

THE ORGANIZATIONAL STRUCTURE OF INSURANCE COMPANIES: THE ROLE OF HETEROGENEOUS RISKS AND GUARANTY FUNDS

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ABSTRACT

We examine a market with observably heterogeneous risks and a government sponsored guaranty fund and consider whether it is optimal to form a single insurer or separate insurers for each consumer type. Given the economic environment, pooling never dominates the formation of separate insurance companies. This result provides an incentive for the phenomenon of insurance fleets.

One of the peculiarities of organizational form within the insurance industry is the presence of a large number of separate insurance companies within a single overarching parent organization. These groups or fleets, as they are known within the industry, would appear to offer less protection against insolvency risk than a single multiline insurance company, since, of necessity, they would have a smaller pool of equity capital in each company than a combined enterprise. The grouping phenomenon is quite strong in the property-liability industry. Cummins and Weiss (1991, p. 122) note that although there were approximately 3,000 property-liability insurance companies in the United States as of 1989, "only 1900 firms play a significant role in the market and 1300 of these are clustered together in approximately 340 insurance groups under common ownership."

Vaughan (1997, p. 226) notes that insurance company groups originally developed in response to legal constraints. For example, fire companies were forbidden to write casualty coverage and vice versa. A natural response to this legal constraint was to form separate companies for each type of coverage and operate them in tandem. However, he also notes that this reason for the fleet form of organization no longer

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exists as the legal constraints to multiline operation have, in general, been removed. This is the only explanation for the existence of the fleet phenomena that we have found in insurance texts or the academic or industry literatures. By itself, it would suggest that fleets continue to exist because of inertia. Given that the group structure would be expected to involve higher legal and administrative costs, it seems unlikely that inertia can explain the continued existence of the fleet form of organization. It must be the case that the group form of organization provides some advantage over a larger multiline firm, at least for some members of the industry.

We provide a model explaining the advantage of the fleet organizational structure based upon the heterogeneity of consumer risk types and the presence of guaranty funds. We assume that there are two distinguishable groups of policyholders with different risk characteristics. These can be interpreted as high and low risks in a given line of insurance (e.g., normal vs. assigned risks in automobile insurance). These can also be interpreted as homogeneous risks in two different lines of insurance. We also assume there is a government sponsored guaranty fund that pays all claims in the event of insurer insolvency and charges a non-risk-adjusted assessment based on premium volume. Using a contingent claims framework, we address the question of whether it is optimal to serve the two groups of policyholders with a single, pooled stock insurance company or with two separate stock insurance companies.¹

In the absence of a guaranty fund, the potential benefit of pooling the two groups is that it improves the subdivision of risks thereby decreasing the probability of ruin. The potential cost is that the different risks imply different default probabilities, so that there is potential cross-subsidization between risk types. In the presence of a guaranty fund charging non-risk-based premiums, the probability of ruin and cross-subsidization are not an issue since benefits are guaranteed and the cost of the insurance is not sensitive to risk. This causes organizational form to affect shareholder wealth. Specifically, when insurance guaranty fund premiums are not risk based, a fleet form of organization benefits shareholders at the expense of the fund because it increases the combined value of the insolvency puts of the fleet, compared to an equivalent multiline company, without a corresponding increase in the guaranty fund premium. In a multiline company, the option to default must be exercised on all lines simultaneously. In the fleet form of organization, the option to default can be exercised separately for each line (company); the right to exercise the options separately is valuable. Essentially, the fleet organization increases the number of states of the world when the group can draw upon guaranty fund coverage without increasing the premium cost of that coverage.

The idea that the presence of guaranty funds may affect the risk-taking incentives of the insurance firm is clearly not a new one. Cummins (1988) advocated risk-based premiums for such funds for precisely this reason. Han, Lai, and Witt (1997) analyze the guaranty fund system from an agency cost perspective. Lee, Mayers, and Smith

¹ Merton (1975) first expressed the cost of deposit insurance in a contingent claims framework. Cummins and Sommer (1996), Cummins and Danzon (1997), and Phillips, Cummins, and Allen (1998) are recent examples of the application of contingent claims analysis in insurance. See Garven (1992) and D'Arcy and Doherty (1988, chapter 6), for general discussions of the application of contingent claims analysis to stock insurance companies.

(1997) provide evidence that the riskiness of stock insurers' asset portfolios increased following the adoption of guaranty funds. Lee and Smith (1999) provide evidence that a decrease in insurer reserves followed the adoption of guaranty funds. A substantial literature exists analyzing the impact of deposit insurance on banking firms, where the moral hazard issues are similar. Our results also have implications for the general literature on corporate financial organization in cases where conditions are similar. An example would be when a particular line of business is subject to litigation or other risks that have a substantial probability of leading to bankruptcy. This situation is examined in MacMinn and Brockett (1995). They analyze a company that divides its assets between two separate entities, segregating its liabilities in one of them. They show that this restructuring increases the value of the insolvency put, resulting in a transfer of wealth from liability holders to shareholders. If the value of the claims against that line of business does not depend on the organizational form, then the parent company may benefit from establishing separate subsidiaries for its risky and safe lines of business.

Although our results flow in a straightforward manner from the contingent claims analysis, this is to our knowledge the first study that suggests that the presence of a guaranty fund charging non-risk-adjusted premiums can explain the persistence of the insurance fleet organizational structure so prevalent in the property-liability insurance industry. We do not claim that non-risk-based guarantee fund premiums are the only, or even the dominant, force leading to insurance fleets. We do claim that it creates an economic incentive for the fleet form of organization.² Given the unusual nature of this organizational form and its prevalence in the industry, the current absence of an explanation for it in the literature is striking. While our explanation clearly may not be the final word on the issue, we present a theoretically sound and intuitive explanation for the persistence of the fleet phenomena that make more economic sense than inertia.

The article is organized as follows: The next section sets out the description of the economic environment. The section "The Problems With Pooling" analyzes the decision to form a single, pooled company or separate companies for both the stock and mutual insurance cases. The penultimate section discusses possible generalizations of the results. The last section summarizes and concludes.

THE ECONOMIC ENVIRONMENT

We carry out the analysis in a single period setting. Insurance contracts are designed and purchased and all investments are made at the beginning of the period, time 0. At the end of the period, time 1, losses are incurred and the assets of the insurer are distributed to the stakeholders. We assume that there are no stakeholders other than policyholders, shareholders, and the guaranty fund. Our objective is to examine the effect of consumer heterogeneity in the presence of guaranty funds on the choice of organizational structure. Consequently, to isolate this effect and abstract from the

² For example, legal and regulatory factors can influence the formation of insurance fleets. Companies may form subsidiaries in response to regulatory restrictions in some states (e.g., New York). As Pat Brockett has pointed out to us, regulation appears to be the driving force in the creation of subsidiaries in Texas; for example, State Farm Lloyds, State Farm Mutual and State Farm Property and Casualty face different regulatory constraints.

investment incentive problem, we assume both policyholders and insurance companies invest their beginning of period proceeds in a risk-free asset offering rate of return r .

We assume there are two types of insurance consumers, both with initial wealth W_0 . For simplicity, we assume that policyholders differ only with respect to the probability that a loss occurs, and that the loss severity is x . The loss probabilities are ρ_A or ρ_B , with $1 > \rho_B > \rho_A > 0$. There are N_B type B and N_A type A consumers, and we let $n_B = N_B/N$ and $n_A = N_A/N$, where $N = N_B + N_A$. We assume the loss amount and loss probabilities are fixed and are common knowledge. Moreover, we assume that each consumer's type is common knowledge. Thus, the problem is not one of asymmetric information. We place no restrictions upon the relative magnitude of W_0 and x . We have framed the problem as one of different risk types. Our analysis applies equally well to heterogeneity within a given line of insurance or to different lines of insurance.³

We assume there is a government sponsored guaranty fund that pays policyholder claims in the event of insurer insolvencies. We assume that these funds are financed by assessments against insurers based upon the insurers' premium volume (i.e., the guaranty fund assessment is $\lambda\Pi$ where λ is a constant between zero and one and Π is the insurer's actual premium income). The assessments may be either *ex ante* or *ex post*; in virtually all jurisdictions funds are financed with *ex post* assessments against solvent insurers. We assume that the coverage provided by this fund is complete and that its assets are always sufficient to cover claims from the policyholders of insolvent insurers (perhaps because of a government guaranty).⁴

We assume insurance firms are organized as stock companies. The inability to trade mutual equity makes application of contingent claims analysis to mutuals problematic.⁵ We assume the insurer has no fixed charges, such as selling expenses, administrative expenses, or taxes and that capital markets are frictionless. Under these assumptions, the pure premium for a type i insured is $\pi_i = \rho_i x / (1 + r)$.

The insurance firm has end-of-period assets A , which are to be distributed among the stakeholders; A is equal to $(1 + r)$ times premium revenues plus equity. We have $A \equiv \min\{A, L\} + \max\{A - L, 0\}$, where L is aggregate losses for the firm at the end of the period.⁶ Then $\max\{A - L, 0\}$ is the terminal payoff to equityholders, while $\min\{A, L\} \equiv L - \max\{L - A, 0\}$ is the terminal payoff to policyholders. We presume in accordance with standard legal practice that policyholders with claims are

³ Phillips, Cummins, and Allen (1998) consider the role of default risk in pricing for multiple line stock insurers. However, the focus of their paper is different.

⁴ We recognize that our assumptions depart from the actual structure of guaranty funds in the United States. First, actual guaranty fund coverage is limited. All states place maximum limits on recovery (usually \$300,000). Coverage for some lines of insurance is excluded entirely. Delays in claim payments may be likely and loss adjustments stricter when dealing with a fund than with an insurer, which has the reputation capital of a continuing franchise at stake. We discuss below the implications of these disparities between our assumptions and current American practice.

⁵ Ligon and Thistle (2005) provide an explanation for the choice between stock and mutual organizational forms that is based on unobservable heterogeneity.

⁶ More generally, L is the realized aggregate indemnity. We discuss this point in more detail below.

regarded as creditors of the insurance firm and, in the event of insolvency, are entitled to satisfaction to the extent of the firm's assets. Equityholders participate in the firm's assets only after satisfaction of the firm's creditors, which given our assumptions will be policyholders with losses. We do not consider *ab initio* the optimality of such legal arrangements.

We assume there are no arbitrage opportunities (other than in transactions with the government) and let V denote the resulting valuation operator. Formally, we have an economy where there are 2^N states of the world defined by which insureds incur losses. Then, no arbitrage opportunities is equivalent to the existence of the valuation operator, which is linear in the risk neutral probabilities over the states of the world. Given this environment it is possible to envision trading in state-contingent claims defined over these states. It is beyond the scope of this study to consider why such direct securitization of risks has not arisen or its optimality versus existing insurance arrangements. We assume that the government has the power to misprice (i.e., create and maintain arbitrage opportunities in favor of or against itself).

The value of equity is

$$C(A, L) = V(\max\{A - L, 0\}), \quad (1)$$

where $C(A, L)$ is the price of a European call option on assets A with exercise price L . Similarly, in the absence of the guaranty fund, the value of policyholders' position is equivalent to the value of losses less the value of a European put on assets A with exercise price L (the insolvency put):

$$V(L - \max\{L - A, 0\}) = V(L) - I(A, L). \quad (2)$$

As indicated in (2), the absence of arbitrage opportunities implies that the policyholders will reduce the premium that they will pay for a promised indemnity of $V(L)$. The consequence is that the value of the insolvency put, $I(A, L)$, is borne *ex ante* by the shareholders. The value of the insurance company is then

$$V(A) = V(L) - I(A, L) + C(A, L). \quad (3)$$

In contrast to many analyses of contingent claims, the terminal value of the exercise price is stochastic.⁷ The put-call parity relationship is

$$C(A, L) - I(A, L) = V(A) - V(L). \quad (4)$$

In our analysis, $V(A)$ is equal to the pure premium plus the initial equity, so that $C(A, L) - I(A, L) = V(E)$.

In the presence of the guaranty fund, the insurer pays an assessment that is proportional to the premiums charged, which is in turn proportional to expected losses. Applying the valuation operator to the assessment, the value of the assessment is $G(L)$. The value of the insurance firm then becomes

⁷ See Fisher (1978) for a discussion of options with stochastic exercise prices.

$$V(A) = V(L) + C(A, L) - G(L). \quad (5)$$

Note that $G(L)$ may be greater than $I(A, L)$ for some insurers and less for others.

THE PROBLEMS WITH POOLING

In this section, we show that, in the presence of the guaranty fund, the provision of insurance to heterogeneous groups by separate firms weakly dominates provision by a single firm. If the insurer serves both type A and type B policyholders, the value of the firm is

$$V(A_p) = V(L_p) - G(L_p) + C(A_p, L_p), \quad (6)$$

where $A_p = (1 + r)(N_A\pi_A + N_B\pi_B + E_p)$ is the firm's total end-of-period assets and $L_p = L_A + L_B$. If insurance is provided by separate insurers, then

$$V(A_i) = V(L_i) - G(L_i) + C(A_i, L_i), \quad i = A, B, \quad (7)$$

where, at time 1, $A_i = (1 + r)(N_i\pi_i + E_i)$.⁸ Here the subscripts indicate company A, which serves type A policyholders, and company B, which serves type B policyholders. For a given total initial equity contribution E_p allocated to each of the separate companies, the shareholders objective is to maximize the value of their position. The value of the shareholders position is $C(A_p, L_p) - G(L_p)$ in a pooled company, and $C(A_A, L_A) + C(A_B, L_B) - G(L_A) - G(L_B)$ in separate companies. However,

$$C(A_A, L_A) + C(A_B, L_B) \geq C(A_A + A_B, L_A + L_B) = C(A_p, L_p); \quad (8)$$

since a portfolio of options is worth at least as much as a simultaneously maturing option on a portfolio.⁹ If the company A and company B risk pools are identical then (8) holds as equality. Heterogeneity in the risk pools of company A and company B is necessary for the inequality to be strict. In general, the difference between left-hand side of (8) and right-hand side of (8) will be increasing in the difference of the variances of the two risk pools. Now, since

$$G(L_A) + G(L_B) = G(L_A + L_B) \quad (9)$$

and

$$V(L_A) + V(L_B) = V(L_A + L_B), \quad (10)$$

relations (8), (9), and (10) imply that for any given contribution of equity, shareholders are at least as well off if policyholders are served by separate firms and policyholders are no worse off. The result follows from the fact that the insurance guaranty

⁸ An insurance company acquires part of its assets $((1 + r)N_i\pi_i)$ and liabilities (L_i) from the same transaction. Thus, the insurance company cannot easily isolate all of its liabilities in one subsidiary (nor does it seem likely that regulators would allow this).

⁹ See, for example, Ingersoll (1987, Proposition 12, p. 302).

fund premiums are insensitive to the choice of organizational form. The fleet form of organization is strictly preferred to the multiline company if inequality (8) is strict.

In the absence of guaranty funds,

$$I(A_A, L_A) + I(A_B, L_B) \geq I(A_A + A_B, L_A + L_B) = I(A_p, L_p), \quad (11)$$

where, again, heterogeneity in the risk pools is necessary for the inequality to be strict.¹⁰ Any advantage to the shareholders from separate firms is dissipated through the increase in agency costs represented in the insolvency put. In the presence of guaranty funds, the government bears this increased agency cost and, thus, separation of risks in separate firms is never dominated by serving the heterogeneous risks through a single firm.

DISCUSSION

The objective of this article is to examine the effect of policyholders' risk characteristics on the organizational structure of insurance companies. Strong conclusions usually rest on strong assumptions, and we have made a number of strong assumptions in the analysis here. However, it is our view that the strong conclusions are robust and hold under much weaker assumptions. A key set of assumptions regards the operation of financial markets. We assume that there is a no arbitrage pricing rule with a corresponding linear valuation operator and that put-call parity holds. We also make use of a number of other standard properties of contingent claim prices. These are standard assumptions and results, and hold in fairly general settings.¹¹

We have assumed that guaranty fund coverage is complete. When guaranty fund coverage is incomplete the premium revenue of the firm adjusts to partially reflect the value of the insolvency put. A number of studies confirm a negative relation between measures of insurance prices and firm riskiness (Sommer, 1996; Cummins and Danzon, 1997; Phillips, Cummins, and Allen, 1998). As suggested by Cummins and Sommer (1996) and Sommer (1996) the premiums, or value of insurance, may be expressed as $V(L) - \theta I(A, L)$ where $0 \leq \theta \leq 1$. Theta represents the portion of the insolvency put borne by policyholders *ex post*. In the absence of guaranty fund coverage, $\theta = 1$. If there are no arbitrage opportunities and if $\theta = 1$, the cost of the full insolvency put is borne *ex ante* by the shareholders and our results regarding organizational form provided in the section "The Problems With Pooling" no longer hold. Any changes in organizational form that increase $C(A, L)$ increase $I(A, L)$ by an equivalent amount. Our assumption is that $\theta = 0$, where the potential benefit to shareholders from government mispricing of the put is greatest. However, so long as $\theta < 1$ shareholders with an opportunity to transfer a portion of the cost of the insolvency

¹⁰ This can be regarded as a generalization of the model in MacMinn and Brockett (1995). They assume (in our notation) that $L_B = 0$. This implies the second insolvency put has zero value, $I(A_B, 0) = 0$. They then show that $I(A_A, L_A) \geq I(A_A + A_B, L_A)$, that is, the lower the value of the underlying asset, the higher the value of the put.

¹¹ See Ingersoll (1987) for a convenient summary of contingent claims pricing in finite economies, Stapleton and Subrahmanyam (1984) on discrete time, and Merton (1990) on continuous time models.

put to the government at a favorable price can benefit from the fleet organizational form.

We allow for either *ex ante* or *ex post* assessment of guaranty fund premiums. *Ex ante* premiums give shareholders less incentive for risk-taking behavior than the actual *ex post* assessment scheme observed most frequently in practice. In the case of the latter, only insurers who survive pay the cost of the scheme, so the share of the cost paid by safer insurers is more highly disproportionate than in an *ex ante* assessment (Han, Lai, and Witt, 1997). Also, in practice, a portion of the cost of the guaranty fund assessment may be transferred to taxpayers through premium tax offsets or to future policyholders through policyholder surcharges, further exacerbating the incentives for risk-increasing behavior. Our assumptions do not allow such cost transfers.

We have assumed all economic agents invest in a risk-free asset. As we pointed out, our motivation was to abstract from the investment incentive problem. Assuming all economic agents invest in the same risky asset has no effect on our results. Moreover, the analysis can easily be extended to account for the investment incentive problem. Allowing the value of the insolvency put to change as the result of different investment decisions has no effect on our results.

We assume that there are no policy expenses, wage expenses, or taxes. Employees and governments have priority over policyholders and shareholders in the event of insolvency so that employees and governments have call options on the firm's assets. This also implies that an insurance policy has the characteristics of subordinated debt, and equityholders own a complex option (a call option on a call option).¹² Subtracting the value of the employees' and governments' call options from the value of assets, and reinterpreting the policyholders' and equityholders' options, again our results continue to hold.

We assume that each individual has a two-point loss distribution, and that the two types differ only with respect to the probability of loss. Since the policyholder views the policy as riskless it is viewed as fairly priced and, hence, all policies are for nominal full coverage. The appropriate interpretation of $V(L)$ is as the value of the indemnity, and the key characteristic of the two types of insureds is that they differ with respect to the pure premium and the value of the indemnity. So long as this is true, our results continue to hold under much more general assumptions on the distributions of losses and the indemnity function. We assume that loss distributions are fixed, so there are no issues of incentives to take care.

We assume that there are no sunk "setup" costs to establishing an insurance company. Our results continue to hold if equity is interpreted as equity net of these setup costs. If it costs more to establish two firms than one firm, then there is a countervailing advantage to forming a single, pooled insurance company. To the extent that setup costs represent central administrative overhead, it may be possible to economize on these costs while maintaining effectively separate firms for the two types of policyholders by organizing the firms into groups. Phillips, Cummins, and Allen (1998) reach a similar conclusion.

¹² See Black and Cox (1976) on subordinated debt and Geske (1979) on complex options in continuous time.

One of the empirical implications of the model is that the value of a group form of organization is increasing in the heterogeneity of risks underwritten by the insurer. We note that ordinary life, term life, and universal life insurance policies are generally underwritten by a multiline life insurance company. The risks underlying these policies are not radically different. The grouping phenomenon is much stronger in the property–liability industry where homeowners, automobile, general liability, and medical malpractice, for example, have significantly different risk characteristics. More generally, greater average risk heterogeneity within a firm increases the benefit of a subsidiary form of organization relative to a division form of organization. Thus, if firms are in some fashion insulated from the cost of the subsidiary form of organization (i.e., the change to the subsidiary form does not increase the value of the insolvency put), then we would expect risk heterogeneity to increase the probability of subsidiary formation and have a positive coefficient in a regression on organizational form.

An additional empirical implication is that the risk of bankruptcy must be economically significant for there to be any interest in grouping and that there must be something that mitigates the increase in the value of the insolvency put to make grouping benefit shareholders. These implications are of interest beyond the insurance industry. Any firm that is exposed to substantial liability risk in a subset of its business lines may gain from adopting a parent–subsidiary (i.e., group) form of organization. The claim against the subsidiary of the persons harmed makes them like debtholders. However, the value of their claim depends upon their legally determined loss and does not depend on the organizational form of the parent–subsidiary organization. So long as the claimants are not permitted to “pierce the corporate veil,” the grouping phenomenon benefits the parent company shareholders at the expense of the legal claimants since, in the event claims exceed assets of the subsidiary, it declares bankruptcy and the assets of the parent’s other subsidiaries are unaffected (MacMinn and Brockett, 1995). It is interesting that major tobacco companies have adopted just this form of organization. For example, Philip Morris USA is a subsidiary, not a division, of Altria. Nondomestic tobacco operations and Altria’s food and beverage operations are separate subsidiaries, not corporate divisions. Thus, like most property–liability insurers, Altria has a fleet form of organization. We would, in general, expect to find the parent–subsidiary form of organization prevalent in firms with substantial litigation risk in a subset of the firm’s business segments and divisional organizations under a single corporate entity in firms where such risks are not present. Thus, we would expect the coefficient on liability risk to be positive in a probit regression on organizational form.

Note, that in the case of traditional debt, grouping would not benefit shareholders because debtholders would recognize the risk to their interests that grouping represents and reduce what they would pay for the firm’s debt. This agency cost of debt reduces shareholder value and would mitigate any gain from grouping. Thus, firms using the group form of organization would be expected to have higher costs of traditional debt and, hence, may use relatively less leverage than comparable multiline firms. Also, traditional debtholders generally have little protection in the event of mergers and acquisitions. Thus, another potential empirical implication of the model is that we would expect target firms to be maintained as separate corporate organizations in mergers and acquisitions until the debt of the target that existed on the merger date is retired.

CONCLUSION

In this article we have shown that in the presence of guaranty funds that charge a non-risk-adjusted premium-based assessment, the riskiness of the policyholder loss distribution affects insurance company organizational structure. Heterogeneity in consumer riskiness creates incentives for a separate insurance firm for each consumer type. The result follows because forming separate firms maximizes the benefit to shareholders of the mispriced guaranty fund insurance. The results suggest that mispriced guaranty fund assessments may create incentives not only for riskier asset portfolios or riskier reserving practices, as has been previously suggested, but may also influence insurance company organizational form. The results provide a possible explanation for the empirical phenomenon of property-liability insurance fleets, which feature separate companies under a common ownership.

REFERENCES

- Black, F., and J. C. Cox, 1976, Valuing Corporate Securities: Some Effects of Bond Indenture Provisions, *Journal of Finance*, 31: 351-368.
- Cummins, J. D., 1988, Risk-Based Premiums for Insurance Guarantee Funds, *Journal of Finance*, 43: 823-839.
- Cummins, J. D., and P. M. Danzon, 1997, Price, Financial Quality, and Capital Flows in Insurance Markets, *Journal of Financial Intermediation*, 6: 3-38.
- Cummins, J. D., and D. W. Sommer, 1996, Capital and Risk in Property-Liability Insurance Markets, *Journal of Banking and Finance*, 20: 1069-1092.
- Cummins, J. D., and M. A. Weiss, 1991, The Structure, Conduct, and Regulation of the Property-Liability Insurance Industry, in: R. W. Kopcke and R. E. Randall, eds., *The Financial Condition and Regulation of Insurance Companies* (Boston: Federal Reserve Bank of Boston).
- D'Arcy, S. P., and N. A. Doherty, 1988, *The Financial Pricing of Property-Liability Insurance Contracts*, Huebner Foundation Monograph 15 (Homewood, IL: Richard D. Irwin).
- Fisher, S., 1978, Call Option Pricing When the Exercise Price Is Uncertain, and the Pricing of Indexed Bonds, *Journal of Finance*, 33: 169-176.
- Garven, J. R., 1992, An Exposition of the Implications of Limited Liability and Asymmetric Taxes for Property-Liability Insurance, *Journal of Risk and Insurance*, 59: 34-56.
- Geske, R., 1979, The Valuation of Compound Options, *Journal of Financial Economics*, 7: 63-81.
- Han, L.-M., G. C. Lai, and R. C. Witt, 1997, A Financial-Economic Evaluation of Insurance Guaranty Fund System: An Agency Cost Perspective, *Journal of Banking and Finance*, 21: 1107-1129.
- Ingersoll, J. E., Jr., 1987, *Theory of Financial Decision Making* (Savage, MD: Rowman and Littlefield).
- Lee, S.-J., D. Mayers, and C. W. Smith, Jr., 1997, Guaranty Funds and Risk-Taking: Evidence from the Insurance Industry, *Journal of Financial Economics*, 44: 3-24.

- Lee, S.-J., and M. L. Smith, 1999, Property-Casualty Insurance Guaranty Funds and Insurer Vulnerability to Misfortune, *Journal of Banking and Finance*, 23: 1437-1456.
- Ligon, J. A., and P. D. Thistle, 2005, The Formation of Mutual Insurers in Markets with Adverse Selection, *Journal of Business*, 78: 529-555.
- MacMinn, R. D., and P. L. Brockett, 1995, Corporate Spin-Offs as a Value Enhancing Technique When Faced with Legal Liability, *Insurance: Mathematics and Economics*, 16: 63-68.
- Merton, R. C., 1977, An Analytic Derivation of the Cost of Deposit Insurance and Loan Guarantees, *Journal of Banking and Finance*, 1: 3-11.
- Merton, R. C., 1990, *Continuous Time Finance* (Cambridge, MA: Basil Blackwell).
- Phillips, R. D., J. D. Cummins, and F. Allen, 1998, Financial Pricing of Insurance in the Multiple-Line Insurance Company, *Journal of Risk and Insurance*, 65: 597-636.
- Sommer, D. W., 1996, The Impact of Firm Risk on Property-Liability Insurance Prices, *Journal of Risk and Insurance*, 63: 501-514.
- Stapleton, R. C., and M. G. Subrahmanyam, 1984, The Valuation of Multivariate Contingent Claims in Discrete Time Models, *Journal of Finance*, 39: 207-228.
- Vaughan, E. J., 1997, *Risk Management* (New York: John Wiley & Sons).

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