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Incentive Contracting and the Role of Participation Rights in Stock Insurers

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ABSTRACT

Corporate limited liability creates incentives for owners to shift risks onto creditors by substituting high-risk assets for low-risk assets because it rewards owners with the benefits of risky activities while penalizing them with only a portion of the costs. However, since rational creditors understand these incentives, the ensuing agency cost is borne *ex ante* by owners, unless they can credibly precommit themselves not to shift risk onto creditors. This article considers one specific contractual arrangement that helps resolve the risk shifting problem in stock insurers: the inclusion of participation rights in insurance policies. We assume that the insurer chooses between two mutually exclusive investment portfolios, where the riskier portfolio is a mean preserving spread of the less risky portfolio. The primary purpose of this analysis is to demonstrate that participating insurance policies resolve the risk shifting problem for stock insurers. We also present empirical evidence on policyholder participation that is consistent with our theory.

Introduction

Corporate limited liability creates a moral hazard by generating a payoff structure that rewards owners with the benefits of risky activities while penalizing them with only a portion of the costs. An important consequence of this asymmetric payoff is that incentives are created for the firm to shift risks onto creditors by substituting high-risk assets for low-risk assets. Because the risk shifting problem raises the cost of new capital provided by creditors, corporate owners have incentives to create contractual arrangements that mitigate this problem.

The risk shifting problem is one of several classic agency problems in the corporate finance literature. The problem is one in which the firm's managers,

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acting on behalf of shareholders, have an incentive to substitute a riskier asset for a less risky one once the firm becomes sufficiently indebted. However, Jensen and Meckling (1976) showed that the ensuing agency cost is borne *ex ante* by shareholders, because rational creditors understand the incentives that firm managers face and price their claims accordingly. Green (1984) and MacMinn (1993) show that convertible debt can eliminate the risk shifting problem.

This article considers one specific contractual arrangement that helps resolve insurers' risk shifting problem: the inclusion of participation rights in insurance policies. We define participation rights as any contractual claim on the firm's residual cash flows.[1] Since mutual policyholders are both owners and creditors, the mutual ownership structure represents one possible solution to the risk shifting problem insurers face. Furthermore, since the owners/policyholders of a mutual insurer are also its residual claimants, the mutual ownership structure can be interpreted as a participating insurance contract (see Smith and Stutzer, 1990). Therefore, the policyholders of a mutual insurer have participation rights as owners, *regardless* of whether the mutual firm issues "participating" insurance policies. However, since the owner and creditor functions for the stock insurer are separate rather than merged, shareholders can have an incentive to shift risk onto the policyholders after the policy is issued. By issuing participation rights to policyholders, stock insurers partially merge the role of owner and creditor and thereby are able to resolve this risk shifting problem.

Mayers and Smith (1981) analyze incentive conflicts between shareholders and policyholders and formulate a number of hypotheses concerning the role that organizational form plays in controlling these conflicts. They note that, in an unregulated insurance market, shareholders will rationally impose contractual limitations upon their dividend and investment policies. Mayers and Smith speculate that "an alternative way to control the policyholder/shareholder conflict is to issue participating policies" (p. 426). Our model provides formal analytic support for their conjecture.

More recently, Doherty (1991) considers participating policies as a contractual innovation that facilitates efficient sharing of undiversifiable risk associated with unstable liability rules. Gollier and Wibaut (1992) show that participating policies lead to optimal risk sharing for mutual insurers. Babbel and Hogan (1992) analyze incentive conflicts and asset portfolio choice in a stochastic dominance framework. They assume that the firm may choose between two

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[1] An insurance policy that includes participation rights is referred to as a "participating policy." Essentially, participating policies enable policyholders to participate in the profits of the firm via dividend payments. In life insurance, dividends are typically paid out of one or more of the following three sources: favorable mortality experience, excess interest earnings on the assets required to maintain legal reserves, and lower than expected operating expenses. Participating policies are less common in property-liability insurance markets, but they do exist. Furthermore, alternative contractual designs such as retrospectively rated policies are in essence participating policies (see Doherty, 1991).

mutually exclusive investment portfolios, where one portfolio is a mean preserving spread of the other. Furthermore, they assume that the firm is sufficiently leveraged (i.e., expected claims costs are high enough relative to the expected payoffs on the investment portfolios) so that a risk shifting problem occurs.

In the model presented here, we similarly assume that expected claims costs are sufficiently high relative to equity so as to create a risk shifting problem. However, Babbel and Hogan discuss policyholder participation in relation to mutual insurers and do not consider the presence of participation rights in insurance policies issued by stock insurers. Consequently, the existing literature has not rigorously analyzed the role of participation rights in resolving incentive conflicts for stock insurers.

This article develops a model of the investment decision of a stock insurer and the agency problems that arise between shareholders and policyholders in a financial market framework.[2] We assume that the insurer may choose between two mutually exclusive investment portfolios, where the riskier portfolio is a mean preserving spread of the less risky portfolio. The primary purpose of this analysis is to demonstrate that the incorporation of participation rights in insurance policies resolves the risk shifting problem for stock insurers. We also present empirical evidence on policyholder participation that is consistent with our theory.

The Model

We assume that the insurance and financial markets are perfectly competitive, and that there are only two dates: now (zero) and then (one). Suppose the financial markets are complete; let s denote a state of nature then, and let $[0,\bar{s}]$ denote the set of states then. The current price of an Arrow-Debreu security that pays one dollar if state s occurs and zero otherwise is denoted p(s).[3] The current market value of any random cash flow X(s), denoted V(X(s)), is calculated by finding the risk adjusted present value of X(s), as shown in equation (1):

$$V(X(s)) = \int_0^{\bar{s}} p(s)X(s)ds. \tag{1}$$

The risk shifting problem is considered in relation to the insurer's investment portfolio choice. Let X(s) denote the payoff on the insurer's investment portfolio then, where I is the cost now of the portfolio. Moreover, assume that X(s) is increasing in the state variable s; that is, $\partial X/\partial s > 0$. Suppose the insur-

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[2] This allows us to define the objective function of the insurer in terms of the market value of its equity. See Garven (1987, pp. 60-61) for a comparison of alternative decision rules for insurers, as well as a theoretical justification for evaluating investment decisions according to the market value criterion implied by the financial market framework.

[3] The price p(s) may also be interpreted as a risk-adjusted discount factor for a dollar received then in state s.

er has access to two mutually exclusive investment portfolios that have identical costs (i.e., $I_1 = I_2$) and generate random payoffs $X_1(s)$ and $X_2(s)$, respectively. Also, assume the portfolio payoffs are positive for all states of nature, and that both portfolios have positive net present values.[4] Suppose portfolio 2 is riskier than portfolio 1 in the Rothschild-Stiglitz (1970) sense; specifically, let $X_2 = X_1 + \theta(X_1\text{-}EX_1)$, where $\theta > 0$. Then X_2 is a mean preserving spread of X_1, as shown in Figure 1 ($EX_1 = EX_2 = \mu$). As shown in Appendix A, portfolio 1 will be more valuable than portfolio 2, *provided* that investors are risk averse and portfolio payoffs are positively correlated with aggregate consumption.[5]

We assume that shareholders maximize the net present value of equity.[6] Further, we assume that shareholders contribute a constant positive amount of initial equity capital (surplus), denoted E_0, whereas policyholders contribute $I\text{-}E_0$.[7] The policyholders' contribution is subsequently referred to as insurance leverage. The assumption that E_0 is constant makes the shareholders' objective equivalent to maximizing the current market value of equity, denoted S.

Define L as the expected value of claims costs. Since the initial equity capital from shareholders is held constant, L must be varied to ensure that policyholder value, denoted D, equals $I\text{-}E_0$. Since shareholders have limited liability, equity represents a call option on the firm's assets with an exercise price equal to L. Although claims costs are random, expected claims costs can be used as the exercise price to value the call if we assume that the insurer can costlessly

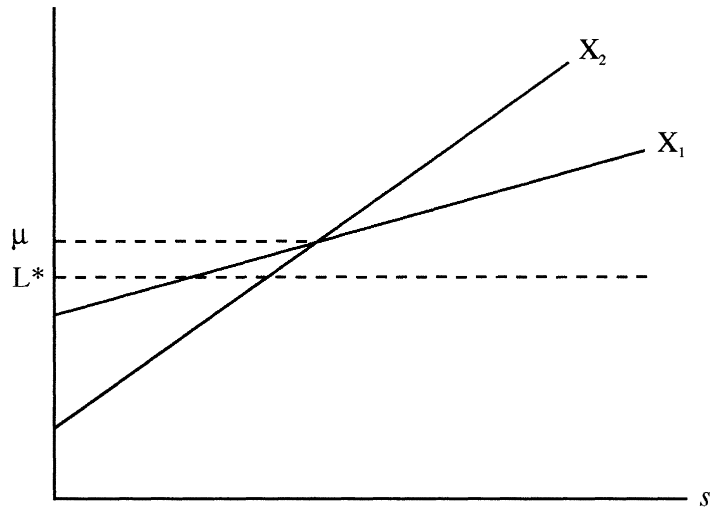
[4] The terminal value of the insurer's investment portfolio is strictly greater than zero if part of the portfolio consists of riskless assets and there is no short selling. The assumption that the net present value of each investment portfolio is positive is used in the proof in Appendix B. A further discussion of this assumption and its implications for the net present value of equity occurs in footnote 6. In the theory of financial intermediation, it is commonly held that financial firms such as banks and insurers are able to appropriate quasi-rents from their investment activities (see Bhattacharya and Thakor, 1993).

[5] The result that $V_1 > V_2$ (shown in Appendix A) does not hold for *all* mean preserving spreads of X_1. If a riskier asset generates higher payoffs in states where marginal utility is high (as reflected by the prices of state contingent claims), then a riskier asset will be more valuable; that is, $V_2 > V_1$. See Jagannathan (1984) for a discussion of the relationship between asset risk and market value.

[6] As noted earlier, we assume that the net present value of each investment portfolio is positive. The assumption stated earlier that the net present value of each portfolio is greater than zero is equivalent to the assumption that the net present value of equity is positive. The net present value of equity assuming portfolio 1 is selected may be written as $S_1\text{-}E_0 = (V_1\text{-}D_1)\text{-}E_0 = V_1\text{-}(I\text{-}E_0)\text{-}E_0 = V_1\text{-}I > 0$. This condition is used in the proof in Appendix B, and it is sufficient to ensure that there exists an insurance contract that finances the portfolio.

[7] In virtually all states and in most developed countries, a minimum level of equity capital is required for solvency purposes. Garven (1987) argues that, even in the absence of explicit solvency regulation, it would be optimal for shareholders to contribute equity capital.

Figure 1
Portfolio Payoffs



hedge claims costs so that actual claims costs equal expected claims costs.[8] Therefore, the current market value of equity, S, is given as

$$S = \int_0^{\bar{s}} p(s)\max[X(s)-L,0]ds. \tag{2}$$

Since the total market value of the insurer's assets is equal to the sum of the equity value S plus policyholder value D,[9] it follows that

$$D = V(X(s)) - \int_0^{\bar{s}} p(s)\max[X(s)-L,0]ds. \tag{3}$$

Next, we apply the put-call parity theorem (see Merton, 1973) to equation (3). Consequently, we may rewrite D as the value of safe (default-free) insurance

[8] The insurance firm hedges claims costs by buying a call option and selling a put option on claims costs with an exercise price equal to *expected* claims costs. Pottier (1994) shows that this portfolio of calls and puts hedges random claims costs so that actual claims costs equal expected claims costs. We assume that claims costs are stochastically independent of the state of the economy. Therefore, the put-call parity theorem implies that such a hedge is costless. Also, see footnote 11 for a related discussion.

[9] This is simply a restatement of Modigliani and Miller's (1958) famous Proposition I; that is, the value of the firm is invariant to its capital structure.

(V(L)), minus the value of a put option (P) that conveys to shareholders the right to default;[10] that is,

$$D = V(L) - P, \tag{4}$$

where V(L) = value of safe (default-free) insurance = $L\int_0^{\bar{s}} p(s)ds$,[11] and

$$P = \text{value of the insolvency put option} = \int_0^{\bar{s}} p(s)\max[L-X(s),0]ds.$$

After issuing policies, shareholders clearly have an incentive to invest in the portfolio that maximizes the current market value of equity. The difference in equity value associated with the two portfolio choices is

$$S_1\text{-}S_2 = (V_1\text{-}V_2) + (P_1\text{-}P_2). \tag{5}$$

Thus, the change in the market value of equity may be decomposed into two terms. The first term on the right-hand side of equation (5), V_1-V_2, represents the difference in asset values associated with the two alternative investment choices. The second term, P_1-P_2, corresponds to the difference in policyholder wealth associated with these choices. The first term is always *positive* and does not vary with L.[12] The second term is *negative* as long as the probability of insolvency is strictly positive for portfolio 2.

In the absence of insurance leverage, we have shown that the market value of portfolio 1 exceeds that of portfolio 2; that is, $S_1 > S_2$. By continuity, the market value of the equity claim on portfolio 1 will exceed the market value of the equity claim on portfolio 2; that is, $S_1 > S_2$ for expected claims costs close to zero. However, for sufficiently *high* levels of expected claims costs, $S_1 < S_2$. Under such circumstances, the increase in the market value of the insolvency put option from choosing portfolio 2 (P_2-P_1) will exceed the loss in the market value of the firm's assets (V_1-V_2). Consequently, equity value for such a firm is maximized *only* if portfolio 2 is selected. The level of claims

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[10] We subsequently refer to this option as the "insolvency" put option. The basic interpretation of risky corporate liabilities was first suggested by Black and Scholes (1973) in their seminal article on the theory of option pricing. Doherty and Garven (1986) and Cummins (1988) apply the option framework to the pricing of insolvency risk in insurance markets. Garven (1992) uses this framework to analyze incentive implications of default risk for mutual and stock insurers.

[11] By integrating p(s) over all possible states of nature, a single period discount factor obtains that is equal to one divided by one plus the riskless rate of interest. Recall that claims costs are assumed to be uncorrelated with the economy (see footnote 8). Therefore, the "underwriting beta" is zero, which means that the value of safe (default-free) insurance is determined quite simply by discounting the expected value of claims at the riskless rate of interest. This expression is therefore simply a special case of the capital asset pricing model and asset pricing theory–based pricing formulas posited by Biger and Kahane (1978), Fairley (1979), Hill (1979), Hill and Modigliani (1987), Kraus and Ross (1982), and Myers and Cohn (1987).

[12] The net cash flow of the firm is equal to the sum of the payoffs to shareholders and policyholders; that is, X = max[X-L,0] + min[X,L]. Consequently, asset value is independent of the financing decision.

costs where shareholders are indifferent ($S_1 = S_2$) between portfolios 1 and 2 is denoted as L^*.[13]

In order for a risk shifting problem to arise, the level of L necessary to finance portfolio 1 must be sufficiently large (specifically, $L > L^*$). When $L > L^*$, shareholders have an incentive to select the riskier asset portfolio. However, rationally informed policyholders recognize this moral hazard and therefore price the insurance based upon portfolio 2. Consequently, shareholders must bear the entire cost associated with this agency problem, which is represented by the loss in asset value V_1-V_2.[14]

Analytics of Participating Insurance Policies

In this section, we show that a participating insurance contract bonds the firm's shareholders to select portfolio 1, hence eliminating the agency cost associated with the risk shifting problem. In equation (4), we noted that the value of risky insurance is equivalent to the value of safe insurance (V(L)) minus the value of an insolvency put option (P). The inclusion of a participation feature adds the value of a call option. Therefore, the current market value of risky insurance with participation rights is denoted $D(\gamma,L^c)$, and can be written as

$$D(\gamma,L^c) = V(L^c) - P^c + C, \tag{6}$$

where L^c = expected claims cost, given that the firm issues participating policies,

γ = participation rate, where $\gamma \in [0,1]$,[15]

P^c = value of the insolvency put option, given that the expected claim cost is L^c, and

$$C = \text{value of participation rights} = \int_0^{\bar{s}} p(s)\max[\gamma X(s) - L^c, 0]ds.$$[16]

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[13] These results are most obvious when $L = \mu$. When this occurs, the equity payoff on asset 2 stochastically dominates (in the first-order sense) the equity payoff on asset 1, since $\max[X_2-\mu,0] \geq \max[X_1-\mu,0]$ for all s. Consequently, $L^* < \mu$. It follows from the definition of L^* that for $L > L^*$, $S_1 < S_2$, and for $L < L^*$, $S_1 > S_2$. Note that the case when $L = \mu$ is analogous to the case of the "actuarially neutral" asset portfolio in Babbel and Hogan (1992). An actuarially neutral asset portfolio is one in which the expected investment returns equal expected claims costs plus fixed expenses, so that the firm is expected to break even on average.

[14] Since $\partial D/\partial L > 0$ (see footnote 22 for a proof) and policyholders rationally expect that shareholders will select portfolio 2, shareholders need to offer a higher promised level of insurance, L, to finance portfolio 2. The higher level of L locks shareholders into choosing portfolio 2. To see this, simply note that $S_1(L_1) - S_2(L_1) < 0$ and $S_1(L_2) - S_2(L_2) < 0$, where $L_2 > L_1 > L^*$, where L_1 and L_2 are defined as the level of expected claims costs such that the financing condition ($D = I-E_0$) obtains for portfolio 1 and portfolio 2, respectively. Since $S_1(L_1) - S_2(L_2) = V_1 - V_2$, shareholders bear the agency cost.

[15] This payoff structure closely resembles payoffs on universal life insurance policies. Interest is credited to the cash value of universal life policies based on current interest rates and the insurer's investment results.

[16] See footnote 22 for a discussion of the payoff structure for the participation feature.

The firm must choose contract parameter values γ and L such that shareholders prefer portfolio 1 over portfolio 2 and are able to raise adequate financing for the purchase of portfolio 1. These conditions are represented by equations (7) and (8).

$$\text{Incentive Compatibility Condition: } S_1^c - S_2^c > 0, \text{ and} \tag{7}$$

$$\text{Financing Condition: } D(\gamma, L^c) = I - E_0, \tag{8}$$

where S_i^c represents the value of equity with insurance leverage and participation, given that investment portfolio i is chosen.

The incentive compatibility condition may be rewritten as

$$\begin{aligned} S_1^c - S_2^c &= (V_1 - V_2) + (D_2 - D_1) \\ &= (V_1 - V_2) + (P_1^c - P_2^c) + (C_2 - C_1) > 0. \end{aligned} \tag{9}$$

The third term on the right-hand side of equation (9), $C_2 - C_1$, is negative when L^c is sufficiently low and positive for higher values of L^c.[17] The level of L^c that satisfies the incentive compatibility and financing conditions depends upon the participation rate (γ) that is chosen. There exists a participating policy such that the incentive compatibility and financing conditions are jointly satisfied.[18] Shareholders are able to credibly precommit themselves to selecting portfolio 1, and policyholders will rationally price their policies to reflect this fact. Consequently, by choosing optimal contract parameters, shareholders are able to completely resolve the risk shifting problem and capture the entire agency cost as an increase in equity value.

The participating insurance contract that satisfies the incentive compatibility and financing conditions leads to maximization of the net present value of equity. Furthermore, shareholders receive the entire net present value of portfolio 1. To see this, note that $S_1^c = V_1 - D_1 = V_1 - I + E_0 > 0$ because the net present value of portfolio 1 is positive. The net present value of equity is $S_1^c - E_0 = V_1 - I > 0$.

Empirical Implications

A risk shifting problem arises when expected claims costs are sufficiently high relative to equity, and, by issuing insurance policies with participation rights, the risk shifting problem can be resolved. Consequently, our theoretical model provides formal analytic support for the Mayers and Smith conjecture concerning the role played by participation rights in resolving stockholder/policyholder incentive conflicts.

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[17] An obvious example occurs when $L^c < \gamma \min X_2 < \gamma \min X_1$. When this occurs, both call options will be exercised. The value of C_1 may be written $\gamma V_1 - V(L^c)$ and the value of C_2 may be written $\gamma V_2 - V(L^c)$. Since $V_1 > V_2$ (shown in Appendix A), it follows that $C_1 > C_2$. Supposing that $L^c = \gamma\mu$, then the payoff associated with the second call option stochastically dominates (in the first-order sense) the payoff associated with the first call option. See footnote 13.

[18] As shown in Appendix B, the set of contracts that satisfy the incentive compatibility and financing conditions must intersect at least once in the interior of the contract set.

An important empirical implication of our theoretical model is that participation rates should be positively correlated with expected claims costs/surplus ratios. Although a comprehensive empirical study is beyond the scope of this article, casual empirical support for our model is obtained by analyzing data collected by the National Association of Insurance Commissioners (NAIC). Since expected claims costs are not directly observable, we use policyholder premiums and liabilities as proxy variables, because they should be positively correlated with expected claims costs. As noted earlier, by merging the owner and creditor roles, mutuals may be interpreted as forms of policyholder participation, regardless of whether such firms actually issue participating policies. Although we do not conjecture any specific relationship between expected claims costs and participating policies for mutual insurers, we nevertheless do present an empirical analysis of mutual data for comparison purposes.

We obtained data for 1,852 stock and mutual life/health insurers from the NAIC data base for 1991. Of these 1,852 firms, only 584 have participating insurance policies in force, including 475 stock insurers and 109 mutual insurers. Table 1 presents summary statistics for these firms. Participating life insurance in force is a much greater percentage of total life insurance in force for mutual insurers that issue participating policies than for stock insurers that issue participating policies.

Table 1
Summary Statistics on Participating Insurance Policies, 1991:
Stock and Mutual Life/Health Insurers

Variable	*Stock*	*Mutual*
Number of Firms with Participating Insurance in Force	475	109
Participating Insurance in Force (in thousands)	\$737,702,461	\$4,158,552,512
Nonparticipating Insurance in Force (in thousands)	\$5,182,287,977	\$255,179,094
Participating Insurance in Force (percent)	12.5	94.2
Nonparticipating Insurance in Force (percent)	87.5	5.8

In order to compare stock and mutual firms with and without participating insurance policies in force, we grouped firms into three different size categories based upon capital and surplus. The sample is stratified according to size in order to differentiate between size and leverage effects.[19] Comparing stock

[19] The size categories are based upon capital and surplus levels used by A. M. Best Company (1992). Large firms have over \$50 million in capital and surplus, medium firms between \$5 million and \$50 million, and small firms less than \$5 million. We originally did not stratify our sample according to size because our theoretical model does not predict any size effect. However, we found that there is a definite relation between size and participation. The association between size and the existence of participating policies may be related to factors such as economies of scope and scale in larger firms. For example, a larger firm may be able to offer a broader range of insurance products, including participating policies.

insurers with and without participating insurance policies in force, across all three size groups there is a statistically significant (at the 0.10 level or better) leverage effect except for one leverage ratio for medium stock firms (see Table 2).[20] Specifically, stock insurers that issue participating policies are more highly leveraged than stock insurers that do not. Within each size category, stock insurers that issue participating policies are also larger than stock insurers that do not.[21]

The same comparisons for mutual life insurers reveal that large and medium-sized mutual insurers that issue participating policies tend to be more highly leveraged than mutual insurers that do not (see Table 3). However, the relationship is not statistically significant as frequently as it is with stock insurers. In the case of small mutuals, three of the four leverage measures indicate that firms which issue participating policies tend to be less leveraged (although the relationship is not statistically significant). Within each size category, mutual insurers that issue participating policies are also larger than mutual insurers that do not.

Conclusion

When expected claims costs are sufficiently high relative to equity, shareholders have an incentive to shift risk onto policyholders by selecting riskier assets after issuing policies. Shareholders bear the ensuing agency cost and, if they cannot credibly precommit themselves to investing in the safer (value maximizing) portfolio, they become locked into selecting the riskier portfolio. A set of participating insurance contracts is shown to exist that simultaneously finances the less risky portfolio and maximizes both firm value and equity value. Therefore, participation rights play a very important economic role by helping to resolve shareholder/policyholder incentive conflicts in the insurance markets.

We have offered one potential explanation for why stock insurers issue participating policies. Certainly other factors, such as strategic and marketing considerations, may be very important. However, the analysis of such factors is beyond the scope of this article. The empirical evidence from the life/health insurance industry presented here suggests a statistically significant relationship between insurance leverage and policyholder participation for stock insurers that is consistent with our theory.

[20] Rather than simply compare stock insurers with and without participation (that is, $\gamma > 0$ compared with $\gamma = 0$), we also compared stock insurers at different *levels* of participation (that is, $\gamma > 0.25$ compared with $\gamma < 0.25$, $\gamma > 0.50$ compared with $\gamma < 0.50$, and $\gamma > 0.75$ compared with $\gamma < 0.75$). Qualitatively, our results did not change from what we report in Table 2. Although fewer of the leverage measures were statistically significant, we continue to find a positive association between leverage and participation rates for stock life insurers.

[21] To further control for size, we also stratified our sample of stock insurers into size deciles based upon capital and surplus. Even with decile groupings, the results are similar qualitatively. Specifically, we continue to observe both size and leverage effects within each decile grouping.

Table 2
Comparison of Stock Life/Health Insurers
with and without Participating Insurance Policies in Force:
Selected Financial Information, 1991

	Median		*Median Two-Sample Test*	
Variable	$\gamma > 0$	$\gamma = 0$	*Z*	*Prob > |Z|*
Panel A: Large Firms				
Number of Firms	150	107		
Size Measures				
Total Admitted Assets	$1,231,183,527	$966,099,164	2.3263	0.0200
Net Premiums Written	$246,780,188	$171,727,581	2.6395	0.0083
Capital and Surplus	$133,843,092	$118,721,993	0.9831	0.3256
Leverage Ratios				
Assets to Capital and Surplus	520.87	306.04	2.6531	0.0080
Capital and Surplus to Liabilities	15.14	21.55	-1.7287	0.0839
Direct Premiums Written to Surplus	1.45	1.13	2.0651	0.0389
Net Premiums Written to Surplus	1.80	1.59	2.0207	0.0433
Panel B: Medium Firms				
Number of Firms	192	413		
Size Measures				
Total Admitted Assets	$70,553,068	$44,166,233	4.3608	0.0001
Net Premiums Written	$20,454,117	$11,523,514	3.6469	0.0003
Capital and Surplus	$13,186,463	$11,616,747	1.0492	0.2940
Leverage Ratios				
Assets to Capital and Surplus	455.19	381.70	1.2126	0.2253
Capital and Surplus to Liabilities	23.84	53.43	-5.7728	0.0001
Direct Premiums Written to Surplus	1.52	0.79	4.8455	0.0001
Net Premiums Written to Surplus	1.42	0.93	3.7228	0.0002
Panel C: Small Firms				
Number of Firms	133	727		
Size Measures				
Total Admitted Assets	$7,821,200	$2,641,482	9.2546	0.0001
Net Premiums Written	$1,330,352	$472,315	5.2534	0.0001
Capital and Surplus	$1,970,408	$1,219,501	4.0140	0.0001
Leverage Ratios				
Assets to Capital and Surplus	388.09	255.56	2.3461	0.0190
Capital and Surplus to Liabilities	25.42	131.57	-9.0581	0.0001
Direct Premiums Written to Surplus	1.03	0.04	7.3769	0.0001
Net Premiums Written to Surplus	1.16	0.55	3.6117	0.0003

Note: γ = dollar amount of participating life insurance in force divided by total dollar amount of life insurance in force. Z = Wilcoxon-Mann-Whitney rank z-statistic. Prob > |Z| = the probability of a greater absolute value of the observed z-statistic under the null hypothesis that the probability distributions for the two groups of insurers ($\gamma > 0$ and $\gamma = 0$) are the same. A normal approximation to the distribution of the rank sum is used.

Table 3
Comparison of Mutual Life/Health Insurers
with and without Participating Insurance Policies in Force
Selected Financial Information, 1991

Variable	*Median* $\gamma > 0$	*Median* $\gamma = 0$	*Median Two-Sample Test* Z	*Median Two-Sample Test* Prob > |Z|
Panel A: Large Firms				
Number of Firms	45	4		
Size Measures				
Total Admitted Assets	$3,207,832,745	$371,947,189	2.9760	0.0029
Net Premiums Written	$561,165,428	$338,399,043	1.1867	0.2353
Capital and Surplus	$195,986,360	$143,177,385	0.8581	0.3908
Leverage Ratios				
Assets to Capital and Surplus	505.07	121.37	2.7934	0.0052
Capital and Surplus to Liabilities	8.12	98.04	-3.1951	0.0014
Direct Premiums Written to Surplus	2.18	2.15	-0.0183	0.9854
Net Premiums Written to Surplus	3.36	2.23	0.8581	0.3908
Panel B: Medium Firms				
Number of Firms	42	11		
Size Measures				
Total Admitted Assets	$190,184,305	$20,228,397	3.2130	0.0013
Net Premiums Written	$37,921,100	$7,525,777	2.0947	0.0362
Capital and Surplus	$18,389,337	$8,728,684	2.3577	0.0184
Leverage Ratios				
Assets to Capital and Surplus	762.26	291.07	1.4585	0.1447
Capital and Surplus to Liabilities	11.93	124.02	-3.1366	0.0017
Direct Premiums Written to Surplus	1.90	1.26	1.9305	0.0536
Net Premiums Written to Surplus	2.01	1.40	1.6561	0.0955
Panel C: Small Firms				
Number of Firms	22	6		
Size Measures				
Total Admitted Assets	$11,232,403	$1,090,144	2.3236	0.0201
Net Premiums Written	$2,572,798	$977,329	0.8118	0.4169
Capital and Surplus	$1,339,747	$326,303	1.7637	0.0778
Leverage Ratios				
Assets to Capital and Surplus	485.64	836.02	-1.0918	0.2749
Capital and Surplus to Liabilities	18.17	92.30	-1.7637	0.0778
Direct Premiums Written to Surplus	2.21	3.78	-0.3640	0.7159
Net Premiums Written to Surplus	1.53	3.66	-0.4766	0.6336

Note: γ = dollar amount of participating life insurance in force divided by total dollar amount of life insurance in force. Z = Wilcoxon-Mann-Whitney rank z-statistic. Prob > |Z| = the probability of a greater absolute value of the observed z-statistic under the null hypothesis that the probability distributions for the two groups of insurers ($\gamma > 0$ and $\gamma = 0$) are the same. A normal approximation to the distribution of the rank sum is used.

Appendix A

Proposition 1

The value of portfolio 1 is greater than the value of portfolio 2.

Proof

The values of portfolio 1 and portfolio 2, denoted $V(X_1)$ and $V(X_2)$, respectively, are

$$V(X_1) = \int_0^{\bar{s}} p(s)X_1(s)ds, \text{ and} \tag{A1}$$

$$V(X_2) = \int_0^{\bar{s}} p(s)[X_1(s) + \theta\{X_1(s) - EX_1\}]ds. \tag{A2}$$

The value of portfolio 1 minus the value of portfolio 2 is

$$V(X_1) - V(X_2) = -\int_0^{\bar{s}} p(s)\theta\{X_1(s) - EX_1\}ds. \tag{A3}$$

The expression for $V(X_1)$-$V(X_2)$ can be rewritten as

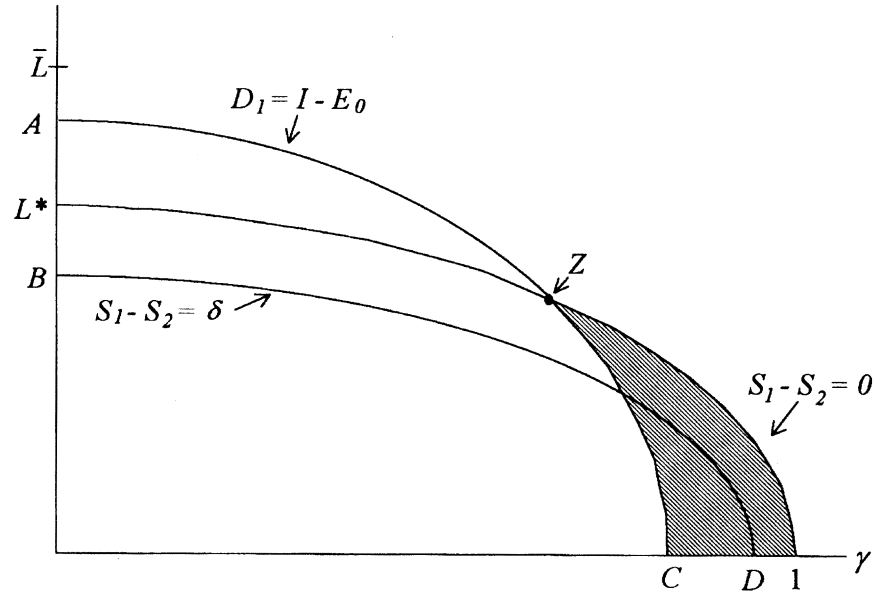
$$V(X_1)\text{-}V(X_2) = \text{-}\theta Cov(k(s), X_1(s)), \tag{A4}$$

where $k(s) = p(s)/f(s)$, the state price per unit probability, and $f(s)$ is the probability density function over s. The states are numbered in increasing order of aggregate consumption, and $X_1(s)$ is increasing in s by assumption. Thus, if $k(s)$ is decreasing in aggregate consumption, then the covariance term is negative and the difference $V(X_1)$-$V(X_2)$ is positive. The state price per unit probability, $k(s)$, is decreasing in aggregate consumption if the representative investor's utility function is strictly concave (see Varian, 1985).

Appendix B

Consider the feasible contract set denoted $H = [0,\bar{L}] \times [0,1]$ as shown in Figure 2, where $\bar{L}$ is chosen so that $D_1(\bar{L}) = V_1$. The risk shifting problem arises whenever the level of expected claims costs, L, required to satisfy the financing condition given by equation (8) (i.e., $D_1(L) = I\text{-}E_0$) exceeds some critical value L^*. Let $\hat{L}$ denote the level of expected claims costs where the financing condition obtains for nonparticipating insurance contracts. Furthermore, let A denote the point on the boundary of the contract set corresponding to the contract $(0, \hat{L})$. At point A, $S_1\text{-}S_2 < 0$. Thus, point A in Figure 2 does not satisfy the incentive compatibility condition given by equation (7).

Figure 2
The Contract Set



The financing condition given in equation (8), $D(\gamma,L^c) = I - E_0$, implicitly defines L as a function of γ. Moreover, by the implicit function theorem, the continuity and differentiability of the function $D_1(\gamma, L^c)$ in the contract parameters (γ,L) assures the existence of a continuous and differentiable function $L(\gamma)$. Since the function $D_1(\gamma,L^c)$ is increasing in both parameters (γ,L), the implicit function $L(\gamma)$ is a monotone decreasing function of γ (i.e., $\partial L/\partial\gamma < 0$).[22]

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[22] To show that policyholder value (D) increases in expected claims costs (L), we calculate the derivative of D with respect to L. D is calculated as the risk-adjusted present value of all possible state-contingent payoffs accruing to policyholders. If the firm becomes insolvent (i.e., if $s \in [0,s_1))$, policyholders receive the residual cash flow X(s). However, if the firm remains solvent (i.e., if $s \in [s_1,\bar{s}])$), the payoff depends upon whether the participation feature is "in the money." Over the interval $s \in [s_1,s_2)$, policyholder claims are paid in full, but they do not have a claim on the firm's residual cash flow. However, over the interval $s \in [s_2,\bar{s}])$, the participation feature pays off. Therefore, $D = \int_0^{s_1} p(s)X(s)ds + \int_{s_1}^{s_2} p(s)Lds + \int_{s_2}^{\bar{s}} p(s)\gamma X(s)ds$. Applying Leibniz's rule,

$\partial D/\partial L = p(s_1)[X(s_1)-L]\partial s_1/\partial L + p(s_2)[L-\gamma X(s_2)]\partial s_2/\partial L + \int_{s_1}^{s_2} p(s)ds$. The first two terms above equal zero, since $X(s_1) = L = \gamma X(s_2)$. Therefore, $\partial D/\partial L = \int_{s_1}^{s_2} p(s)ds > 0$.

We assume that the payoff on the participation feature is $\max[\gamma X(s)-L, 0]$. However, our results also go through for more general alternative payoff structures. For example, rather than specify

Next, let $\hat{\gamma}$ denote the participation rate, where $D_1 = \hat{\gamma}V_1 = I - E_0$ for $L = 0$. Furthermore, let C denote the point on the boundary of the contract set corresponding to the contract $(\hat{\gamma},0)$. The positive net present value of portfolio 1 is a sufficient condition for the existence of a $\hat{\gamma} < 1$. The continuity of the function $D_1(\gamma,L^c)$ in the contract set implies that the contour curve representing the financing condition is a continuous path connecting points A and C. Since $L(\gamma)$ is a monotone decreasing function of γ, the continuous path connecting points A and C must pass through the interior of the contract set.

Next, we establish a similar result for the incentive compatibility condition represented by the function $S_1^c - S_2^c > 0$. Since $V_1\text{-}V_2 > 0$, we know that there exists an L^* such that $S_1\text{-}S_2 = 0$ for nonparticipating insurance contracts (i.e., where $\gamma = 0$), and $S_1^c - S_2^c > 0$ for $\gamma = 0$ and $L < L^*$. Let B denote a point on the boundary of the contract set where $S_1^c - S_2^c = \delta > 0$ for $\gamma = 0$ and $0 < L < L^*$. Now consider points to the right of C in Figure 2 along the boundary where $L = 0$. For any $\gamma \in [\hat{\gamma},1)$ and $L = 0$, $S_1^c - S_2^c = (1\text{-}\gamma)(V_1\text{-}V_2) > 0$ and $D_1 = \gamma V_1 \geq I - E_0$. Next, define $F(\gamma,L) \equiv S_1^c - S_2^c$. Since $S_1^c - S_2^c$ is continuous and differentiable in the contract parameters, it follows that the function $F(\gamma,L)$ is also continuous in the contract parameters. Consequently, the incentive compatibility condition can be written as $F(\gamma,L) > \delta$ for some $\delta > 0$.

Next, consider values for δ corresponding to $L = 0$ and $\gamma \in (\hat{\gamma},1)$, and let D denote a point such that the incentive compatibility condition obtains for δ. By continuity, for L in a neighborhood of zero, there exists a $\gamma \in (\hat{\gamma},1)$ such that $F(\gamma,L) > \delta$ for some $\delta > 0$. Therefore, by continuity, the function $F(\gamma,L) = \delta$ must pass through the interior of the plane representing the contract set at least once. The continuous path representing the contour curve $F(\gamma,L) = \delta$ must connect the points B and D. It follows that the two contour curves that represent the incentive compatibility and financing conditions have at least one point of intersection in the interior of the contract set. Figure 2 depicts this result.

The set of contracts that solve the risk shifting problem is represented by the shaded area in Figure 2. Since $S_1 = S_2$ when $L = L^*$ or $\gamma = 1$, any point on the contour curve connecting these two points satisfies the incentive compatibility condition. Moreover, any point on the interior of the curve connecting L^* and $\gamma = 1$ satisfies the incentive compatibility condition, as shown earlier. The contour curve representing $S_1 = S_2$ intersects the financing condition at point Z. Thus, any contract along the financing condition curve from Z to C solves the risk shifting problem; that is, shareholders are able to credibly precommit themselves to the choice of portfolio 1. Since D is increasing in the participation rate, γ, any point to the right of the curve representing the financing

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$\gamma X(s)$ as the payoff on the underlying asset, a function $h(\gamma,X(s))$ could be used, where h is increasing in both γ and X(s). Regardless of the specific functional form of the participation feature, its value must be positively related to the participation rate γ in order for there to be an inverse relationship between γ and L.

condition (curve AC) results in a level of policyholder financing that exceeds $I - E_0$. The excess financing can be distributed now as a cash dividend to shareholders, thereby resulting in the same net present value of equity as would obtain along the curve ZC. Thus, contracts represented by all points located in the shaded area and along its boundary solve the risk shifting problem. Furthermore, a participation rate of one ($\gamma = 1$), or equivalently mutualization, also represents a solution to the risk shifting problem.

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