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Significant attention has focused on the determinants of corporate insurance purchases. While this analysis generally involves observable firm characteristics, its implications have been untested. This is primarily due to the difficulty in obtaining data on corporate insurance purchases. We examine one industry where data on insurance purchases are systematically reported: the insurance industry. A reinsurance contract is an insurance policy purchased by one insurance company from another. Our examination of reinsurance purchases by property/casualty insurance companies provides strong evidence on the effects of ownership structure, size, geographic concentration, and line-of-business concentration on the demand for reinsurance.

I. Introduction

Recent studies have focused on the determinants of the corporate demand for insurance.[1] These analyses explicitly recognize that while the primary motive for individuals' insurance purchases, risk aversion, can partially explain the demand for insurance by closely held corporations and partnerships, it provides a deficient explanation for insurance purchases by widely held corporations. The corporate form is itself a contractual structure with significant risk-management capabilities. Since the corporation's owners, its stockholders, can hold well-diversified portfolios of financial claims, idiosyncratic losses can be managed through diversification. Thus, the analysis has focused on, instead of risk aver-

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1. See Mayers and Smith (1982, 1987), Main (1983), and Smith and Witt (1985).

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sion, the structure of the tax code, costs of financial distress including potential investment-incentive effects of a corporation's capital structure, the corporation's ownership structure, comparative advantages in real service production, and the composition of corporate managers' compensation packages.

While this analysis of the corporate demand for insurance generally involves observable firm characteristics, its implications have been untested. This is primarily due to the difficulty in obtaining data on corporate insurance purchases. Under extant accounting rules, corporations are only required to make footnote-level disclosures of insurance purchases if they are material. Yet, there is one industry where data on insurance purchases are systematically reported: the insurance industry. A reinsurance contract is an insurance policy purchased by one insurance company, the ceding company, from another, the reinsurer. Hence, within the insurance industry, reinsurance purchases are like traditional insurance purchases by industrial corporations.

In this article, we empirically examine the determinants of reinsurance purchases for a sample of 1,276 property/casualty insurance companies. These data include firms across a broad range of ownership structures—stocks, mutuals, Lloyd's, reciprocals. Moreover, we distinguish among stocks that are widely held, closely held, owned by a single family, owned by a mutual, and owned by an association. For some purposes we avoid the complex ownership structure problems implied by subsidiaries and group membership by focusing on a subset of 330 nonsubsidiary nongroup firms.

In Section II, we review the basic hypotheses about the corporate demand for insurance. We describe our data in Section III, analyze the evidence from reinsurance purchases in Section IV, and present our conclusions in Section V.

II. The Corporate Demand for Insurance

Insurance purchases affect the firm's current market value through changing tax liabilities, contracting costs, or incentives with respect to real investment decisions for either the corporation or its claimholders. Although each provides a potential motive for corporate insurance purchases, they are not mutually exclusive. In the rest of this section we discuss the determinants of corporate insurance purchases and indicate specific adaptations for reinsurance purchases by insurance companies.

Taxes. The tax code provides incentives for firms to purchase insurance.[2] The provisions of the code imply a convex tax function for

2. For a more complete analysis of this incentive see Mayers and Smith (1982), Smith and Stulz (1985), or Smith and Witt (1985).

low levels of taxable income and an essentially linear function for taxable income above $100,000.[3] The convexity implies corporations have expected tax liabilities greater than the tax liabilities associated with their expected pretax income. Therefore, the corporate demand for insurance will be generally greater for firms with expected income in the convex region of the tax schedule or with more volatile pretax income.

Insurance companies' ability to deduct indemnity payments to policyholders while investing in tax-exempt municipal bonds makes the convex section of the tax function more important than for manufacturing firms of similar size (see Hendershott and Koch 1980). Since insurance firms typically face a significant probability of taxable income within the convex region, the purchase of reinsurance can reduce the firm's expected tax liability by reducing the volatility of pretax income. A second tax incentive is provided for insurance companies that are members of groups. Reinsurance can transfer profits within the group, allowing recognition of profits so that group taxes are reduced.[4] Thus, we expect to observe more reinsurance by group members than by similar unaffiliated insurance companies.

Expected bankruptcy costs. Transactions costs of bankruptcy can induce corporations to purchase insurance since the probability of incurring the costs is reduced by shifting risk to the insurance company. Warner's (1977) evidence that direct bankruptcy costs are less than proportional to firm size suggests small corporations are more likely to purchase insurance. Expected bankruptcy costs should also be more important for firms with higher cash-flow volatilities. For insurance companies, group membership can reduce the demand for externally provided reinsurance by providing a substitute mechanism for lowering expected bankrupty costs through pooling.

The probability of bankruptcy had additional importance for insurance companies: product quality is a negative function of the firm's default risk. Insurance purchasers assess the probability of default and adjust their demand prices accordingly. Moreover, since risk-averse purchasers pay a premium over the actuarially fair rate to eliminate a risk, an insurance company has incentives to reduce its default probability with reinsurance.[5]

Investment incentives. Myers (1977) shows that firms have incen-

3. The introduction of the alternative minimum tax in 1986 imposes potentially important nonlinearities above $100,000. However, our data are from 1981, prior to the introduction of this provision.

4. Note that a significant component of state taxation of insurance firms is through a premium tax. To the extent that premium income is taxed, rather than profits, this argument for reinsurance is reduced.

5. See Johnson and Stulz (1987). Fixed costs reflected in insurance premiums are likely sufficient to assure that reinsurance dominates the alternative solution of the insured diversifying across insurance companies.

tives to forgo valuable investment opportunities. Myers argues that in some circumstances, with risky debt in the capital structure, taking a positive net present value project makes stockholders worse off because the project's benefits accrue to the bondholders. Mayers and Smith (1987) demonstrate that in certain cases, the purchase of insurance controls this underinvestment incentive.

Insurance companies also can have underinvestment problems. For example, consider a company that experiences an abnormally large loss that reduces the value of both the equity and the firm's outstanding policies. The equity holders now might rationally choose to reject a positive net present value project because the benefits accrue primarily to the policyholders who have prior claim on the firm's assets. However, if the firm had purchased reinsurance, the loss would be indemnified, and the incentive to forgo the value-increasing project would be reduced. These problems are expected to be more severe the smaller the firm's capitalization and the more volatile its cash flows.[6]

Reinsurance also facilitates intrafirm specialization in investment management. For firms with subsidiaries, asset control is maintained by the parent company while regulatory requirements are met by the subsidiary through reinsurance with the parent company.[7] Thus, the assets ultimately backing the policy sold by a subsidiary appear on the parent's, not the subsidiary's, balance sheet.

Optimal risk sharing. Closely held corporations are more likely to purchase insurance than firms with less concentrated ownership for the same reason that individuals purchase insurance: risk aversion. Insurance contracts allow owners of closely held firms to specialize in risk-bearing only in dimensions in which they have expertise and thus a comparative advantage (see Arrow 1974, ch. 5).

Ownership structure varies within the insurance industry. For example, there are Lloyd's associations, where insurance contracts are offered by individual underwriters; stock companies that employ the standard corporate form; and mutuals and reciprocals that are more like cooperatives with customer and owner functions merged. Stock

6. While we do not employ data on company capitalization, given the different accounting conventions used across ownership structures, one must be careful when empirically testing this proposition.

7. Indirect evidence of this use of reinsurance by subsidiaries is provided in Mayers and Smith (1989). We find that parent chief executive officer (CEO) compensation is more closely related to assets as a measure of firm size, while subsidiary CEO compensation is more closely related to net premiums written, a sales measure. Additionally, Best (1982) indicates that "100% reinsured" with the parent, where the parent is also a property/casualty company, is common. Given the other control mechanisms available between parent and subsidiary firms, full reinsurance coverage is feasible. However, a reinsurance contract with an unaffiliated reinsurer is likely to restrict coverage by specifying deductibles, coinsurance provisions, and upper limits to control incentive problems. See Huberman, Mayers, and Smith (1983).

company ownership structure also varies from single-owner companies to those that are widely held. Because of variation in risk exposure, ownership structure can be an important determinant of cross-sectional differences in reinsurance purchases: closely held stocks and Lloyd's are expected to reinsure more than firms with less concentrated ownership.

Real-service efficiencies. Insurance firms develop a comparative advantage in processing claims because of scale economies and gains from specialization. Thus, noninsurance corporations can increase expected net operating cash flows by purchasing insurance when insurance companies are the low-cost supplier of these services.

Reinsurance firms regularly provide a set of services to ceding insurance companies. The reinsurer frequently has broader experience with low probability events and provides information on pricing and claims adjustment services in particular areas.[8] This information is more likely to be valued highly by small insurance firms, especially those that are geographically diversified or that offer insurance across many lines. Therefore, real-service efficiency arguments can explain both reinsurance purchases by insurance companies in addition to insurance purchases by nonfinancial corporations.

Reinsurance can also be a specialized form of financing. Reinsurance reduces insurance in force, thus relaxing the regulatory constraint on the ratio of capital to insurance in force. This motive is likely to be especially important for mutuals since they cannot raise capital by selling equity.

III. Data Description

Our basic data are from the A. M. Best Company (Oldwick, New Jersey); their 1981 line-of-business file (Best's) contains data on premiums, losses, and expenses categorized into 26 insurance lines for a large sample of property/casualty insurance firms. The file also identifies each firm's ownership structure (Lloyd's, stock, mutual, or reciprocal), group membership, and reports total admitted assets and the number of states licensed. The file contains usable data on 1,276 firms: 854 stock companies, 320 mutual companies, 60 reciprocal associations, and 42 Lloyd's associations.

Our measure of reinsurance activity is the ratio of reinsurance premiums ceded to total business premiums. Total business is defined as direct business plus reinsurance assumed. Direct business is gross premiums (including policy and membership fees written and renewed

8. See, e.g., Bickelhaupt (1983, p. 824): "Reinsurers also offer many technical advisory services to new insurers or those expanding to new types of insurance or territories."

TABLE 1 **Summary Statistics on Distribution of Ratio of Reinsurance Premiums Ceded to Total Business Premiums for 1,276 Property/Casualty Insurance Companies**[a]

Moments		Quantiles	
Mean	.38	100% MAX	1.33
SD	.33	99%	1.00
Skewness	.63	95%	1.00
Kurtosis	−.80	90%	.99
		75% Q3	.62
		50% MED	.31
		25% Q1	.10
		10%	.02
		5%	.00
		1%	.00
		0% MIN	−.29

[a] Total business premiums are defined as direct business written plus reinsurance assumed.

during the year) less return premiums. Reinsurance assumed is the premium income from supplying reinsurance services.[9]

Table 1 displays summary information on the distribution of the ratio of reinsurance premiums to total business premiums for the 1,276 property/casualty insurance companies. Note that the ratio is not bounded by zero and one; the minimum in our sample is −0.29 and the maximum is 1.33. This occurs primarily because of temporal mismatches in income flows. For example, negative values for reinsurance ceded can result from a return of premium by the reinsurer. Conversely, the ratio can exceed one for a firm that has decided to exit from a line of business or a state because it has stopped issuing new policies but reinsures policies in force. We do not believe that this temporal mismatching represents a significant problem for our analysis since there is no apparent reason for it to introduce bias in our procedures. Moreover, the total number of observations of this ratio that lie outside the zero-to-one range is less than 2% of the 1,276 observations.[10]

Our discussion suggests several proxy variables to explain the cross-sectional variation in the ratio of reinsurance premiums ceded to total business premiums.

Size. Firm size affects the demand for insurance through taxes, expected bankruptcy costs, investment incentives, and real-service ef-

9. We considered other measures of reinsurance activity, specifically measures of net reinsurance activity as opposed to just reinsurance purchased. However, for our purposes, it seems inappropriate to treat reinsurance assumed as simply the negative of reinsurance purchased (ceded). For example, one component of the reinsurance market operates like a simple pooling contract. Under such a contract the average pool member's net reinsurance activity would be zero, just like a firm with no participation in the reinsurance market.

10. Observations outside the zero-to-one range appear symmetrical with 13 negative and 12 greater than one.

ficiencies. The real-service and bankruptcy-cost effects are straightforward: larger firms should have a lower demand for reinsurance for these reasons. Expected bankruptcy costs are more likely to be an important factor for small firms, and small firms are less likely to have the specialized internal talent available in larger firms. However, the effects of size through the tax and investment-incentive motives are ambiguous.

We measure firm size by total admitted assets. Means and medians for admitted assets by ownership classification are reported in columns 4 and 5 of table 2.

Business concentration. We expect business concentration to be closely related to the real-service benefits of reinsurance. Other things equal, the less concentrated the insurer's business across lines of insurance, the more valuable the reinsurer's rating information. However, to make specific predictions about the impact through taxes, expected bankruptcy costs, and real-investment incentives requires additional knowledge of the expected cash-flow volatilities for specific lines as well as potential exposure across lines to common underlying factors such as liability rule changes. For example, firms with high line-of-business concentration could specialize in low-volatility lines of business. The impact of business concentration on the demand for reinsurance is thus ambiguous.

We measure line-of-business concentration by the Herfindahl index of concentration across lines of business.[11] Means and medians for our line-of-business concentration measure by ownership classifications are reported in table 2, columns 6 and 7.

Geographic concentration. Geographic concentration can affect reinsurance purchases for three reasons: (1) It increases the volatility of taxable income and thus increases tax-related incentives to reinsure. (2) It increases the volatility of firm value and thus increases incentives to reinsure because of expected bankrupty costs and investment incentives. (3) It reduces the value of real services provided by the insurer and hence reduces the demand for reinsurance. Thus, whereas tax, expected bankrupty costs, and investment incentives all imply a positive association between reinsurance activity and geographic concentration, the real-service incentive implies a negative association.

We measure geographic concentration by the negative of the number of states licensed. Means and medians for the number of states licensed by ownership classification are reported in table 2, columns 8 and 9.

11. The Herfindahl index is calculated for each company as

$$H = \Sigma S_L^2,$$

where L stands for line of insurance and $S_L = PI_L/TPI$; PI_L is the dollar amount of direct business written in a particular line of insurance and TPI is the dollar amount of direct business totaled across all 26 lines of insurance.

TABLE 2 **Mean (Median) Admitted Assets, Business Concentration, Geographic Concentration, and Best's Rating for Total Sample of 1,276 Firms and Nonsubsidiary/Nongroup Subsample of 330 Firms in the Property/Casualty Insurance Industry**

Ownership Classification	Ownership Classification Totals			Admitted Assets (in Thousands)		Business Concentration (Herfindahl)		Geographic Concentration (No. of States)		Best's Rating
	Total Company Type (1)	Group Members (2)	Nonsubsidiary/ Nongroup (3)	Total Sample (4)	Nonsubsidiary/ Nongroup (5)	Total Sample (6)	Nonsubsidiary/ Nongroup (7)	Total Sample (8)	Nonsubsidiary/ Nongroup (9)	Nonsubsidiary/ Nongroup (10)
1. Lloyd's associations	42	35	7	2,472.6	3,033.4	.52	.36	1.5	3.4	2.0
				(745.3)	(2,234.7)	(.49)	(.35)	(1.0)	(1.0)	(0)
2. Mutuals	320	114	206	154,567.5	41,554.5	.43	.46	10.9	6.7	4.8
				(19,794.5)	(13,249.3)	(.34)	(.38)	(3.0)	(2.0)	(6)
3. Reciprocal associations	60	27	33	172,535.4	85,991.5	.63	.71	10.3	3.4	2.2
				(13,571.0)	(9,740.9)	(.53)	(.64)	(2.0)	(1.0)	(0)
4. Mutual-owned stocks	118	110	...	110,636.4	...	.42	...	15.4	...	...
				(16,372.1)		(.37)		(6.5)		
5. Association-owned stocks	38	12	20	90,326.3	40,707.8	.58	.66	9.3	9.5	2.4
				(22,954.9)	(18,492.0)	(.51)	(.71)	(3.0)	(2.5)	(0)
6. Single-owner stocks (subsidiaries)	80	38	...	41,702.9	...	.51	...	8.4	...	...
				(8,536.9)		(.44)		(2.0)		
7. Closely held stocks (subsidiaries)	36	16	...	17,677.9	...	.60	...	6.7	...	...
				(5,591.5)		(.52)		(2.0)		
8. Widely held stocks (subsidiaries)	500	436	...	259,474.1	...	.41	...	23.6	...	...
				(31,926.9)		(.32)		(16.5)		
9. Single-owner stocks (nonsubsidiaries)	22	1	21	6,996.4	6,592.6	.68	.66	4.0	4.2	2.5
				(3,677.8)	(3,607.7)	(.65)	(.55)	(1.0)	(1.0)	(3)
10. Closely held Stocks (nonsubsidiaries)	32	6	26	16,616.1	11,047.9	.65	.71	8.8	5.6	2.1
				(7,781.6)	(6,488.5)	(.57)	(.62)	(2.0)	(1.0)	(1)
11. Widely held Stocks (nonsubsidiaries)	28	11	17	321,291.5	62,774.8	.57	.68	21.1	15.7	3.2
				(40,649.6)	(19.226.9	(.52)	(.64)	(15.5)	(13.0)	(5)

NOTE.—Numbers in parentheses are medians.

Ownership structure. Although ownership structure is ultimately endogenous, from an econometric perspective, it is a predetermined variable with respect to reinsurance purchases. We control for differences in ownership structure with dummy variables representing different ownership classifications. Best's classifies firms as Lloyd's, stocks, mutuals, and reciprocals. We augment Best's classifications by classifying stock companies as ultimately owned by an association,[12] by a single family (at least 50% owned by one family), as closely held (100 or fewer shareholders), or as widely held (more than 100 shareholders). We also indicate whether the stock company is a subsidiary and for all companies whether they are a member of a group.[13]

Our hypotheses explaining variation in reinsurance purchases across ownership structures imply that the more significant the fraction of total wealth that the insurance company represents to its owners, the greater will be the demand for reinsurance services by the insurance company.[14] Thus we expect the Lloyd's to have the greatest demand for reinsurance followed in order by single-family, closely held, and widely held stocks.[15] We also expect subsidiaries and group members to reinsure more. However, the relative ordering of mutuals, reciprocals, and stocks owned by associations depends on the relative importance of the financing aspects of reinsurance, the potential reduction in expected bankruptcy costs from the issuance of assessable policies (reciprocals), and the specific knowledge of risks for insurance offered to association members.

Groups and subsidiaries pose potential problems for our analysis. In a group the interfirm affiliation can reflect an ownership relation (e.g., a parent company with several subsidiaries could constitute a group) as well as other relations. Companies in groups frequently have "group business pooling" arrangements with the other members of the group. To the extent that these complex contractual arrangements are not captured by our dummy variables, including group members introduces a potential bias in our estimated coefficients. There is also the potential for bias if, for example, firms in groups tend to concentrate in different lines of business than nongroup firms. Reinsurance contracts

12. Examples of associations that own stock insurance companies are the American Medical Association, California Farm Bureau Federation, Blue Shield Association, Catholic Mutual Relief Society of America, and AGWAY, Inc.—a farm supply and food marketing cooperative.

13. This additional information (except for group membership, which is on the file) is obtained from the 1982 *Best's Insurance Reports.*

14. Hence, we assume that variation in individual risk aversion is not sufficient to allow sorting by individuals to wash out cross-sectional variation in reinsurance demand.

15. That some Lloyd's have no specific limitation on the underwriters' liability should be sufficient to generate a difference between Lloyd's and single family stocks. Three of the seven Lloyd's that are not members of insurance groups indicate limitations on underwriter's liability in the 1982 *Best's Insurance Reports.*

between parent and subsidiaries can bias our measure of firm size for subsidiaries and cause problems in interpreting the relation between firm size and reinsurance. For subsidiaries, the causality could be reversed—subsidiaries have smaller measured admitted assets because they reinsure. While one solution to the problem of groups and subsidiaries would be to treat related firms as entities, that consolidation poses problems for at least one reason: the Best's sample is not an exhaustive listing of all insurance companies, hence we would end up measuring partial entities.

We control these firm-definition problems by restricting part of our analysis to that subset of firms where these problems are less severe: the nonsubsidiary, nongroup property/casualty insurance companies. Although this restriction reduces our sample of companies by 74% (as indicated in table 2), it allows more focused tests of our hypotheses. For example, our ownership structure definitions for stand-alone insurance companies are likely more closely related to our hypotheses than they are for subsidiaries: a subsidiary that is ultimately closely held is more likely a part of a larger portfolio of companies. Moreover, including subsidiaries adds dimensions to the ownership structure problem that we do not fully understand. For example, small property/casualty insurance companies that are ultimately closely held are frequently separated from their owner(s) by a holding company whose only asset is the subsidiary insurance company.[16]

Best's rating. The default risk of the insurer affects the demand for reinsurance through investment incentives and expected bankruptcy costs. Both arguments imply that riskier firms have incentives to purchase more reinsurance. As a proxy for default risk we employ Best's General Rating from the 1982 *Best's Insurance Reports—Property Casualty*. Best's assigns a group rating where companies operate under an intercompany reinsurance arrangement or where common management and underwriting prevail without a business pooling arrangement. Thus Best's ratings are easiest to interpret for our subset of 330 nonsubsidiary, nongroup firms.

Best's ratings range from A+ to C, but for 85 firms of our sample of 330 (25.8%) a rating is not assigned. Best's lists several reasons for nonassignment, for example, not qualifying for the minimum rating of C and having less than 5 years of continuous operating experience. We assign a value of six for companies with a Best's rating of A+, five for A, four for B+, down to one for C. We assign a value of zero for those firms with no rating. In table 2, we report the average Best's rating for each ownership structure class.[17]

16. We believe that one reason for this organizational structure is that it allows the firm's owners to reduce the regulatory constraints on leverage by allowing debt issuance by the holding company.

17. The qualitative interpretations of our analysis are unchanged if we use a separate indicator variable for each Best's rating rather than these numerical assignments.

Lines of business. We control for variation in the demand for reinsurance across lines by using each company's percentage of direct business in each of 23 lines as control variables.[18] Table 3 reports means and ranges for the percentages of direct business by line and ownership classification. The average Lloyd's in our sample does almost 41% of its direct business in commercial multiple peril and the average mutual does about 14% of its direct business in auto physical damage.[19] Hence, there appears to be considerable line specialization by ownership class.

In our analysis of the corporate demand for insurance we have argued that it is important to hold things like the lines in which the firm operates constant in order to examine the impact of size, business concentration, geographic concentration, Best's rating, and ownership structure. However, we suspect that the line-of-business data reported by Best's are not ideal for our purposes. One problem with the data is aggregation: Best's data treat all fire insurance policies, for example, as having identical risk factors. This poses potential problems in the interpretation of our results that we discuss in more detail below.

IV. Evidence from the Reinsurance Market

Ownership structure. We first examine whether, consistent with our hypotheses, the ratio of reinsurance ceded to total business varies across ownership structures. These tests have low power because they do not control for potentially important variation in company size, business concentration, geographic concentration, Best's rating, or lines of business. However, because the tests are simple pairwise comparisons, they allow us to use nonparametric as well as parametric statistics. Consistency between the parametric and nonparametric results strengthens our confidence about the parametric regression results that follow, where we control for the other factors.

Table 4 contains three regressions of reinsurance activity on ownership class dummy variables (intercepts are omitted to avoid singularity). Regression 1 employs the total sample of 1,276 companies to estimate the mean reinsurance ratio for each ownership class. Regression 2 also employs the full 1,276 insurance company sample but includes additional dummy variables indicating group membership and interactions between group membership and ownership classification.

18. One of the 26 lines of business reported by Best's (miscellaneous) was originally omitted to avoid singularity in the regression matrix for analysis on the entire sample of insurance companies (1,276). Since none of the 330 firms in the final sample (which omits subsidiaries and group members) write business in reinsurance or international, those two lines are also omitted in the analysis of that sample.

19. Regulation is likely to account for some of the observed line-of-business concentration in Lloyd's. The state laws authorizing American Lloyd's frequently provide that only certain types of insurance may be written by Lloyd's groups.

TABLE 3 **Summary Statistics (Mean/Range) for Percentages of Direct Business Written in Each of 23 Lines of Insurance by Ownership Classification for 1,276 Property/Casualty Insurance Companies**

Line of Insurance	Lloyd's Associations	Mutuals	Reciprocal Associations	Mutual-Owned Stocks	Association-Owned Stocks	Single-Owner Stocks (Subsidiaries)	Closely Held Stocks (Subsidiaries)	Widely Held Stocks (Subsidiaries)	Single-Owner Stocks (Nonsubsidiaries)	Closely Held Stocks (Nonsubsidiaries)	Widely Held Stocks (Nonsubsidiaries)
Fire	.1182	.1085	.0782	.0491	.0175	.0530	.0312	.0502	.0332	.0730	.0814
	(.667)	(1.000)	(.786)	(.788)	(.200)	(.764)	(.323)	(.883)	(.512)	(1.000)	(1.000)
Allied lines	.0936	.0528	.0374	.0299	.0420	.0503	.0390	.0202	.0091	.0130	.0129
	(.390)	(1.000)	(.437)	(.640)	(1.000)	(.996)	(1.000)	(.333)	(.086)	(.237)	(.113)
Farmowners multiple peril	.0013	.0470	.0014	.0064	.0231	.0004	.0031	.0035	.0005	.0005	.0047
	(.020)	(.646)	(.051)	(.371)	(.169)	(.012)	(.059)	(.122)	(.012)	(.014)	(.121)
Homeowners multiple peril	.0749	.2620	.0396	.1936	.0824	.0406	.0967	.0801	.0983	.0307	.0735
	(.607)	(.0955)	(.821)	(1.000)	(.780)	(.625)	(.976)	(.856)	(.858)	(.562)	(.429)
Commercial multiple peril	.4090	.0642	.0652	.0790	.0567	.0521	.0095	.0718	.0323	.0222	.0233
	(.965)	(.926)	(.864)	(.863)	(.928)	(.450)	(.150)	(.885)	(.645)	(.274)	(.233)
Ocean marine	.0000	.0061	.0168	.0089	.0049	.0065	.0335	.0090	.0000	.0014	.0006
	(.000)	(1.000)	(1.000)	(.750)	(.180)	(.171)	(1.000)	(1.000)	(.000)	(.046)	(.008)
Inland marine	.0728	.0228	.0448	.0223	.0065	.0172	.0171	.0484	.0157	.0072	.0554
	(.827)	(.934)	(.851)	(.432)	(.055)	(.226)	(.124)	(1.000)	(.267)	(.065)	(.963)
Medical malpractice	.0008	.0585	.2031	.0069	.2368	.0133	.0007	.0128	.0403	.0036	.1328
	(.016)	(1.000)	(1.000)	(.606)	(1.000)	(3.75)	(.027)	(1.000)	(.886)	(.062)	(1.000)
Earthquake	.0000	.0002	.0005	.0003	.0000	.0001	.0000	.0011	.0009	.0016	.0001
	(.000)	(.018)	(.023)	(.011)	(.000)	(.003)	(.000)	(.093)	(.019)	(.050)	(.001)

Group accident and health	.0037 (.150)	.0058 (.879)	.0071 (.231)	.0075 (.449)	.0445 (.999)	.0024 (.139)	.0000 (.000)	.0107 (1.000)	.0000 (.000)	.0000 (.000)	.0184 (.514)
Credit accident and health	.0000 (.000)	.0000 (.001)	.0000 (.000)	.0000 (.000)	.0000 (.000)	.0000 (.000)	.0108 (.391)	.0029 (1.000)	.0194 (.427)	.0000 (.000)	.0000 (.000)
Other accident and health	.0025 (.102)	.0050 (1.000)	.0001 (.004)	.0115 (.550)	.0005 (.018)	.0120 (.837)	.0006 (.017)	.0088 (1.000)	.0000 (.000)	.0013 (.029)	.0796 (1.000)
Workmens' compensation	.0099 (.282)	.0553 (1.000)	.0756 (1.000)	.0786 (.973)	.0727 (.857)	.0657 (1.000)	.1588 (1.000)	.1488 (1.000)	.0475 (1.000)	.1041 (1.000)	.0480 (.355)
Other liability	.0215 (.274)	.0372 (1.000)	.0626 (1.000)	.0528 (1.000)	.0323 (.332)	.1400 (1.000)	.0974 (1.000)	.1163 (1.000)	.0361 (.569)	.0596 (.565)	.0734 (1.000)
Auto liability	.0421 (.381)	.1448 (.733)	.1881 (.939)	.2588 (.799)	.2290 (1.000)	.2038 (.894)	.2400 (.935)	.1789 (.840)	.1742 (.674)	.2699 (.928)	.2138 (.803)
Auto physical damage	.1194 (.999)	.1074 (.625)	.1615 (1.000)	.1663 (.516)	.1290 (.500)	.2181 (1.000)	.1436 (.908)	.1622 (.995)	.2871 (1.000)	.2409 (1.000)	.1033 (.400)
Aircraft	.0000 (.000)	.0004 (.103)	.0162 (.973)	.0004 (.038)	.0000 (.000)	.0018 (.109)	.0195 (.546)	.0070 (1.000)	.0000 (.000)	.0329 (1.000)	.0009 (.026)
Fidelity	.0003 (.004)	.0003 (.020)	.0001 (.003)	.0039 (.401)	.0001 (.004)	.0037 (.166)	.0000 (.001)	.0048 (1.000)	.0040 (.082)	.0116 (.333)	.0018 (.019)
Surety	.0005 (.011)	.0064 (.990)	.0003 (.018)	.0044 (.377)	.0216 (.820)	.0745 (1.000)	.0919 (1.000)	.0158 (1.000)	.1540 (1.000)	.1253 (1.000)	.0322 (.577)
Glass	.0001 (.003)	.0002 (.003)	.0003 (.014)	.0002 (.005)	.0002 (.005)	.0001 (.002)	.0000 (.001)	.0003 (.010)	.0000 (.001)	.0001 (.001)	.0002 (.002)
Theft	.0015 (.039)	.0009 (.067)	.0003 (.0007)	.0007 (.015)	.0002 (.0007)	.0005 (.008)	.0001 (.002)	.0019 (.326)	.0000 (.000)	.0001 (.001)	.0013 (.020)
Boiler	.0001 (.002)	.0033 (.245)	.0000 (.000)	.0028 (.212)	.0000 (.000)	.0000 (.001)	.0000 (.000)	.0014 (.176)	.0000 (.000)	.0000 (.000)	.0357 (.998)
Credit	.0049 (.205)	.0000 (.002)	.0000 (.000)	.0000 (.001)	.0000 (.000)	.0000 (.002)	.0000 (.000)	.0113 (1.000)	.0017 (.037)	.0000 (.000)	.0000 (.000)

NOTE.—The first number in each pair expresses the mean; the second number—in parentheses—expresses the range.

TABLE 4 **Cross-Sectional Regressions of Reinsurance Activity (Ratio of Reinsurance Premiums Ceded to Total Business Premiums) on Ownership Classification Dummy Variables for Total Sample of 1,276 Firms and the Nonsubsidiary, Nongroup Subsample of 330 Firms in the Property/Casualty Insurance Industry***

	Variables												
Regression No.	Lloyd's Assoc.	Mutual	Recip Assoc.	Assoc. Owned	Mutual Owned (Sub.)	Single Owner (Sub.)	Closely Held (Sub.)	Widely Held (Sub.)	Single Owner (Nonsub.)	Closely Held (Nonsub.)	Widely Held (Nonsub.)	Group	*N*
1	.88	.25	.26	.29	.43	.33	.52	.46	.25	.27	.18	...	1,276
	(19.32)	(15.03)	(6.93)	(5.97)	(15.75)	(10.05)	(10.56)	(34.90)	(3.91)	(5.24)	(3.18)		
2	.79	.23	.23	.24	.28	.30	.42	.23	.26	.22	.15	.27	1,276
	(7.22)	(11.44)	(4.54)	(4.23)	(2.78)	(6.76)	(6.52)	(6.23)	(4.07)	(3.90)	(2.08)	(7.00)	
†	−.16	−.22	−.19	−.12	−.12	−.21	−.05	...	−.49)	.01	−.19	...	...
	(−1.27)	(−4.29)	(−2.26)	(−1.14)	(−1.02)	(−2.74)	(−.45)		(−1.64)	(.08)	(−1.60)		
3‡	.79	.23	.23	.26	...	...	...	...	.26	.22	.15	...	330
	(10.73)	(17.00)	(6.75)	(5.87)					(6.04)	(5.80)	(3.09)		

NOTE.—Assoc., Recip., Sub., Nonsub. are abbreviations for association, reciprocal, subsidiary and nonsubsidiary, respectively. Group is a dummy variable indicating group membership. *F* indicates the value of the *F*-statistic under the null hypothesis that all coefficients are identically equal to zero. *N* represents the sample size. Classifications Assocation Owned, Mutual Owned, Single Owner (Sub.)/(Nonsub.), Closely Held (Sub.)/(Nonsub.), and Widely Held (Sub.)/(Nonsub.) are all stock companies. Parentheses contain *t*-statistics.

* These regressions omit the intercept term to avoid singularity in the regression matrix. Alternatively, we could have omitted one of the ownership classification dummy variables. The coefficients reported in regressions 1 and 3 are the mean ratios for the respective ownership classification and sample.

† This row and the one below contain coefficient estimates and *t*-statistics (respectively) for interaction effects between group membership and the indicated ownership classification.

‡ This regression excludes subsidiary companies and group members.

Regression 3 employs the subsample of 330 companies that excludes subsidiaries and group members.

Each regression indicates that reinsurance is a significant fraction of total business for all ownership classes. The extremes appear to be the Lloyd's associations in regression 1, with a mean ratio of .88, and the widely held (nonsubsidiary/nongroup) stock companies from regression 3, where the mean ratio is .15. From regression 2, group membership increases the reinsurance ratio by 27% for widely held stock subsidiaries. Three (out of 10) interaction terms between group membership and ownership classification have statistically significant negative coefficients, but in all three the interaction term coefficient point estimates are less (in absolute value) than the significant positive coefficient estimate on group membership. Thus, group membership is generally associated with larger apparent usage of reinsurance. Regression 2 also suggests, at least weakly, that subsidiaries purchase more reinsurance than do nonsubsidiaries, even controlling for group membership. The nonsubsidiary ownership classifications all indicate lower mean ratios than their respective subsidiary counterparts. An additional implication from comparing mean ratios from regression 3 with those from regression 1 is that subsample mean ratios appear close to those from the full sample (except for the Lloyd's associations). Thus, at least based on the mean, the subsample appears representative of the full sample for the nonsubsidiary ownership classes; group membership appears most important for subsidiary companies.

Table 5 contains pairwise comparisons of mean and median reinsurance activity for the alternate ownership classes. The tests are two-sample *t*-tests with unequal variances for the means and Wilcoxon two-sample (Mann-Whitney) tests for the medians (see Siegel and Castellan 1988). Panel A of table 5 reports tests for the full sample of 1,276 companies, and panel B reports the results for the subsample of 330 nongroup/nonsubsidiary companies. While the mean and median tests provide reinforcing implications, the significance level typically is lower for the median.

The table 5 evidence suggests strongly that Lloyd's associations spend a larger proportion of their premiums on reinsurance than any other ownership class. Also, there is weak evidence that widely held (nonsubsidiary) stock companies spend a smaller proportion of their premiums on reinsurance than other ownership classes. These results are consistent with our ownership-structure hypotheses. Finally, from panel A, there is evidence that subsidiaries purchase more reinsurance than nonsubsidiary firms. For example, except for the Lloyd's, mutual-owned stock companies have larger mean and median reinsurance ratios than any other nonsubsidiary ownership class. This increase in the reinsurance ratio for subsidiaries and group members is consistent with the use of group business pooling arrangements. If our data al-

TABLE 5 **Pairwise Comparisons of Mean/(Median) Reinsurance Activity (Ratio of Reinsurance Premiums Ceded to Total Business Premiums) for Alternative Ownership Classifications (Two-Sample *t*/[Wilcoxon Two-Sample *Z*])**

	A. Total Sample of 1,276 Property/Casualty Insurance Companies									
Ownership Classifications	Mutual	Reciprocal Association	Association Owned	Mutual Owned (Subsidiary)	Single Owner (Subsidiary)	Closely Held (Subsidiary)	Widely Held (Subsidiary)	Single Owner (Non-subsidiary)	Closely Held (Non-subsidiary)	Widely Held (Non-subsidiary)
Lloyd's association	15.75 (9.28)	11.94 (7.27)	9.89 (6.18)	9.16 (6.83)	10.80 (7.56)	5.28 (4.57)	10.13 (7.46)	8.85 (5.80)	11.39 (6.58)	13.75 (6.43)
Mutual		−.44 (.50)	−.79 (−.14)	−5.46 (−4.30)	−2.38 (−1.29)	−4.72 (−4.71)	−11.08 (−8.08)	.03 (1.11)	−.66 (−.59)	1.98 (1.90)
Reciprocal association			−.38 (−.34)	−3.55 (−3.04)	−1.42 (−1.08)	−3.87 (−3.77)	−5.22 (−4.20)	.26 (.63)	−.19 (−.86)	1.80 (1.16)
Association owned				−2.56 (2.11)	−.81 (−.57)	−3.21 (−3.10)	−3.59 (−2.93)	.52 (.96)	.21 (−.31)	1.89 (1.39)
Mutual owned (subsidiary)					2.13 (2.03)	−1.42 (−1.30)	−.94 (−.82)	2.68 (2.61)	3.22 (2.16)	5.49 (3.39)
Single owner (subsidiary)						−2.87 (−2.72)	−3.53 (−3.24)	1.24 (1.40)	1.17 (.45)	3.26 (2.04)
Closely held (subsidiary)							1.01 (1.06)	3.31 (2.89)	3.65 (3.09)	5.21 (4.07)
Widely held (subsidiary)								3.44 (3.11)	4.69 (2.85)	7.66 (4.21)

Single owner (nonsubsidiary)							−.39	.99
							(−.98)	(.04)
Closely held (nonsubsidiary)								1.92
								(1.77)

B. Sample of 330 Nongroup/Nonsubsidiary Property/Casualty Insurance Companies

Ownership Classifications	Mutual	Reciprocal Association	Association Owned	Single Owner (Nonsubsidiary)	Closely Held (Nonsubsidiary)	Widely Held (Nonsubsidiary)
Lloyd's associations	7.12	6.61	5.39	5.34	6.63	7.55
	(4.25)	(3.70)	(3.29)	(3.19)	(3.81)	(3.68)
Mutual		.06	−.40	.41	.24	2.26
		(.30)	(.42)	(.74)	(.49)	(2.02)
Reciprocal Associations			−.38	−.39	.14	1.68
			(.19)	(.26)	(.01)	(1.38)
Association Owned				−.01	.48	1.55
				(.20)	(.03)	(1.02)
Single owner (nonsubsidiary)					.49	1.54
					(−.20)	(.46)
Closely held (nonsubsidary)						1.49
						(1.20)

NOTE.—The two-sample *t*-test assumes unequal variances. The Wilcoxon two-sample test is a median test. This test is also referred to as the Mann-Whitney test (see, e.g., Siegel and Castellan 1988).

lowed us to distinguish between reinsurance purchases where the reinsurer is another member of the same group and purchases where the firm obtains reinsurance from outside the group, then we could control more effectively for these group problems. However, without that data, our most effective tests must focus on the subset of 330 nongroup, nonsubsidiary firms.

Size concentration and Best's rating. In table 5, we examine the impact of ownership structure on reinsurance purchases without controlling for other factors. In table 6 we examine the effects of size, line-of-business concentration, geographic concentration, default risk, and organization/ownership structure on reinsurance purchases. We report three regressions: regression 1 contains the size, line-of-business concentration, Best's rating, and geographic concentration measures as independent variables; regression 2 adds the ownership class dummy variables; and regression 3 adds the percentage of business written in each of 23 lines of insurance as control variables.[20]

We omit the widely held stock ownership class dummy variable from regressions 2 and 3 to avoid singularity. Thus, the t-statistics for ownership class variables test whether the mean ratio for the ownership class is different from the widely held stock mean ratio. We also examine pairwise tests of the equality of estimated ownership class coefficients from regression 3 and report these F-statistics at the bottom of table 6.

Again, Lloyd's appear to have a larger ratio of reinsurance to total business premiums than other ownership classes: the F-statistics from table 6 range from 17.08 to 30.96 and the t-statistic of 5.80 from regression 3 are all highly significant. However, part of this difference may reflect the fact that Best's data do not differentiate well between insurance business where the cash flows are more uncertain and where they are not.

There is also strong evidence that widely held stocks reinsure less than closely held, single-owner, and association-owned stocks: the t-statistics for these comparisons are significant at least at the .05 level. Moreover, there is weak evidence that the ratio of reinsurance to total business is smaller for widely held stocks than for any other ownership class: the widely held/reciprocal test has the largest p-value of any widely held stock test, and it is .147. There is also weak evidence that single-owner stocks reinsure more than mutuals and reciprocals.

20. In table 6, regressions 2 and 3 imply restrictions on the interactions among the independent variables. As a specification check, we employ an analysis of covariance where our ownership classification variables are interpreted as treatments and other variables are covariates. Tests for interaction effects between the ownership classes and line-of-business concentration, size, geographic concentration, and Best's rating indicate they are not significant at the .10 level.

TABLE 6 **Cross-sectional Regressions of Reinsurance Activity (Ratio of Reinsurance Premiums Ceded to Total Business Premiums) on Ownership Classification Dummy Variables, Size, Line-of-Business Concentration (HERF), Geographic Concentration (LICENSE), and Best's Rating for Nonsubsidiary, Nongroup Subsample of 330 Property/Casualty Insurance Companies**

A. Variables

Regression No.	Intercept	Lloyd's Assoc.	Mutual	Recip. Assoc.	Assoc. Owned	Single Owner	Closely Held	SIZE	Business Concentration (HERF)	Geographic Concentration (LICENSE)	Best's Rating	F	$\bar{R}_2$
1	1.211							−.055	−.079	−.003	−.015	13.80	.13
	(8.84)							(−6.60)	(−1.75)	(−3.00)	(−2.76)		
2	.967	.547	.115	.094	.114	.058	.031	−.049	−.013	−.003	−.013	11.10	.23
	(6.57)	(6.31)	(2.36)	(1.66)	(1.87)	(.94)	(.53)	(−5.91)	(−.29)	(−3.21)	(−2.38)		
3*	1.053	.475	.084	.077	.112	.149	.131	−.033	−.129	−.002	−.014	7.26	.39
	(5.58)	(5.80)	(1.81)	(1.45)	(1.96)	(2.44)	(2.22)	(−3.62)	(−2.43)	(−2.16)	(−2.41)		

B. Tests of the Equality of Ownership Classification Coefficients for Regression 3 (F-Statistic/P-Value)

Ownership Classification	Mutual	Recip. Assoc.	Assoc. Owned	Single Owner	Closely Held
Lloyds assoc.	30.96	28.25	20.79	17.08	19.25
	(.0001)	(.0001)	(.0001)	(.0001)	(.0001)
Mutual		.04	.45	1.98	1.10
		(.8516)	(.5012)	(.1609)	(.2951)
Recip. assoc.			.52	1.91	1.18
			(.4732)	(.1680)	(.2774)
Assoc. owned				.40	.11
				(.5288)	(.7424)
Single owner					.12
					(.7242)

NOTE.—Assoc. and Recip. are abbreviations for association and reciprocal. Classifications association-owned, single owner, closely held, and widely held are stock companies. The SIZE variable is the log of total admitted assets. HERF is the Herfindahl line-of-business concentration measure, and LICENSE is the negative of the number of states in which the businesses are licensed. F indicates the value of the F-statistic under the null hypothesis that all coefficients are identically equal to zero $\bar{R}_2$ is the adjusted R^2.

* Regression 3 controls for the percentage of business written in individual lines of insurance. Thus, this regression includes an additional 23 variables, one for each of the lines of insurance in table 3. We omit the coefficient estimates and t-statistics for those variables; however, they are available from the authors.

The evidence in table 6 also suggests that size, line-of-business concentration, geographic concentration, and Best's rating have a significant negative impact on the demand for reinsurance. The significant coefficient on our geographic concentration variable implies that the real-service efficiency argument (which implies a negative coefficient) is quantitatively more important than the sum of the other effects through taxes, expected bankruptcy costs, and investment incentives (which all imply positive coefficients). Real-service efficiencies also imply negative coefficients for size and line-of-business concentration, but for these variables the signs of the other effects (except for bankruptcy costs on size which is also negative) are ambiguous. Thus, our tests do not allow us to identify a dominant factor in explaining the signs and significance of size and line-of-business concentration as explanatory variables for reinsurance demand.

We do not report coefficients and t-statistics in table 6 for the 23 line-of-insurance variables that are included in regression 3 since none of our hypotheses are related to the magnitudes of any of the coefficients. However, the importance of including these control variables should be obvious from an examination of the reported statistics; for example, the coefficient on line-of-business concentration is insignificant unless variables controlling for the percentage of business written in individual lines are included. More directly, the importance of including these variables can be assessed by observing that the adjusted R^2 in regression 3 is substantially larger than in regression 2 (.39 vs. .23) where the variables are not included.

V. Conclusions

The examination of reinsurance purchases by 1,276 property/casualty insurance companies provides evidence that ownership structure matters. Generally, the less diversified the owners' portfolios, the greater the reinsurance purchases. Thus Lloyd's reinsure most, while widely held stocks reinsure least. Moreover, subsidiary and group relations affect the demand for reinsurance. Subsidiaries and group members reinsure more (although our data do not allow us to distinguish between intragroup transactions and reinsurance transactions with external companies).

We also provide evidence that size, credit standing, and geographic concentration reduce the demand for reinsurance and weak evidence that line-of-business concentration reduces reinsurance demand, as well. Our estimated negative effect of geographic concentration suggests that the real-services argument is quantitatively important. The substantial explanatory improvement we obtain in our cross-sectional regression, by including the percentages of business written in the individual lines, indicates the importance of controlling for variation in

operating characteristics across lines of business for explaining variation in reinsurance purchases.

There are some potentially important limitations to our analysis: (1) The power of our tests is reduced by our lack of information about the tax status of individual firms. (2) More powerful tests could be designed if we had independent estimates of the operating cash flow volatilities of each line. (3) Our data are aggregated into lines of insurance; while within lines, policies are undoubtedly heterogeneous in their riskiness. With more detailed information about the risks of the specific policies sold by particular firms, tests with greater power are possible. (4) Our data do not distinguish between reinsurance purchases where the reinsurer is another member of the same group and purchases where a group member obtains reinsurance from an external reinsurer. With such data, more powerful tests employing our larger sample of firms are possible.

Our original motivation for this article was to provide evidence on the corporate demand for insurance. For industrial firms, the signs of the partial effects of ownership structure, credit standing, and size should be direct corollaries of our insurance industry results. Similarly, we expect the industrial firms' insurance demand to vary with the operating characteristics of their business. However, we doubt that the demand for insurance by noninsurance firms is related to their geographic or line-of-business concentration. If data on industrial firms' insurance purchases were available, then other proxies for real-service efficiencies, tax benefits, bankruptcy costs, and investment incentive effects would be required.

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