the secondary market. Thus, the claims costs at the end of the period, L_1 , equal the aggregate policyholder loss: $L_1 = \sum_{i=1}^n \mathcal{L}_i$. All stakeholder contributions are paid in full at the outset. We begin with the simple and well-known case of the stock insurance company, which is then incrementally generalized to include frictional costs and account for the specifics of mutual insurers.

⁴Note that our model set-up neither requires identical insurance policies nor a homogeneous pool of policyholders.

3.1 Stock Insurer Claims Structure

Equity Stake

A stock insurer is bankrupt if the market value of the assets A_1 available at the end of the period is insufficient to cover its claims costs (liabilities) L_1 , i.e., $A_1 < L_1$. The shareholders are residual claimants with limited liability who receive $A_1 - L_1$ if $A_1 > L_1$ and zero otherwise. This payoff profile at time $t = 1$ equals that of a European call option on the company's assets, struck at the value of the policyholders' claims. Hence, the present value of the equity of a publicly traded stock insurer, EC_0^S , can be expressed as follows:

$$\begin{aligned}
 EC_0^S &= e^{-r} \mathbb{E}^{\mathbb{Q}} (EC_1^S) \\
 &= e^{-r} \mathbb{E}^{\mathbb{Q}} (\max [A_1 - L_1, 0]) \\
 &= e^{-r} \mathbb{E}^{\mathbb{Q}} (A_1 - L_1 + \max [L_1 - A_1, 0]) \\
 &= e^{-r} \mathbb{E}^{\mathbb{Q}} (A_1 - L_1) + DPO_0^S,
 \end{aligned} \tag{1}$$

where $\mathbb{E}^{\mathbb{Q}}$ denotes the expectation under the risk-neutral measure \mathbb{Q} and r is the riskless interest rate. The call option payoff is equivalent to a long position in the assets and a short position in the liabilities ($A_1 - L_1$), plus the so-called default put option of the stock insurer: $DPO_1^S = \max [L_1 - A_1, 0]$. The present value of the latter, $DPO_0^S = e^{-r} \mathbb{E}^{\mathbb{Q}} (\max [L_1 - A_1, 0])$, reflects the conditional expectation of the liabilities in case of bankruptcy and is therefore a measure for the firm's default risk or its safety from the policyholders' perspective (see, e.g., Gründl and Schmeiser, 2007). The smaller DPO_0^S , the more likely the insurer is to be solvent at time $t = 1$. Under the chosen model set-up, shareholders are subject to a binding participation constraint, i.e., they will only provide equity capital if the investment is associated with a net present value (NPV) of zero (see, e.g., Gatzert and Schmeiser, 2008). Therefore, their initial contribution \mathcal{EC}^S must equal the discounted expected payoff of their claims: $\mathcal{EC}^S = EC_0^S$.

Policyholder Stake

If the stock insurer is solvent at time $t = 1$, the insurance company fully indemnifies the policyholders for their incurred losses. In case of bankruptcy, however, they only receive that part of their claims which is covered by the remaining market value of the assets. This payoff profile results in the following relationship for the present value of the policyholders' claims in the stock insurer, P_0^S :

$$\begin{aligned}
 P_0^S &= e^{-r} \mathbb{E}^{\mathbb{Q}} (P_1^S) \\
 &= e^{-r} \mathbb{E}^{\mathbb{Q}} (\min [A_1, L_1]) \\
 &= e^{-r} \mathbb{E}^{\mathbb{Q}} (L_1 - \max [L_1 - A_1, 0]) \\
 &= e^{-r} \mathbb{E}^{\mathbb{Q}} (L_1) - DPO_0^S.
 \end{aligned} \tag{2}$$

The first term represents the present value of future claims costs, which corresponds to a default-free premium volume, and the second term is the present value of the default put option. This relation implies

that the higher the default risk of a stock insurer, i.e., the more valuable its default put option, the less it should charge for coverage. If the price of each individual insurance policy π_i^S is fair, i.e., the contracts are associated with an NPV of zero for the policyholders, the firm's underwriting revenue of $\Pi^S = \sum_{i=1}^n \pi_i^S$ must equal P_0^S . Having collected the initial stakeholders' contributions, the stock insurer can invest its total capital at the beginning of the period $A_0 = \mathcal{E}C^S + \Pi^S = EC_0^S + P_0^S$ in the capital markets.

Frictions

There are various market frictions that may have an impact on the pricing of the claims on the stock insurer's assets. In the following, we discuss the three most important categories: agency costs of outside equity, agency costs of debt, and bankruptcy (financial distress) costs.⁵ For a graphical illustration of the effects on the different payoff profiles at time $t = 1$, refer to Figure 1, which shows the equity and the policyholder stake of the stock insurance company before and after the introduction of frictional costs.

Agency costs of equity arise due to the separation of ownership and control (see Jensen and Meckling, 1976). More specifically, to the detriment of the firm's owners, management may direct corporate resources toward perquisites and nonpecuniary benefits, carry out negative-NPV projects, or even misappropriate capital. Assuming that the incentive problem associated with this owner-manager conflict consumes a fraction α_S of the stock insurer's end-of-period surplus of asset over liabilities, we define the present value of the agency costs of equity faced by the stock insurer, AC_0^S , as follows:⁶

$$\begin{aligned} AC_0^S &= e^{-r} \mathbb{E}^Q (AC_1^S) \\ &= e^{-r} \mathbb{E}^Q (\alpha_S \max [A_1 - L_1, 0]) \\ &= \alpha_S e^{-r} \mathbb{E}^Q (A_1 - L_1 + \max [L_1 - A_1, 0]) \\ &= \alpha_S (e^{-r} \mathbb{E}^Q (A_1 - L_1) + DPO_0^S). \end{aligned} \tag{3}$$

As a consequence, shareholders can only extract the percentage $(1 - \alpha_S)$ of the equity value at time $t = 1$, which, in turn, lowers the present value of the equity capital in the presence of frictions to EC_0^{Sf} :

$$\begin{aligned} EC_0^{Sf} &= EC_0^S - AC_0^S \\ &= (1 - \alpha_S) (e^{-r} \mathbb{E}^Q (A_1 - L_1) + DPO_0^S). \end{aligned} \tag{4}$$

Owing to rational expectations, the shareholders anticipate this reduction in value and, corresponding to the previously mentioned binding participation constraint, adjust their contribution $\mathcal{E}C^{Sf}$ accordingly. However, for the insurance company to come into existence at all, AC_0^S needs to be paid in at the outset.

⁵In their recent article, Laux and Muermann (2010) also contemplate the costs of raising external capital that occur due to asymmetric information between managers and investors. A nonnegligible amount of the proceeds of initial public offerings, for example, is absorbed by the underwriting syndicate. Assuming that such issuance costs are proportional and incurred for both raising capital and collecting premiums, they show that the effects are the same as for the governance problems due to the owner-manager conflict. Hence, we deem it unnecessary to introduce this additional layer of complexity.

⁶Jensen and Meckling (1976) argue that, apart from a deadweight loss, the agency costs of equity may also comprise monitoring and bonding expenses aimed at mitigating the respective incentive problem. We assume that those are accounted for through the choice of α_S .

As a result, it is ultimately borne by the policyholders in form of a loading on top of the fair price π_i^S of each individual contract, which increases the firm's overall premium volume to $\Pi^{\text{Sf}} = P_0^S + AC_0^S$. The risk-averse policyholders are willing to commit to a higher ex ante premium to initiate risk sharing, as long as it allows them to increase their utility compared to the case without insurance (see, e.g., Laux and Muermann, 2010).

Furthermore, agency costs of debt occur because shareholders have an incentive to prompt management to change the company's risk strategy after the policyholders have bought their contracts (see Jensen and Meckling, 1976). This agency-theoretic consideration is also known as the asset substitution problem. Due to its call-option-like payoff profile, higher risk investments increase the value of the insurer's equity capital. Yet, they simultaneously decrease the value of the policyholder stake.⁷ If the risk shift is achieved through transactions with a negative NPV, the overall firm value declines. The difference between the firm value with and without the asset substitution problem is a measure for the agency costs of debt (see, e.g., Leland, 1998). In our model framework, however, all financial instruments are zero-NPV investments, since we have assumed that the no-arbitrage condition holds and capital markets are complete. Therefore, shareholders have no reason to resort to negative-NPV projects and the owner-policyholder conflict does not result in a real cost (see, e.g., Gavish and Kalay, 1983). Instead, it merely leads to a redistribution of wealth from policyholders to shareholders. Suppose that the firm can choose between a high risk and a low risk investment opportunity that are mutually exclusive and exhibit return standard deviations of σ_H and σ_L ($< \sigma_H$), respectively. This implies:

$$EC_0^S(\sigma_H) > EC_0^S(\sigma_L), \quad (5)$$

and

$$P_0^S(\sigma_H) < P_0^S(\sigma_L). \quad (6)$$

As the policyholders have rational expectations, they anticipate the asset substitution and demand Π^{Sf} to be based on σ_H straightaway. Similarly, in view of the high risk strategy, shareholders are prepared to contribute $\mathcal{EC}^{\text{Sf}} = EC_0^{\text{Sf}}(\sigma_H)$.

Finally, financial distress costs are attributable to the fact that the event of bankruptcy is associated with various expenses. When the insurance company is no longer able to meet its obligations, legal proceedings are instituted and an insolvency administrator is appointed. Such measures need to be financed by a fraction of the remaining value of the firm's assets (see Jensen and Meckling, 1976).⁸ Consequently, financial distress costs rise with the probability of default and are primarily of concern to the policyholders, since they reduce their payoffs in those states where the shareholders' claims on the firm are already forfeit. Let β be a bankruptcy charge that applies to the asset value A_1 if the latter

⁷To see this, compare Equations (1) and (2), assume that the Black and Scholes (1973) model is applied, and recall that the value of a put option rises in the return volatility of the underlying.

⁸Note that Jensen and Meckling (1976) introduce bankruptcy expenses as one component of the agency costs of debt. In later articles, however, authors have begun to treat them as a separate type of frictional cost (see, e.g., Leland, 1998).

is insufficient to cover the claims costs L_1 . Under these circumstances, the following expression for the present value of the bankruptcy costs of the stock insurer, BC_0^S , can be derived:

$$\begin{aligned}
BC_0^S &= e^{-r} \mathbf{E}^Q (BC_1^S) \\
&= e^{-r} \mathbf{E}^Q (\beta L_1 \mathbf{1}_{A_1 < L_1} - \beta \max [L_1 - A_1, 0]) \\
&= \beta e^{-r} \mathbf{E}^Q (L_1 \mathbf{1}_{A_1 < L_1} - \max [L_1 - A_1, 0]) \\
&= \beta (BPO_0^S - DPO_0^S).
\end{aligned} \tag{7}$$

$BPO_0^S = e^{-r} \mathbf{E}^Q (L_1 \mathbf{1}_{A_1 < L_1})$ is the present value of a cash-or-nothing binary put option that pays off L_1 if $A_1 < L_1$ or else expires worthless.⁹ Intuitively, Equation (7) can be interpreted as follows: if the asset value at the end of the period falls below the value of the liabilities by an infinitesimally small amount, the company needs to declare bankruptcy and directly incurs expenses of βL_1 . Subsequently, the charges decline proportionally with A_1 . In other words, for all realizations of A_1 that are smaller than L_1 , the policyholders lose an amount of βA_1 to the bankruptcy proceedings. BC_0^S reduces the present value of the policyholder stake in the presence of frictions to P_0^{Sf} :

$$\begin{aligned}
P_0^{Sf} &= P_0^S - BC_0^S \\
&= e^{-r} \mathbf{E}^Q (L_1) - (1 - \beta) DPO_0^S - \beta BPO_0^S.
\end{aligned} \tag{8}$$

Nevertheless, to ensure that the risk-neutral shareholders invest in the stock insurance company, the policyholders need to provide the full amount P_0^S , i.e., their contribution remains $\Pi^{Sf} = P_0^S + AC_0^S = P_0^{Sf} + BC_0^S + AC_0^S$. To sum up, despite the impact of the aforementioned frictions on the payoff profiles of the claims at time $t = 1$, they do not change the overall value of the firm's assets at the beginning of the period, A_0 . Instead, they lead to a different distribution of the initial contributions between owners and policyholders:

$$A_0 = \underbrace{EC_0^{Sf}}_{\mathcal{E}^{Sf}} + \underbrace{P_0^{Sf} + BC_0^S + AC_0^S}_{\Pi^{Sf}}. \tag{9}$$

3.2 Mutual Insurer Claims Structure

Equity Stake

We now explicitly separate the ownership and the policyholder stake that mutual clients acquire with their insurance contracts. As discussed in the first section, one important difference compared to stock insurance companies is the recovery option, i.e., the right to demand additional premiums in times of

⁹We refrain from factoring L_1 out of the expectation term, since it may be treated as a random variable.

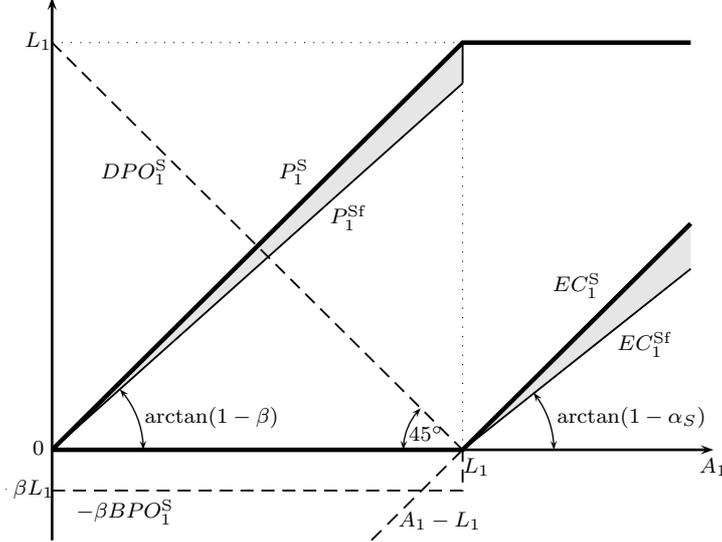


Figure 1: Payoff Profiles of the Claims on a Stock Insurer's Assets at Time $t = 1$

This figure shows the payoff profiles of the equity capital and the policyholder stake of a stock insurance company at time $t = 1$ before (EC_1^S, P_1^S) and after the introduction of frictions (EC_1^{Sf}, P_1^{Sf}). Agency costs of equity and bankruptcy costs are represented by the shaded areas between EC_1^S and EC_1^{Sf} as well as P_1^S and P_1^{Sf} , respectively. The dashed lines illustrate the elements of the replicating portfolios.

financial distress. Provided a mutual insurer exhibits such a feature, we can express the present value of its equity claims, EC_0^M , analogously to EC_0^S as follows:

$$EC_0^M = e^{-r} \mathbb{E}^{\mathbb{Q}}(A_1 - L_1) + RO_0^M + DPO_0^M, \quad (10)$$

where RO_0^M equals the present value of the recovery option and DPO_0^M denotes the present value of the default put option of the mutual insurer. These two building blocks will be discussed in the following. The payoff profile of the default put option of the mutual at time $t = 1$ is depicted in Figure 2. It differs from that of its stock insurer counterpart because the mutual firm remains solvent as long as the recovery option has not been fully exhausted. More specifically, the assets at time $t = 1$ have to fall under a lower default threshold $X = L_1 - AP^{\max}$ than for the stock insurance company before bankruptcy is declared and the remaining assets are distributed among those members with valid claims. AP^{\max} denotes the upper limit on additional premiums that can be charged through the recovery option.¹⁰ Formally, we define the present value of the mutual insurer's default put option, DPO_0^M , as

$$DPO_0^M = PO_0^M + BPO_0^{M'}, \quad (11)$$

where $PO_0^M = e^{-r} \mathbb{E}^{\mathbb{Q}}(\max[X - A_1, 0])$ is the present value of a European put option with strike price X and $BPO_0^{M'} = e^{-r} \mathbb{E}^{\mathbb{Q}}(AP^{\max} \mathbf{1}_{A_1 < X})$ is the present value of a cash-or-nothing binary put option, which

¹⁰ AP^{\max} is usually defined in a company's charter. In our model, it could easily be adjusted to account for members' potential default risk or reluctance to pay additional premiums.

reflects the fact that, in the instance in which the mutual insurer becomes insolvent, the assets will have dropped below the liabilities by an amount of AP^{\max} . By comparing the respective payoff profiles in Figure 2, we notice that generally $PO_0^M \leq DPO_0^M \leq DPO_0^S$. In addition, the smaller AP^{\max} , the higher DPO_0^M and, in the special case of $AP^{\max} = 0$ (i.e., a mutual without recovery option), we get $X = L_1$, $PO_0^M = DPO_0^M = DPO_0^S$, and $BPO_0^{M'} = 0$.

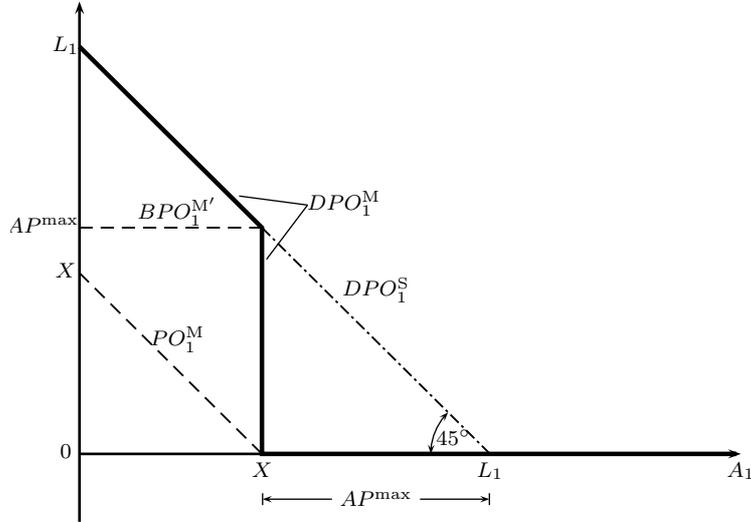


Figure 2: Payoff Profile of the Mutual Insurer's Default Put Option at Time $t = 1$

The solid line represents the payoff profile of the mutual insurer's default put option at time $t = 1$ (DPO_1^M). AP^{\max} denotes the upper limit on additional premiums that can be charged through the recovery option. The elements of the replicating portfolio (PO_1^M and $BPO_1^{M'}$) are illustrated by the dashed lines. For comparison purposes, the dot-dashed line indicates the payoff profile of the default put option of a stock insurer with identical assets and liabilities (DPO_1^S).

Furthermore, Figure 3 shows the payoff profile of the recovery option at time $t = 1$. The corresponding present value, RO_0^M , adheres to the relationship:

$$RO_0^M = DPO_0^S - DPO_0^M. \quad (12)$$

When $X \leq A_1 \leq L_1$, i.e., the deficit $L_1 - A_1$ is less than AP^{\max} , additional premiums are collected from the members to eliminate the shortage. RO_0^M is maximized for $AP^{\max} = L_1$, in which case the mutual insurer's default put option is worthless ($DPO_0^M = 0$). On the other hand, without a recovery option ($AP^{\max} = 0$), we have $RO_0^M = 0$ and $DPO_0^M = DPO_0^S$.¹¹ Since, in any case, DPO_0^S perfectly decomposes into RO_0^M and DPO_0^M , the recovery option does not cause a difference between EC_0^S and EC_0^M . However, in its presence, the clients of a mutual insurer ceteris paribus benefit from a higher safety level of their policies, which is reflected by the aforementioned fact that $DPO_0^M < DPO_0^S$, unless $AP^{\max} = 0$.

¹¹Thus, the choice of AP^{\max} determines how DPO_0^S is split into DPO_0^M and RO_0^M .

Economically, the recovery option is equivalent to contingent equity capital.¹² Intuitively, it is a simple ex post extension of the idea of risk pooling. Each mutual client enters the respective binding commitment ex ante, i.e., before it is revealed whether he or she actually suffers a loss. If due, the additional premium at time $t = 1$ then needs to be paid by all members, not just those with valid insurance claims. Consequently, the probability that the latter are fully indemnified is greater for a mutual than for a stock firm.¹³

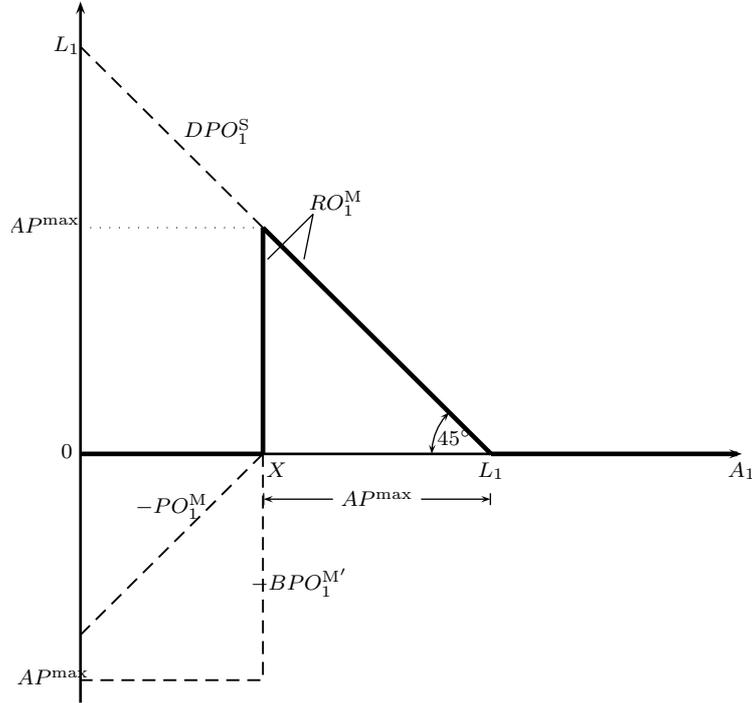


Figure 3: Payoff Profile of the Mutual Insurer's Recovery Option at Time $t = 1$

The solid line represents the payoff profile of the recovery option at time $t = 1$ (RO_1). The recovery option can be drawn upon by the mutual insurer to compensate for deficits up to the maximum additional premium AP^{\max} . The elements of the replicating portfolio (DPO_1^S , PO_1^M , and $BPO_1^{M'}$) are illustrated by the dashed lines.

There is commonly no secondary market for ownership stakes in mutual insurance companies. As a consequence, the payoff profile of the equity capital of a mutual insurer and, in turn, its present value crucially depend on the premium refund policy of the management and the ability of the members to

¹²Being an equity substitute, in some jurisdictions the recovery option can be accounted for by mutual insurers when calculating their solvency capital charges.

¹³As an illustration for this reasoning, consider the following simple example. Define m as the number of individuals with losses at time $t = 1$, which, in all reasonable cases, should be smaller than the number of members or policyholders n . In addition, for the sake of simplicity, let all losses be of the same size \mathcal{L} , such that we have $L_1 = m\mathcal{L}$. Assuming a pro-rata distribution rule, this implies that if $A_1 < L_1$, stock insurer policyholders with valid claims are compensated with $\frac{A_1}{m}$. In contrast to that, mutual members have to pay an additional premium of $\frac{(L_1 - A_1)}{n}$ while being fully indemnified for their losses. Thus, for the mutual contracts to be more beneficial, the following needs to hold: $-\mathcal{L} + \mathcal{L} - \frac{(L_1 - A_1)}{n} > -\mathcal{L} + \frac{A_1}{m}$. This ultimately reduces to the condition $\frac{(L_1 - A_1)}{n} < \frac{(L_1 - A_1)}{m}$ that is met so long as $n > m$.

prompt an initial public offering (IPO) or break-up of the company. Let δ be the payout (premium refund) ratio and p_L the probability of demutualization or liquidation.¹⁴ If $A_1 > L_1$, members either receive the whole value of the equity with probability p_L or a premium refund of $\delta(A_1 - L_1)$ with probability $(1 - p_L)$. We summarize these two cases in the parameter $\gamma = p_L + (1 - p_L)\delta$, which can be interpreted as the expected payoff per unit of equity capital, given the company is solvent at time $t = 1$. Since $\delta \in [0, 1]$ and $p_L \in [0, 1]$, we have $\gamma \in [0, 1]$. The fraction $(1 - \gamma)$, in contrast, represents that part of $(A_1 - L_1)$ that cannot be extracted by the members.¹⁵ Again, due to rational expectations, this is anticipated ex ante. In reality, $(1 - \gamma)$ is likely to be a large percentage of the total equity capital. Therefore, despite their risk aversion, prospective mutual members should be unwilling to pay for the nonrealizable component of the equity stake. Against this background, we define the present value of the member capital, MC_0^M , as follows:

$$MC_0^M = \gamma (e^{-r}E^Q(A_1 - L_1) + RO_0^M + DPO_0^M). \quad (13)$$

However, for the company to be founded at all, the full amount of EC_0^M is required at time $t = 0$. Otherwise, the total asset value and hence all payoffs at time $t = 1$ will be even lower, leading members to further reduce the contributions that they are prepared to accept. This initial situation cannot result in an equilibrium with risk sharing. Thus, we assume that risk-neutral founding capital providers, whose repayment is contractually guaranteed, step in. In line with Equation (13), the present value of their claims, FC_0^M , is given by the expression

$$FC_0^M = (1 - \gamma) (e^{-r}E^Q(A_1 - L_1) + RO_0^M + DPO_0^M).^{16} \quad (14)$$

Owing to their risk neutrality, these external investors are subject to the same participation constraint as the shareholders of the stock firm. Consequently, to achieve a zero-NPV investment, their initial cash outlay $\mathcal{F}C^M$ must equal FC_0^M .

Policyholder Stake

Consistent with Equation (10), the present value of the mutual insurer's policyholder stake, P_0^M , is:

$$P_0^M = e^{-r}E^Q(L_1) - RO_0^M - DPO_0^M. \quad (15)$$

As in the stock insurer case, $e^{-r}E^Q(L_1)$ equals the fair insurance premium volume without default risk. Instead of subtracting DPO_0^M , however, we now have a short position in the combination of the recovery option and the default put option of the mutual.¹⁷ If, at the end of the period, the assets have fallen below the claims costs, the policyholder stake of the mutual insurance company is associated with the same financial loss as that of a stock insurer. This is due to the fact that the members are either charged

¹⁴From an agency-theoretic perspective, the firm's management generally has a preference to retain as much capital in the company as possible (see, e.g., Jensen, 1986). This aspect of the owner-manager conflict lowers the premium refund ratio δ . Furthermore, in contrast to a corporation, there are no blockholders in a mutual insurer. Therefore, p_L will depend on the members' ability to coordinate an agreement on the demutualization or liquidation of the firm.

¹⁵Note that $p_L = 1$ or $\delta = 1$ directly results in $\gamma = 1$ such that there is no nonrealizable equity component.

¹⁷Recall from Equation (12) that $DPO_0^S = RO_0^M + DPO_0^M$.

$L_1 - A_1$ through the recovery option (when $X < A_1 < L_1$) or, in case of insolvency (when $A_1 < X$), they suffer a deficit of $L_1 - A_1$. Consequently, P_0^M equals P_0^S .

Premium

Unlike the stock insurer, which collects equity capital and premiums separately, the mutual firm sells contracts that comprise both the ownership and the policyholder stake at the same time. Hence, the fair price of a mutual policy π_i^M must comprise both a charge for the insurance coverage and for the member capital such that the aggregate premium revenue of $\Pi^M = \sum_{i=1}^n \pi_i^M$ corresponds to the sum $MC_0^M + P_0^M$.¹⁸ This implies that, in the absence of frictions, the mutual insurer has the time $t = 0$ asset value $A_0 = \mathcal{FC}^M + \Pi^M = FC_0^M + MC_0^M + P_0^M$ at its disposal.

Frictions

Below, we introduce agency costs of outside equity, agency costs of debt, and bankruptcy costs into the claims structure of the mutual insurer. The consequences of each of these frictions are different than for the stock insurance company. Figure 4 illustrates the respective changes of the payoff profiles at the end of the first period.

Let α_M be the percentage of the overall equity capital that is absorbed by the owner-manager conflict in a mutual insurer. Mayers and Smith (1981, 2005) argue that mutuals are equipped with less efficient governance mechanisms than stock insurance companies and should therefore be associated with higher agency costs of equity. Consequently, we assume $\alpha_M > \alpha_S$ and, consistent with Equation (3), specify the present value of the agency costs of equity incurred by the mutual insurer, AC_0^M , as follows:

$$AC_0^M = \alpha_M EC_0^M = \alpha_M (MC_0^M + FC_0^M). \quad (16)$$

Since the owner-manager conflict applies to both equity components in the same manner, it is reasonable to apply a pro-rata distribution rule for these costs. Thus, in a set-up with market frictions, the present value of the ownership claims held by the mutual members decreases to MC_0^{Mf} :

$$\begin{aligned} MC_0^{Mf} &= MC_0^M - \alpha_M MC_0^M \\ &= (1 - \alpha_M) \gamma (e^{-r} E^Q (A_1 - L_1) + RO_0^M + DPO_0^M). \end{aligned} \quad (17)$$

Similarly, the following is an expression for the present value of the founding capital payoff in the presence of frictions, FC_0^{Mf} :

$$\begin{aligned} FC_0^{Mf} &= FC_0^M - \alpha_M FC_0^M \\ &= (1 - \alpha_M)(1 - \gamma) (e^{-r} E^Q (A_1 - L_1) + RO_0^M + DPO_0^M). \end{aligned} \quad (18)$$

¹⁸Note that for the position of the mutual members to be equivalent to that of the policyholders of a stock insurer who additionally own all shares of their company, full participation in the mutual insurer's equity capital payoff is needed.

To ensure the participation of the risk-neutral founding capital providers, AC_0^M needs to be fully borne by the members of the mutual insurer. Hence, π_i^M is increased by a loading, which leads to a new premium volume of $\Pi^{\text{Mf}} = MC_0^{\text{Mf}} + P_0^M + AC_0^M$.

Moreover, the owner-policyholder conflict is not relevant in the context of the mutual insurer. This is due to the fact that members hold both types of claims in the company (see, e.g., Garven, 1987). Suppose the mutual has the same investment opportunities as the stock insurer. If members could fully participate in the firm's equity payoff, then they would be indifferent between the high (σ_H) and the low risk investment opportunity (σ_L). Because of the necessity to accommodate founding capital providers, however, the latter will be favored. To see this, consider the following relationships:

$$MC_0^M(\sigma_H) + P_0^M(\sigma_H) < MC_0^M(\sigma_L) + P_0^M(\sigma_L) \quad (19)$$

$$FC_0^M(\sigma_H) > FC_0^M(\sigma_L). \quad (20)$$

Raising the volatility of the company's asset portfolio would cause a redistribution of value from the members to the outside investors. Therefore, Π^{Mf} should be based on σ_L . In addition, as the members' preference for the low risk strategy is correctly anticipated by the founding capital providers, their initial contribution will be $\mathcal{F}C^{\text{Mf}} = FC_0^{\text{Mf}}(\sigma_L)$.

Finally, we assume that the mutual insurer faces the same bankruptcy charges β as the stock insurer. Due to the lower default threshold X established by the recovery option, however, the respective absolute value should ceteris paribus be smaller. Accounting for these considerations, the present value of the bankruptcy costs of the mutual insurer, BC_0^M , can be expressed as

$$BC_0^M = \beta \left(BPO_0^{\text{M}''} - PO_0^M \right). \quad (21)$$

$BPO_0^{\text{M}''} = e^{-r} \mathbb{E}^{\mathbb{Q}}(X \mathbf{1}_{A_1 < X})$ is the present value of a cash-or-nothing binary put option with a payoff of X if $A_1 < X$ and zero otherwise. Equation (21) can be interpreted in the very same way as Equation (7): given the value of the mutual insurer's assets at time $t = 1$ turns out to be below the firm's default threshold X , a sum of βA_1 is spent for the bankruptcy proceedings. Thus, when financial distress is not costless, the present value of the mutual insurer's policyholder stake declines to P_0^{Mf} .¹⁹

$$\begin{aligned} P_0^{\text{Mf}} &= P_0^M - BC_0^M \\ &= e^{-r} \mathbb{E}^{\mathbb{Q}}(L_1) - RO_0^M - (1 - \beta) PO_0^M - BPO_0^{\text{M}'} - \beta BPO_0^{\text{M}''}. \end{aligned} \quad (22)$$

Despite the fact that they forgo the corresponding payoff at time $t = 1$, however, BC_0^M needs to be contributed by the risk-averse members of the mutual. Consequently, they still make an initial payment

¹⁹Recall from Equation (11) that $DPO_0^M = PO_0^M + BPO_0^{\text{M}'}$.

In addition, the two bars on the right depict how the claims structure is affected by the introduction of frictions. Since the shareholders of the stock insurer prompt management to choose the high risk strategy, value is shifted from the policyholder to the equity stake. At the same time, bankruptcy costs (BC_0^S) further reduce the size of the former to P_0^{Sf} . Similarly, the present value of the agency costs AC_0^S is separated from the equity value EC_0^{Sf} . Risk sharing does not take place unless both types of frictional costs are borne by the policyholders. Thus, the premium volume of the stock insurance company in the presence of frictions is $\Pi^{Sf} = P_0^{Sf} + BC_0^S + AC_0^S$. The mutual insurer, in contrast, runs the low risk strategy. Its agency costs AC_0^M are larger than those of the stock insurer and accrue to both the realizable and nonrealizable equity components, reducing their values to MC_0^{Mf} and FC_0^{Mf} , respectively. Yet, due to the recovery option and the low risk investment strategy, the mutual insurer faces smaller bankruptcy costs BC_0^M than the stock insurer. Finally, its premium volume Π^{Mf} includes all present values except FC_0^{Mf} .

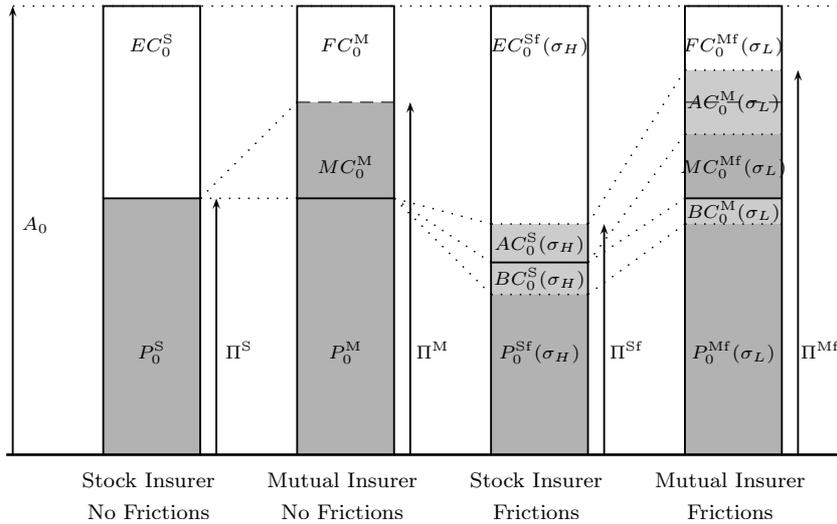


Figure 5: Composition of the Premium Revenues (Stylized)

This figure illustrates the composition of the stock and the mutual insurer premium volume according to the model framework before (Π^S, Π^M) and after the introduction of frictions (Π^{Sf}, Π^{Mf}). Agency costs of equity (AC_0^S, AC_0^M) and bankruptcy costs (BC_0^S, BC_0^M) are represented by the areas shaded in light grey. Together with the part of the equity capital that is paid in by external investors ($EC_0^S, FC_0^M, EC_0^{Sf}, FC_0^{Mf}$), the premium volumes make up the initial asset value of the firms A_0 .

4 Numerical Analysis

In this section, we make concrete assumptions for the dynamics of the firms' assets and provide closed-form solutions for the various option prices in our model framework. Subsequently, we discuss a numerical example as well as various model sensitivities to illustrate the effects of recovery option, equity participation, and market frictions on the claims structures. In a last step, based on the implementation of

the model, we derive normative insights with regard to feasible combinations of premium volume, safety level, and capital structure of stock and mutual insurance companies.

4.1 Option Pricing Formulae

Suppose that trading takes place continuously in time and that the term structure of interest rates is flat and deterministic. The insurance companies' assets are assumed to be stochastic, and their dynamics are modeled by a Geometric Brownian Motion under the risk-neutral measure \mathbb{Q} :

$$\frac{dA_t}{A_t} = rdt + \sigma dW_t^{\mathbb{Q}}, \quad (24)$$

where the drift is given by the risk-free interest rate r , $\sigma \in \sigma_L, \sigma_H$ denotes the return volatility of the assets, and dW_{A_t} is a standard Wiener process under \mathbb{Q} .²⁰ The insurer's claims are assumed to be deterministic.²¹ Under these assumptions, closed-form solutions for the present values of the various European options described in Section 3 are available. In line with the one-period model from Section 3, the present value of the stock insurer default put option, DPO_0^S , can be computed as follows (see Black and Scholes, 1973):

$$\begin{aligned} DPO_0^S &= e^{-r} \mathbb{E}^{\mathbb{Q}} (\max [L_1 - A_1, 0]) \\ &= e^{-r} L_1 \Phi(-d_1) - A_0 \Phi(-d_2), \end{aligned} \quad (25)$$

where $\Phi(x)$ is the cumulative distribution function of the standard normal distribution and

$$d_1 = \frac{\ln(A_0/L_1) + r - \sigma^2/2}{\sigma}, \quad d_2 = \frac{\ln(A_0/L_1) + r + \sigma^2/2}{\sigma}.$$

To determine BC_0^S , we also need to calculate BPO_0^S . Rubinstein and Reiner (1991) show that the price of this cash-or-nothing binary put option is:

$$\begin{aligned} BPO_0^S &= e^{-r} \mathbb{E}^{\mathbb{Q}} (L_1 \mathbf{1}_{A_1 < L_1}) \\ &= e^{-r} L_1 \Phi(-d_1). \end{aligned} \quad (26)$$

Furthermore, the present value of the mutual insurer's default put option, DPO_0^M , comprises two components. The first one is a European put option, whose price PO_0^M adheres to the following formula (see Black and Scholes, 1973):

$$\begin{aligned} PO_0^M &= e^{-r} \mathbb{E}^{\mathbb{Q}} (\max [X - A_1, 0]) \\ &= e^{-r} X \Phi(x_1) - A_0 \Phi(x_2) \\ &= e^{-r} (L_1 - AP^{\max}) \Phi(-x_1) - A_0 \Phi(-x_2), \end{aligned} \quad (27)$$

²⁰As a consequence, asset returns are normally distributed. We are aware that, for most investments, this is not entirely consistent with available empirical evidence (see, e.g., Officer, 1972). With regard to our research goal, however, it can be viewed as an acceptable simplification.

²¹This decision is made for reasons of computational convenience. Since the model framework in Section 3 has been deliberately kept on a general level, different assumptions for the asset and claims dynamics as well as associated option-pricing frameworks can be applied without loss of generality.

where

$$x_1 = \frac{\ln(A_0/(L_1 - AP^{\max})) + r - \sigma_A^2/2}{\sigma_A}, \quad x_2 = \frac{\ln(A_0/(L_1 - AP^{\max})) + r + \sigma_A^2/2}{\sigma_A}.$$

The second component is a cash-or-nothing binary put option that pays AP^{\max} if $A_1 < X$ and zero otherwise. Its present value equals (see Rubinstein and Reiner, 1991)

$$\begin{aligned} BPO_0^{M'} &= e^{-r} \mathbb{E}^{\mathbb{Q}}(AP^{\max} \mathbf{1}_{A_1 < X}) \\ &= e^{-r} AP^{\max} \Phi(-x_1). \end{aligned} \quad (28)$$

Based on Equations (27) and (28), it is possible to derive DPO_0^M :

$$\begin{aligned} DPO_0^M &= PO_0^M + BPO_0^{M'} \\ &= e^{-r}(L_1 - AP^{\max})\Phi(-x_1) - A_0\Phi(-x_2) + e^{-r}AP^{\max}\Phi(-x_1) \\ &= e^{-r}L_1\Phi(-x_1) - A_0\Phi(-x_2). \end{aligned} \quad (29)$$

This formula clearly resembles Equation (25), which describes the price of the default put option of a stock insurer. Yet, the probabilities with which the terms $e^{-r}L_1$ and A_0 are weighted differ. To grasp the intuition behind this, recall from Section 3.2 that the assets A_1 have to fall below the threshold X before the default put option of the mutual insurer is in the money. Contingent on $A_1 < X$, however, the payoff profiles of DPO^M and DPO^S are congruent (refer back to Figure 2): in case $A_1 < X$, both options pay $L_1 - A_1$. As a result, the formula for DPO_0^M includes $e^{-r}L_1$ and A_0 , but weighted with the probabilities $\Phi(-x_1)$ and $\Phi(-x_2)$ instead of $\Phi(-d_1)$ and $\Phi(-d_2)$.

Combining Equations (25) and (29), the value of the recovery option can be expressed as

$$\begin{aligned} RO_0^M &= DPO_0^S - DPO_0^M \\ &= e^{-r}L_1\Phi(-d_1) - A_0\Phi(-d_2) - e^{-r}L_1\Phi(-x_1) + A_0\Phi(-x_2) \\ &= e^{-r}L_1(\Phi(-d_1) - \Phi(-x_1)) - A_0(\Phi(-d_2) - \Phi(-x_2)).^{22} \end{aligned} \quad (30)$$

Finally, $BPO_0^{M''}$ is required to compute BC_0^M . Following the same rationale as above, we get

$$\begin{aligned} BPO_0^{M''} &= e^{-r} \mathbb{E}^{\mathbb{Q}}(X \mathbf{1}_{A_1 < X}) \\ &= e^{-r} X \Phi(-x_1) \\ &= e^{-r}(L_1 - AP^{\max})\Phi(-x_1). \end{aligned} \quad (31)$$

4.2 Numerical Example and Sensitivities

Based on the aforementioned formulae, the claims in mutual and stock insurance companies can now be valued. Table 1 contains the basic input parameters that underlie our numerical analyses. It is important to note that all of our results with regard to the aggregate premium revenue of the two organizational

forms similarly hold for the price of their individual insurance contracts, since the respective policyholder pools are assumed to be identical (refer to Section 3). Hence, in the following, we will use the terms “premium” and “premium volume” interchangeably. The resulting option prices, frictional costs, claims values, and stakeholder contributions can be found in Table 2.

A_0	100.00	value of the assets at time $t = 0$
L_0	85.00	value of the liabilities at time $t = 0$
AP^{\max}	5.00	additional premium volume cap
r	0.02	risk-free interest rate
σ_H	0.20	asset return volatility for high risk strategy (owner-policyholder conflict)
σ_L	0.10	asset return volatility for low risk strategy (owner-policyholder conflict)
α_S	0.10	deadweight-loss fraction for owner-manager conflict (stock insurer)
α_M	0.20	deadweight-loss fraction for owner-manager conflict (mutual insurer)
β	0.10	bankruptcy charge
γ	0.10	fraction of realizable equity (mutual insurer)

Table 1: Input Parameter Values

In the set-up without frictions, the value of the default put option of the stock insurer DPO_0^S (0.2017) perfectly splits into RO_0^M (0.0866) and DPO_0^M (0.1151). Moreover, the total equity value of the mutual consists of the realizable component attributable to the members MC_0^M (1.5202) and the founding capital FC_0^M (13.6815). Due to the fact that, in the absence of frictions, both firms choose the same risk strategy, the equity stake $FC_0^M + MC_0^M$ (13.6815 + 1.5202 = 15.2017) and the policyholder stake P_0^M (84.7983) of the mutual are worth the same as their stock insurer equivalents EC_0^S and P_0^S . The mutual premium volume Π^M (86.3185) exceeds the stock insurer premium volume Π^S (84.7983) by the members’ contribution to the equity capital MC_0^M (1.5202).

In the presence of frictions, the stock insurer switches to high risk investments, causing a sharp increase in its default risk as reflected by DPO_0^S (2.1613). At the same time, value is shifted from the policyholder to the ownership stake. Agency costs AC_0^S (1.7161) and bankruptcy costs BC_0^S (1.8073) lead to a deadweight loss on the claims such that EC_0^{Sf} (15.4452) and P_0^{Sf} (81.0314) do not sum up to the initial value of the assets A_0 (100.0000). The amount $AC_0^S + BC_0^S$ (3.5234) is included in the premium volume Π^{Sf} (84.5548). Since the mutual insurer sticks with the low risk strategy, its default risk is unchanged ($DPO_0^M = 0.1151$). However, it exhibits higher agency costs AC_0^M (3.0403) and lower bankruptcy costs BC_0^M (0.1163) than the stock insurer. The latter reduce the value of its policyholder stake to P_0^{Sf} (84.6820). AC_0^M , in contrast, pertains to both FC_0^{Mf} (10.9452) and MC_0^{Mf} (1.2161). The mutual’s premium volume Π^{Mf} (89.0548) consists of all claims values and frictional costs except FC_0^{Mf} .

The sensitivities of the mutual insurer’s premium revenue with regard to key input parameters of the model are illustrated in Figure 6.²³ All four subfigures relate to the more realistic set-up with fric-

²³The charge β simply determines the part of the frictionless policyholder claims P_0^S and P_0^M that is spun off into the present value of the bankruptcy costs (see Section 3). Since the latter needs to be included in the premium volume anyway, β does not have an impact on Π^{Sf} and Π^{Mf} and is thus not considered in this analysis.

Stock Insurer	No Frictions (σ_L)	Frictions (σ_H)	Mutual Insurer	No Frictions (σ_L)	Frictions (σ_L)
Basic Options			Basic Options		
–	–	–	RO_0^M	0.0866	0.0866
DPO_0^S	0.2017	2.1613	DPO_0^M	0.1151	0.1151
–	–	–	$BPO_0^{M'}$	0.0737	0.0737
–	–	–	PO_0^M	0.0414	0.0414
BPO_0^S	4.8965	20.2341	$BPO_0^{M''}$	1.2046	1.2046
Frictional Costs			Frictional Costs		
AC_0^S	0.0000	1.7161	AC_0^M	0.0000	3.0403
BC_0^S	0.0000	1.8073	BC_0^M	0.0000	0.1163
Sum	0.0000	3.5234	Sum	0.0000	3.1493
Claims			Claims		
EC_0^S/EC_0^{Sf}	15.2017	15.4452	FC_0^M/FC_0^{Mf}	13.6815	10.9452
–	–	–	MC_0^M/MC_0^{Mf}	1.5202	1.2161
P_0^S/P_0^{Sf}	84.7983	81.0314	P_0^M/P_0^{Mf}	84.7983	84.6820
Sum	100.0000	96.4766	Sum	100.0000	96.8433
Contributions			Contributions		
$\mathcal{E}C^S/\mathcal{E}C^{Sf}$	15.2017	15.4452	$\mathcal{F}C^M/\mathcal{F}C^{Mf}$	13.6815	10.9452
Π^S/Π^{Sf}	84.7983	84.5548	Π^M/Π^{Mf}	86.3185	89.0548
Sum (A_0)	100.0000	100.0000	Sum (A_0)	100.0000	100.0000

Table 2: Numerical Example

This table contains the values of all building blocks in the claims structure of a stock and a mutual insurer for the parameter values shown in Table 1 under the model set-up with and without frictions. In the presence of frictions, agency and bankruptcy costs cause a positive deadweight loss on the equity and the policyholder stakes of both companies, and the results for the stock insurer are based on the high risk investment strategy (σ_H).

tions. For comparison purposes, we have included a dashed line, representing the premium volume of the corresponding stock insurer. The previously described results for the parameter values of Table 1 are indicated by dotted lines. Figure 6(a) allows us to assess the discrepancy between Π^{Mf} and Π^{Sf} in terms of the extent to which mutual members participate in the firm's equity payoff. The lower γ , the less equity value is included in the mutual premiums. Due to the different agency costs, bankruptcy costs, and risk strategies, however, we have $\Pi^{Mf} > \Pi^{Sf}$ in any case, even when $\gamma = 0$. A similar relationship can be observed for the severity of the agency conflict between owners and managers of the mutual insurer as shown in Figure 6(b). In the hypothetical setting with $\alpha_M = \alpha_S$, Π^{Mf} still exceeds Π^{Sf} because of the companies' different risk strategies ($\sigma_L < \sigma_H$) and the fact that mutual members contribute MC_0^{Mf} to the firm's equity capital through their premiums ($\gamma > 0$). Furthermore, in Figure 6(c), we see a nonlinear decline of Π^{Mf} for an increasing σ_L .²⁴ At the point where $\sigma_L = \sigma_H$, equality of Π^{Mf} and Π^{Sf} is precluded by the fact that $\alpha_M > \alpha_S$ and $\gamma > 0$. Finally, Figure 6(d) is a plot of the premium volumes

²⁴Overall, the reduction appears relatively moderate, since only P_0^{Mf} actually falls in σ_L . The remaining three components of the mutual premium volume, i.e., BC_0^M , AC_0^M , and MC_0^{Mf} , grow with the firm's asset volatility.

against the paid-in equity capital, i.e., $EC_0^S(\sigma_H)$ and $EC_0^M(\sigma_L)$.²⁵ Here, we vary the initial asset value A_0 while holding L_0 constant. As could be expected, Π^{Mf} lies strictly above Π^{Sf} . Also, both curves are upward sloping and concave, meaning that, for larger amounts of equity, the policies grow more expensive.

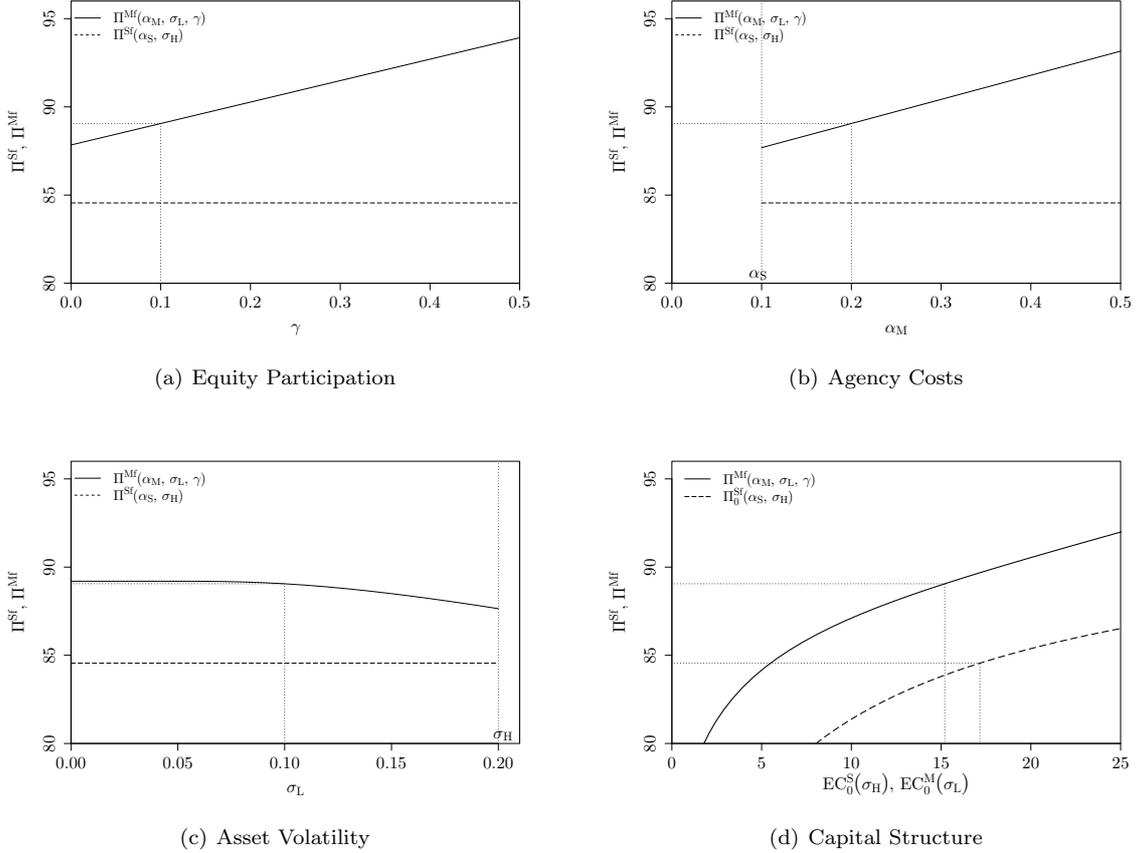


Figure 6: Determinants of the Difference in Premium Volumes

This figure shows the sensitivities of the mutual insurer's premium volume Π^{Mf} in the presence of frictions with regard to equity participation, agency costs, asset volatility, and capital structure. The corresponding revenues of the stock insurer Π^{Sf} are included as dashed lines for comparison purposes. Dotted lines indicate the values from Table 2 that arise for the original model configuration (Table 1). In accordance with their definition, the following restrictions have been imposed on the input parameters: $0 \leq \gamma \leq 1$, $\alpha_M \geq \alpha_S$, and $0 \leq \sigma_L \leq \sigma_H$. $EC_0^S(\sigma_H) = EC_0^{Sf} + AC_0^S$ and $EC_0^M(\sigma_L) = MC_0^{Mf} + FC_0^{Mf} + AC_0^M$ equal the paid-in equity capital at time $t = 0$ of the stock and the mutual insurer, respectively.

To sum up, our model framework suggests that the premiums of the mutual insurer should *ceteris paribus* be higher than those of the stock insurer, unless the following conditions are jointly fulfilled: the mutual's equity is entirely nonrealizable ($\gamma = 0$), the companies choose exactly the same asset risk ($\sigma_L = \sigma_H$), and each organizational form is equally successful at keeping the owner-manager conflict in

²⁵Recall from Figure 5 that the paid-in equity capital at time $t = 0$ equals $EC_0^S(\sigma_H) = EC_0^{Sf} + AC_0^S$ for the stock and $EC_0^M(\sigma_L) = MC_0^{Mf} + FC_0^{Mf} + AC_0^M$ for the mutual insurer.

check ($\alpha_M = \alpha_S$).²⁶ In reality, however, the degree of equity participation (γ) might be low but it will almost never be zero, since both the probability of liquidation (p_L) and the payout ratio (δ) should be strictly positive. Likewise, the actual number of investment choices for institutions is virtually infinite such that the stock insurer will always be able to implement a more risky investment strategy (σ_H) if it so desires. Finally, empirical studies have documented that mutual managers dispose of more leeway for the pursuit of their own interests (α_M) than their stock insurer counterparts (see, e.g., Mayers and Smith, 2005). In short, these variables seem to leave little room for an equality of premiums and safety levels. Hence, in the next section, we will exclusively focus on the role of the firms' equity capital.

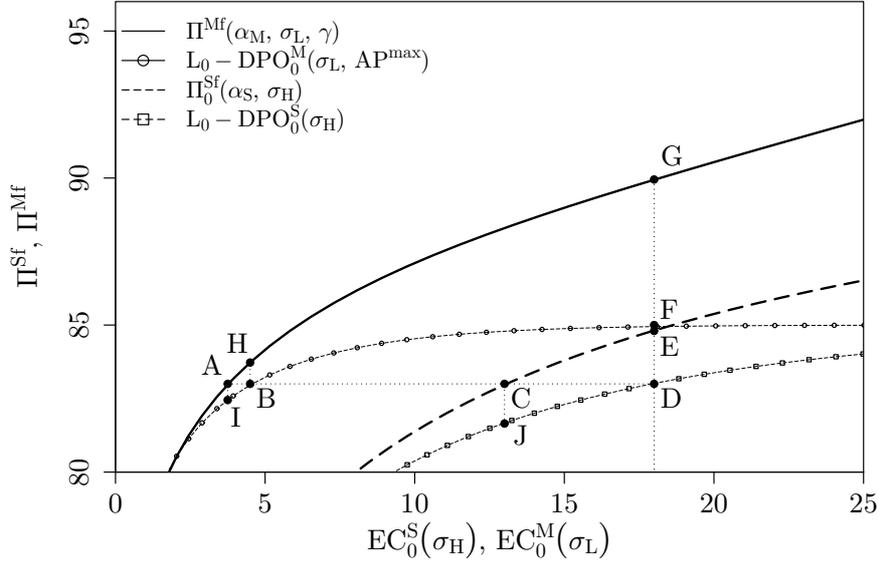


Figure 7: Comparison of Premium Revenue, Safety Level, and Equity Capital

This figure depicts feasible combinations of premium volume, equity capital, and safety level in the presence of frictions. $EC_0^S(\sigma_H) = EC_0^{Sf} + AC_0^S$ and $EC_0^M(\sigma_L) = MC_0^{Mf} + FC_0^{Mf} + AC_0^M$ equal the paid-in equity capital at time $t = 0$ of the stock and the mutual insurer, respectively. The curves $L_0 - DPO_0^S$ and $L_0 - DPO_0^M$ represent the firms' safety levels. Points A and C highlight a case in which the premiums of both organizational forms are equal. For the corresponding safety levels, refer to points I and J. Points B and D illustrate a mutual and a stock insurer with identical safety level. Their premiums are indicated by points H and E. Points D and F (safety levels) as well as points E and G (premiums) mark an example in which both firms exhibit the same amount of equity capital.

4.3 On the Relationships between Premiums, Safety Level, and Equity

In the following, we identify feasible combinations of the three central magnitudes premium size, safety level, and equity capital. Again, the calculations are based on the assumption of frictions and the parameter values shown in Table 1. The discussion will be centered around Figure 7, which offers a consolidated

²⁶Clearly, the latter two conditions hold in a frictionless market.

view of our main numerical results. By definition, all four curves begin at the origin. Let us first consider equity-premium-combinations for the mutual (solid curve) and the stock insurer (dashed curve).²⁷ As highlighted before, the solid curve lies strictly above the dashed curve. Hence, the mutual is only able to offer policies for the same premium as the stock company if it commands less initial equity. An example for this notion is indicated by points A and C. Conversely, if both organizational forms hold the same amount of equity capital, then the mutual members should be charged higher premiums than the policyholders of the stock insurer (compare points E and G). Furthermore, the safety levels are illustrated by two additional curves labeled $L_0 - DPO_0^M$ and $L_0 - DPO_0^S$. The higher the values on these curves, the lower the firms' risk of insolvency as measured by their default put options. By comparing points B and D, we find that the mutual insurer requires a smaller amount of paid-in equity capital to achieve the same safety level as the stock insurer. This is another way of saying that the mutual exhibits a higher safety level than an identically capitalized stock company (refer to points D and F). Each of these outcomes is independent of the chosen parameter values. Other configurations would simply change the magnitude but not the direction of the observed effects.

Finally, comparing points H and B with points E and D, we see that the mutual company is able to provide less expensive policies than the stock insurer with the same safety level. To put it differently, despite its smaller equity buffer, a mutual insurer exhibits a higher safety level than a stock insurer with an equal premium (consider points I and J). Based on the model sensitivities evaluated in the previous section as well as further unreported numerical results, it can be determined that this relationship does not hold for relatively large α_M , σ_L , γ , or a combination of them. Under those circumstances, the mutual premium exceeds the premium of the stock insurer with identical safety level. However, as the parameter values that lead to this scenario are not very realistic, we deem it to be a rather theoretical case. Table 3 summarizes the findings that have been derived in this section. Overall, there exists no amount of equity capital for which the two organizational forms should exhibit both the same safety levels and premiums.

5 Empirical Analysis

We now want to investigate whether observed market prices are consistent with the clear-cut conditions for the relationships between mutual and stock insurer premiums as derived in the previous section. To ensure comparability, the insurance product under consideration needs to be as homogeneous as possible. Therefore, our sample is based on annual accounting figures for the German motor vehicle liability insurance sector.²⁸ The data has been obtained from Hoppenstedt, a major provider of company information for a wide variety of industries of the German economy. To ensure consistency, we have carried out cross-checks with the annual reports of the respective insurers. The sample consists of 99 stock and 14 mutual insurers for which repeated observations over a differing number of time periods between 2000 and 2006

²⁷Note that, in the absence of frictions, the stock insurer premium converges toward the present value of the claims costs (L_0) as the amount of initial equity capital is raised. Owing to the embedded equity contribution of the members, however, there is no such asymptote for the mutual premium.

²⁸Specialty insurers have been excluded.

Equality of	Mutual Insurer	Stock Insurer	Example
Premium	less equity higher safety level*	more equity lower safety level*	A, C I, J
Safety Level	less equity lower premium*	more equity higher premium*	B, D H, E
Equity	higher premium higher safety level	lower premium lower safety level	E, G D, F

Table 3: Main Normative Results

This table summarizes the main normative results that have been derived based on the option-theoretic model framework, including the corresponding example points in Figure 7. Generally, both safety level and premium of an insurance company with a given amount of equity capital should be higher if it adopts the legal form of a mutual. The asterisk highlights those results that are theoretically dependent on the chosen input values.

are available. Hence, we are working with unbalanced panel data, covering 532 and 87 firm years for stock and mutual insurance companies, respectively. We approximate the price of insurance through the average annual gross premium ($AvPrem$), which is obtained by dividing the annual premium volume in the motor liability business line of each firm by the corresponding number of contracts.²⁹ Within the analysis, we control for various additional factors that are likely to influence premiums. The average annual loss ($AvLoss$), defined as the total losses in the motor insurance line divided by the number of contracts, is employed as a proxy for underwriting risk.³⁰ In a similar manner, the average annual costs of the motor liability business line ($AvCosts$) are employed to account for differences in the efficiency of the companies. Furthermore, we include the equity ratio (EqR), i.e., the book value of equity divided by the book value of the assets, and the log total premium volume of all lines in a given year (LTP) to control for capital structure and firm size effects. Table 4 contains some descriptive statistics on the panel dataset.

The Lagrange multiplier (pooling) test, conducted in line with Gouriéroux et al. (1982), suggests significant cross-sectional and time effects in our data (χ^2 statistic: 2,134.13, two degrees of freedom). In this case, the pooled ordinary least squares (OLS) estimator is known to be inefficient: it does not fully exploit the information inherent in panel datasets (see, e.g., Petersen, 2008). Instead, more sophisticated models are needed to make the most effective use of our data. Based on the Hausman test (see Hausman, 1978) with a χ^2 test statistic of 483.70 and four degrees of freedom, we reject the random effects (RE) model. A likely reason for this outcome are significant correlations between unit-specific components and regressors, implying an inconsistent RE (and pooled OLS) estimator. While a fixed effects (FE) model

²⁹An alternative measure for the insurance price is the economic premium ratio (EPR), which has been suggested by Winter (1994) and is frequently used in the literature. For a given business line of an insurer, the EPR is the ratio of premium revenues net of expenses and policyholder dividends relative to the estimated present value of losses (see Phillips et al., 2006). When considering insurance products that are less homogeneous than motor liability coverage in terms of the scope of benefits and the sums insured, the EPR will be more accurate compared to the average annual premium.

³⁰Ideally, one should additionally control for the line-specific volatility of losses, which, however, cannot be retrieved from public databases. Since the expected loss forms the major part of the premium in common insurance pricing principles and, for well-diversified insurance pools, differences in the standard deviations of the losses should be relatively moderate, we believe that an omission of the loss volatility does not have a critical impact on our results.

Panel A: Pooled Sample of Stock and Mutual Insurers							
	Abbreviation	Mean	Std. Dev.	Minimum	Maximum	Skewness	Kurtosis
Average Annual Premium	<i>AvPrem</i>	256.6744	57.8718	110.8053	577.1687	0.5238	5.5277
Average Annual Loss	<i>AvLoss</i>	225.6424	63.3354	54.6619	514.9426	0.7426	4.5793
Average Annual Costs	<i>AvCosts</i>	40.4934	23.1798	5.8454	287.5176	3.1525	26.7360
Equity Ratio	<i>EqR</i>	0.2244	0.1127	0.0387	0.7432	1.3999	5.5725
Log Total Premiums	<i>LTP</i>	19.0946	1.4775	13.4902	22.9681	-0.2079	2.8635
Panel B: Mutual Insurers							
	Abbreviation	Mean	Std. Dev.	Minimum	Maximum	Skewness	Kurtosis
Average Annual Premium	<i>AvPrem</i>	206.7204	40.2694	149.1075	327.2924	1.1263	3.9781
Average Annual Loss	<i>AvLoss</i>	180.2888	45.4460	110.6300	371.1519	2.4661	10.3262
Average Annual Costs	<i>AvCosts</i>	27.1455	13.3401	5.8454	53.9230	-0.0729	1.9150
Equity Ratio	<i>EqR</i>	0.2798	0.1253	0.1138	0.5804	0.8573	2.7524
Log Total Premiums	<i>LTP</i>	19.3349	1.2750	16.2262	21.1092	-0.7238	3.3359
Panel C: Stock Insurers							
	Abbreviation	Mean	Std. Dev.	Minimum	Maximum	Skewness	Kurtosis
Average Annual Premium	<i>AvPrem</i>	264.8436	56.2097	110.8053	577.1687	0.4961	6.3869
Average Annual Loss	<i>AvLoss</i>	233.0593	62.7851	54.6619	514.9426	0.6260	4.8106
Average Annual Costs	<i>AvCosts</i>	42.6762	23.7181	9.3966	287.5176	3.2660	26.9900
Equity Ratio	<i>EqR</i>	0.2154	0.1079	0.0387	0.7432	1.5321	6.5753
Log Total Premiums	<i>LTP</i>	19.0553	1.5054	13.4902	22.9681	-0.1359	2.8267

Table 4: Descriptive Statistics

Descriptive statistics for the variables that enter the empirical analysis. In Panel A, all available data has been pooled. Panels B and C refer to the subsamples of mutual and stock insurers. The currency is Euro. *AvPrem* = annual premium volume in the motor liability business line divided by the number of contracts, *AvLoss* = total losses in the motor liability line divided by the number of contracts, *AvCosts* = annual costs divided by the number of contracts, *EqR* = book value of equity divided by book value of assets, *LTP* = log total premium volume.

with unit-specific intercept terms could handle this sort of correlation, the so-called FE within estimator is based on a transformation of the regression equation into deviations from individual means and is thus incapable of capturing the impact of time-invariant variables (see, e.g., Greene, 2007). This is a serious issue since our analysis is focused on the legal form, which, if at all, changes very rarely over time. Therefore, we decide to apply the Hausman-Taylor estimator, an instrumental variables approach combining characteristics of FE and RE models (see Greene, 2007). It is capable of handling correlations between independent variables and unobserved unit-specific effects and enables us to estimate coefficients for time-invariant regressors. Consider the following linear regression equation:

$$AvPrem_{it} = \mu + \beta_1 AvLoss_{it} + \beta_2 AvCosts_{it} + \beta_3 EqR_{it} + \beta_4 LTP_{it} + \gamma_1 Stock_i + u_i + \epsilon_{it},$$

where μ is the intercept and $Stock_i$ is a time-invariant dummy variable reflecting the legal form of insurer i , which is set to one for stock and zero for mutual companies.³¹ The u_i are N (here: 113) unit-specific fixed effects, and ϵ_{it} represents the independent and identically distributed error terms. In order to estimate this model, Hausman and Taylor (1981) propose the following instruments: exogenous regressors, i.e., those explanatory variables that are uncorrelated with the unit-specific effects, are their own instruments, whereas endogenous time-varying and time-invariant regressors are instrumented by their own individual means (over time) and those of the exogenous time-varying regressors, respectively. Hence, the analysis requires at least as many exogenous time-varying as there are endogenous time-invariant regressors, i.e., one in our case. Based on a correlation test between the above explanatory variables and their unit-specific components from a fixed effects model, we identify EqR as exogenous.

Table 5 contains our estimation results.³² Apart from EqR , all time-varying regressors seem to be key determinants of the insurance premium. For the time-invariant variable $Stock$, in contrast, the Hausman-Taylor estimator does not indicate a significant impact on the average annual premium. To put it differently, we do not find evidence that mutuals charge more than stock insurers.

6 Selected Economic Implications

If there was full competition in insurance markets, identical contracts should carry the same price. However, our discussion regarding stock and mutual insurers highlighted that, irrespective of the covered risks, the policies offered by these two legal forms differ with regard to the associated rights and obligations as well as the impact of market frictions. Thus, one should expect competition to let prices converge to the presented theoretical levels. Nevertheless, the empirical analysis in the previous section suggests an equality of stock and mutual insurance premiums. Although our normative results do generally not exclude this possibility, in all reasonable cases, such an outcome would require the mutual to hold substantially less equity than the stock firm. This explanation is opposed by the fact that in most jurisdictions, sol-

³¹Note that we deliberately do not incorporate a separate dummy variable for the recovery option, as it has been shown to influence the company's safety level but not the premium size (see Section 4).

³²The heteroskedasticity and autocorrelation consistent (HAC) covariance matrices of Andrews (1991) as well as Driscoll and Kraay (1998) have been applied.

Hausman-Taylor Estimator	
Intercept	-213.4151*** (-2.6692)
<i>AvLoss</i>	0.3420*** (15.4295)
<i>AvCosts</i>	0.6053*** (7.3825)
<i>EqR</i>	20.0231 (1.0095)
<i>LTP</i>	19.2463*** (7.0319)
<i>Stock</i>	-3.9429 (-0.0470)

Table 5: Estimation Results

Coefficients and t-statistics (in parentheses) for the Hausman-Taylor estimator. The average annual premium (*AvPrem*) is regressed on the following set of explanatory variables: average annual losses (*AvLoss*), average annual costs (*AvCosts*), equity ratio (*EqR*), log total premium (*LTP*), and the time-invariant variable legal form (*Stock*). *** denotes statistical significance on the one percent confidence level.

vency regulation frameworks prescribe a minimum capital buffer for insurance companies, implying that mutuals will not be able to reduce their equity to an arbitrarily low level in order to the pricing of their competitors. Apart from that, within the empirical analysis, we explicitly controlled for capital structure effects as well as other relevant factors such as underwriting risk and administration costs. Thus, it seems that the empirically observed premiums are not compatible with full competition and policies offered by stock insurers are overpriced relative to policies of mutuals. This situation can only prevail due to factors that are exogenous to our model.

First of all, the observed deviation from the theoretical premium relationship could be caused by superior marketing and sales efforts of stock companies. Furthermore, differences could arise due to information asymmetries in insurance markets. If prospective customers are unaware of economic differences associated with the organizational form of insurance companies, they will be unable to identify differences in the present values of the policies. This may cause the observed violations of the normative conditions derived in Section 4. Yet, a long-term coexistence of mutual and stock insurers with identical prices calls for both of the following additional requirements to hold: (a) individuals' willingness to pay for insurance contracts is higher than or equal to the theoretical mutual premium and (b) the competitive pressure is not intensive enough to drive prices below the theoretical mutual premium.³³ Otherwise the mutual insurer would be driven out of the market.³⁴ Due to the fact that both legal forms have coexisted over an

³³Depending on the intensity of competition, companies may charge more than the theoretical levels. However, for the market to exist at all, premiums must not exceed the willingness to pay.

³⁴Note that, on the basis of a recovery option as well as reserves accumulated from past generations of members who overpaid for their policies without being granted any form of adequate compensation, mutual insurers may be able to temporarily operate with premiums below the competitive level.

extensive period of time, we conjecture that the described situation prevails in today's insurance industry. This implies that both organizational types actually charge premiums above the levels that would be observed in a fully competitive market. Hence they may earn economic rents that lead to a transfer of wealth between stakeholder groups. Evidently, through dividends and share price increases, the stock insurer's shareholders benefit from a situation where policyholders overpay for their contracts. A similar wealth transfer can be expected between different member generations of a mutual insurer that accumulates capital reserves from its earnings. Notwithstanding improvements in the firm's default probability, this should be most advantageous for those members who eventually participate in the liquidation or demutualization of the firm.

7 Conclusion

In this paper, we contribute to the literature by developing a normative theory of the relationship between stock and mutual insurance premiums based on a contingent claims framework. To consistently price policies provided by firms in these two legal forms, we extend the work of Doherty and Garven (1986) to the mutual case, thus ensuring that the formulae for the stock insurer are nested in our more general model. This set-up allows us to separately consider the ownership and policyholder stakes included in the mutual insurance premium and explicitly takes into account recovery options, restrictions on the ability of members to realize the value of their equity stake, as well as relevant market frictions. Based on a numerical implementation of our model, we are able to show that, for the premiums of stock and mutual insurers to be equal, the latter would need to hold comparatively less equity capital. We then evaluate panel data for the German motor liability insurance sector and demonstrate that observed premiums are not consistent with our normative findings. The combination of theory and empirical evidence is not compatible with full competition in insurance markets and suggests that policies offered by stock insurers are overpriced relative to policies of mutuals. Consequently, we suspect considerable wealth transfers between the stakeholder groups.

A more detailed identification of the size and direction of these wealth transfers could be an interesting avenue for future research. Since such an analysis would need to be based on a separate consideration of the different stakes, our contingent claims model is well suited for an application in this context. On the empirical side, however, more comprehensive insurance company data would be required. With the latter at hand, one could also conceive of extending our analysis beyond a single line of business in order to gather an even broader understanding of agency cost differences between the two legal forms. Another interesting research question centers around the coexistence of stock and mutual insurance companies. Our normative framework could be a starting point for a further consideration of this topic. As previously discussed, rational individuals would not be willing to pay for the nonrealizable component of the equity stake. Hence, we suggested that mutual insurers can only come into existence if their initial members are compensated accordingly (e.g., by future member generations) or if a third party acts as founding capital provider. Since both cases are rarely observed in practice, it would be interesting to further explore why mutuals actually coexist with stock companies.

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