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Abstract

Since changes in the firm-specific or unsystematic risks faced by a corporation have no effect on firm value, corporate insurance purchases might seem unwarranted. However, more than 57 percent of insurance premiums are paid by businesses. This apparent contradiction has motivated researchers to suggest factors other than simple risk reduction that create corporate incentives to purchase insurance. This article tests the practical validity of most of the analytic arguments regarding corporate demand for insurance. In general, the empirical evidence from corporate property insurance purchases is consistent with the various theoretical arguments regarding corporate demand for insurance. The results suggest insurance helps to reduce various agency costs associated with stakeholder conflicts, provides real services, and reduces taxes. Finally, the less risky nature of regulated industries compared with unregulated industries is believed to lessen the various corporate incentives to purchase property insurance.

Introduction

This article tests the determinants of property insurance purchasing behavior of publicly traded corporations. Recognizing that risk aversion is an inadequate explanation for the insurance purchasing behavior of corporations, some authors (e.g., Main, 1982 and 1983; Mayers and Smith, 1982 and 1987; and Skogh, 1989) have sought to develop a positive theory of corporate insurance purchasing behavior. These studies argue that corporate insurance purchases are driven by (i) the underinvestment problem (interest conflicts between shareholders and debtholders); (ii) interest conflicts between owners and managers; (iii) the comparative advantage of insurers in providing risk-related services (also known as real services), such as claims handling or loss prevention); (iv) effects of the firm's expected tax liability; (v) the existence of bankruptcy costs; and (vi) the regulatory status of the firm. Smith and Stulz (1985)

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and Shapiro and Titman (1985) have extended some of these motivations to other forms of corporate hedging.

Three prior studies (Mayers and Smith, 1990; Core, 1997; and Yamori, 1999) have tested some of these theories by using data on reinsurance purchases by U.S. property and liability insurers, directors' and officers' insurance purchases by Canadian firms, and aggregate insurance purchases by Japanese firms. However, due to differences in the data used we are able to extend these studies by testing arguments for corporate insurance demand that the prior studies either could not test (tax motivations and bondholder-shareholder conflicts) or could not consistently test (the impact of size, regulation, and growth opportunities).

The article is organized as follows: First, the hypotheses that have been advanced to explain corporate incentives for insurance purchases are presented. Second, the data used to test these hypotheses are discussed. Third, the specific variables chosen to represent these hypotheses are presented. This includes the dependent variable, which incorporates unique data on insurance purchases that are unavailable from public sources. Finally, the results are summarized and compared to the prior empirical studies of corporate insurance demand.

HYPOTHESIS DEVELOPMENT

Prior research provides several hypotheses regarding the relation between the amount of insurance purchased by a widely held firm and the firm's various operating characteristics. Each of these hypotheses is described more fully in this section.

Underinvestment Problem

The underinvestment problem arises out of conflicts between shareholders and debtholders. Myers (1977) argues that since limited liability conveys to shareholders a potentially valuable put option, shareholders of leveraged firms might find that future discretionary projects with positive net present values are actually disadvantageous to them since the project's benefits accrue to the bondholders. Mayers and Smith (1987) show that one possible solution to this problem involves bonding the investment decision through the purchase of insurance. An optimally structured policy will simultaneously reallocate the benefits of the investment decision to shareholders while covering the cost of the policy by increasing the current market value of the bonds. Therefore, a firm that has more debt in its capital structure would buy more insurance coverage against its firm-specific risks than a firm with less debt in its capital structure. MacMinn (1987) and Garven and MacMinn (1993) specifically show how insurance covenants in debt issues can eliminate underinvestment. Further, Myers (1977) suggests that the magnitude of the underinvestment problem will be greater for firms with more growth opportunities. As a result, such firms are likely to use less debt in their capital structure and are more likely to purchase insurance.

Management Incentives

Difference in risk preferences presents a source of incentive-conflict between owners and managers with respect to corporate insurance purchasing policy. The total wealth of a manager often consists of common stock and stock options of the employing firm, a manager's human capital, and other assets whose return is not directly de-

pendent on that of the firm (see Agrawal and Mandelker, 1987). Jensen and Meckling (1976) observe that ownership of common stock and stock options by managers would produce incentive alignment that increases with the percentage of shares owned by managers.

On the other hand, Morck, Shleifer, and Vishny (1988) suggest that stock ownership by managers can lead to a managerial entrenchment effect that also increases with the percentage of shares controlled by managers.

If a manager holds a certain amount of common stock and stock options of the employing company, the manager's incentive to keep the company's income from fluctuating due to uninsured firm-specific risks varies according to the manager's wealth structure. If the firm has insurance coverage against its unsystematic risks, the variance of the return on the firm's assets is reduced. The value of common stock and stock options decreases with decreases in the variance. However, this reduction in the variance of the return on the firm's assets also would reduce the variance of the return on human capital-related income, and thus the expected value of human capital would increase. Hence, the impact of managerial share ownership on the demand for insurance is ambiguous. Nevertheless, we would expect the impact of managerial share ownership on the balance between incentive alignment and managerial entrenchment to vary with firm size, with increased share holdings by managers potentially increasing managerial entrenchment as firm size declines.

Real Services

Insurers have a comparative advantage in loss control and claims administration as well as other real services. Since insurance companies specialize in such real services and can take advantage of economies of scale, the costs of pre- and post-accident activities related to risks can be less for corporations with insurance than for those without insurance (see Mayers and Smith, 1982).

Boiler and machinery insurance is an example of the importance of the loss control function of insurance coverage. Explosion of a boiler is a typical hazard whose probability of occurring can be significantly reduced by well-designed loss control techniques. In other words, the safety projects with respect to boiler and machinery exposures can be positive net present value investment alternatives if elaborate measures are taken with respect to inspection and operation. However, proper inspection and operation of boilers and machinery should be accompanied, in practice, by specialized technical services. The insurance coverage for boilers and machinery is characterized by a combination of loss indemnification and loss prevention techniques. In addition, the existence of "administrative-services-only (ASO)" or "claims-only" policies and experience rating in liability insurance support the argument that insureds may benefit from insurers' expertise in claims administration and settlement.

If benefits from the real services provided by insurers are greater than the sum of costs for loading factors and the opportunity costs of the pure premium, buying insurance would represent a positive net present value project. Small firms would be more likely to benefit from the real services that insurers provide and would be more likely to purchase insurance than would large firms.

Tax Effects

Several insurance-related provisions of the tax code affect corporate purchasing of insurance, especially property insurance (see Main, 1983, and Chen and PonArul, 1989, for detailed discussion of possible tax effects). As stated in Mayers and Smith (1982), the required adjustment in the depreciable basis of property that replaces destroyed property produces the expected tax shield sooner with insurance than with self-insurance. Hence, the larger the amount of cumulative depreciation of the firm's assets, the greater will be the demand for property insurance. Also, insurance allows the firm to protect its other tax shields, such as investment tax credits and tax-loss carry-forwards (see MacMinn, 1987).

Expected Bankruptcy Costs

Bankruptcy costs can be categorized as either direct costs or indirect costs. Direct costs consist of all the costs pertaining to administration of the bankruptcy (e.g., legal fees, management's labor spent on the bankruptcy procedure, and so forth). Indirect costs include any kind of implicit loss due to bankruptcy, such as lost goodwill and lost credit. Insurance coverage reduces the probability of bankruptcy. Thus, a firm with more expected bankruptcy costs, higher probability of bankruptcy, or higher bankruptcy costs would have a greater incentive to purchase insurance than would a firm with lower expected costs (see Mayers and Smith, 1982).

Regulatory Environment

Since insurance companies are assumed to have a specialty in assessing loss distributions, regulators may have an incentive to force firms to buy insurance. If loading factors in premiums are shifted from insureds to product customers, firms would have no reason to act against the regulators' interests. Therefore, according to Mayers and Smith (1982), firms in a regulated industry would purchase more insurance than those in an unregulated industry, given a similar level of growth opportunities. On the other hand, Grillet (1992) argues that regulated firms buy less insurance because regulators are expected to guarantee a reasonable rate of return and hence a decreased likelihood of bankruptcy. Because of these conflicting hypotheses, the net effect of price regulation on insurance demand is ambiguous.

DATA

The data used in this study are collected on a by-firm basis across 38 industries. Data for all of the independent variables, except the cost of risk, are available from public sources such as annual reports and proxy statements. The cost of risk data are obtained from the 1990 Cost-of-Risk Survey, which was conducted jointly by the Risk and Insurance Management Society (RIMS) and Tillinghast. Data used in our study are for fiscal year 1989. Data for the measure of insurance demand are not readily available since no public source reports the amount of insurance purchased on a by-firm basis.[1] Therefore, we used a survey of the risk managers of 688 publicly traded

[1] Mayers and Smith (1990, p. 20) state that the implications of the existing analysis of the corporate demand for insurance have been untested "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."

companies to collect insurance demand data. The dependent variable was limited to property insurance premiums because of problems in determining an appropriate exposure basis for liability insurance premiums.

The survey sample consisted of companies whose risk manager could be identified from the *Directory of Buyers of Insurance, Benefit Plans, and Risk Management Services* and whose stock is traded in either the New York Stock Exchange (NYSE), the American Stock Exchange (AMEX), or the over-the-counter (OTC) market. A questionnaire was sent to 688 companies that are dispersed over 38 industries classified by a two-digit, Primary Standard Industrial Classification (SIC) code.[2] Based on numbers from the U.S. Census Bureau, these 38 industries represent 76.2 percent of U.S. firms on the basis of sales. Several industries such as agriculture, forestry, fishing, finance, insurance, real estate, services, and public administration were excluded from the survey target for two reasons. First, companies in those industries are believed to have relatively less insurable value in their fixed assets. Second, inconsistency could arise in important independent variables among industries.[3] The grouping of industries used by the 1990 Cost-of-Risk Survey was reflected in determining target industries. The 38 industries included in our study are grouped into 15 different categories by the Cost-of-Risk Survey.

A response rate of 35.4 percent was ultimately achieved by the mailing. Out of 688 companies in the mailing sample, 251 responded to the survey questionnaire. However, among the surveys returned, 64 responses could not be included in the final sample because premiums provided could not be broken down into the various insurance lines that are described below. As a result, 187 companies constituted the final sample. Table 1 shows the target risk classes and industries, and the response results. The representative distribution of respondents relative to the survey sample and the fact that respondents reported property premiums ranging from $0 to more than $5 per $1,000 of insurable values suggest that sample selection bias is not a serious problem.

Other data are obtained from the COMPUSTAT tape, the Compact Disclosure disc or the Laser Disclosure disc. The discs contain information selected from the Securities and Exchange Commission (SEC) filings, including 10-K reports, proxy statements, and so forth.

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[2] Two pilot mailings were conducted before the final questionnaire was sent to all companies in the mailing sample. The first pilot mailing was performed with a questionnaire that was more complicated than the one used in the final mailing. The questionnaire was directed to chief financial officers, which resulted in a low response rate: two responses out of 10 companies. The second pilot questionnaire was restructured to exclude liability insurance-related questions. Moreover, the second mailing was directed to risk managers instead of chief financial officers. As a result, the time period for response was shortened, and the response rate was increased from 20 to 40 percent.

[3] For example, compare the debt/equity ratio of insurance companies or banks with that of other industrial firms. The financial intermediaries usually use premiums received, loss reserves, or deposits as a funding source rather than debt. Therefore, this ratio would not be meaningful.

VARIABLES

In this section, we briefly describe the specific variables used to test the hypotheses presented above. Table 2 defines the variables and provides summary statistics for each of the variables.

TABLE 1
Responses to the Questionnaire

Risk Class	Number of Companies in Mailing Sample	Number of Responses	Number of Companies in Final Sample (Response Rate %)
Mining	38	11	10 (26.3)
Construction	29	11	7 (24.1)
Food, textiles	51	21	15 (29.4)
Lumber, furniture	29	9	3 (10.3)
Printing, publishing	26	12	7 (26.9)
Chemicals	67	26	20 (29.9)
Primary metals and stone	49	12	11 (22.4)
Metal products	30	15	11 (36.7)
Machinery	66	26	19 (28.8)
Electric equipment and instruments	77	22	22 (28.6)
Transportation equipment	33	13	11 (33.3)
Electric utility	36	21	17 (47.2)
Natural gas utility	29	20	15 (51.3)
Wholesale	71	15	10 (14.1)
Retail	57	17	9 (15.8)
Total	688	251 (35.4)	187 (27.2)

Property Insurance Demand

The amount of insurance purchased by a firm is represented by the ratio of property insurance premiums to the value of insurable assets. The dependent variable can be defined as property insurance costs per unit value of insurable assets.[4] The denomi-

[4] A very important issue in studying the demand for insurance by corporations is establishing an accurate measure of quantity demanded. The insurance premiums paid by a firm are a function of price and quantity. Price, in turn, is a function of the frequency and severity distributions of the loss exposures that the firm seeks to cover under the insurance policy. As a result, we wish to isolate a measure of quantity from the compound function underlying the property insurance premiums paid by a firm. We control for frequency and severity differences by including the property exposure cost-of-risk measure on the right-hand side of our estimation equation. Further, we refine our construct for measuring quantity of insurance demanded by scaling the premiums by a measure of the firm's insurable property. This construct for measuring insurance demand has the advantage of controlling for both risk differences and levels of assets exposed to loss. This is important since a large firm may spend more on property insurance than a small firm, but when the difference in insurable assets between the two firms is considered, we would expect the large firm to purchase proportionately less insurance.

TABLE 2

Descriptive Statistics and Definitions for Variables (N = 187)

Variable	Definition	Mean	Standard Deviation	Minimum	First Quartile	Median	Third Quartile	Maximum
Relative property premiums	Property insurance premiums/ (Property, plant, and equipment – Lands and capitalized leases + Average inventory in $ thousands)	1.4439	1.1564	0	0.6539	1.0821	2.0119	5.6937
Debt-equity ratio	Book value of long-term debt/ (Long-term debt + Market value of equity)	0.2710	0.1987	0	0.1277	0.2236	0.3892	0.9362
Market-to-book ratio	(Market value of firm's equity + Book value of liabilities)/ Book value of total assets	1.4293	0.5639	0.8079	1.0945	1.2485	1.6038	4.5284
Managerial shareownership	Percentage of shares owned by managers	8.5258	14.5301	0.0100	0.8000	2.6200	9.4400	99.9900
Total assets	Book value of total assets in $ billions	4.9827	17.1069	0.0114	0.3599	1.1642	3.6090	173.2970
Tax shields	(Investment tax credits + Tax loss carry-forwards)/Total assets	0.0253	0.0846	0	0	0.0002	0.0024	0.6202
Cumulative depreciation	Cumulative depreciation/Historical cost of fixed assets	0.4082	0.1378	0	0.3297	0.4009	0.4860	0.8176
Solvency probability	Working capital/Total assets	0.1480	0.1961	–0.6619	0.0326	0.1509	0.2824	0.5749
Regulated	Dummy variable = 1 (if firm is a regulated utility)	0.1711	0.3776	0	0	0	0	1.0000
Cost of risk	Property premiums + Unreimbursed property losses as a percentage of revenues	0.1156	0.0649	0.0200	0.0600	0.1000	0.1414	0.2500

nator, the value of insurable assets, is represented by the balance sheet figure for *Property, plant, and equipment* less *Lands and capitalized leases* plus *Inventory*. The value of *Inventory* is averaged based on quarterly data, to eliminate seasonal fluctuations. The amount of *Lands and capitalized leases* is subtracted because they are not usually subject to insurance.

The questionnaire, included in the appendix, was used to collect property insurance premium data. Respondents were asked to provide property insurance premiums in five categories and to exclude property insurance premiums paid to a wholly owned captive insurer. From the five insurance lines property damage, business interruption, boiler and machinery and business interruption, flood and earthquake, and others, only premiums for property damage and boiler and machinery are chosen as the numerator of the dependent variable. Premiums for the business interruption insurance line are excluded because the revenue-expense structures vary by firm, even when firms are similar with respect to other characteristics. Also, the insurance line of flood and earthquake is not considered so that regional factors do not reduce the homogeneity of the dependent variable. The dependent variable representing property insurance demand is calculated as the ratio of insurance premiums for property damage coverage and boiler and machinery coverage to the firm's value of assets that are insurable against accidental losses (relative property premiums).

Leverage and Growth Opportunities

For testing the underinvestment problem hypothesis, we include proxies for leverage and growth opportunities. We measure leverage by the ratio of long-term debt to long-term debt plus equity (debt-equity ratio). The results were unaffected by using the ratio of total debt to total debt plus market value of equity instead. We measure growth opportunities by the ratio of the market value of the firm's equity plus the book value of the firm's liabilities divided by the book value of the firm's assets (market-to-book ratio). We expect the potential underinvestment problem, and therefore the demand for insurance, to be greater for firms with higher leverage and more growth opportunities.[5]

Managerial Share Holdings

The ratio of shares owned by managers to shares outstanding is selected to test the managerial incentives hypothesis. Agrawal and Mandelker (1987) perform an empirical study on the relation between management incentives and real investment policy. The test employs three different proxy variables: the ratio of bonuses related to firm value to total compensation, the ratio of bonuses related to firm value to annual salary plus bonus, and the ratio of the number of shares owned by managers to the number of shares outstanding. The results of Agrawal and Mandelker's empirical study are not significantly different from each other, regardless of which proxy variable is included in the regression model. This finding leads us to choose the por-

[5] According to Nance, Smith, and Smithson (1993), preferred stock is often used as another way to reduce the variability of corporate income. Therefore, preferred stock can lessen corporate incentives to purchase insurance. This argument was tested by including the ratio of preferred stock to preferred stock plus debt in our model. The coefficient on this ratio was not statistically significant, and the other results were qualitatively unaffected.

tion of shares owned by managers as the proxy variable to measure managerial incentives because this proxy is the most readily available. Data for the numbers of shares owned by managers are available from the Proxy Statement.

We would prefer to measure managers' wealth and degree of diversification of human capital directly, but in the absence of direct information, we would expect that managers of large firms would have better diversification of human capital than managers of small firms. Stated another way, we would expect that for a given level of managerial share holdings, the degree of entrenchment would increase with decreases in firm size. As a result, we include an interaction term, (managerial shareownership)*ln(total assets), to control for the joint effect of size and managerial share holdings on insurance purchases. We would expect the sign on this interaction term to be negative. Because of the competing hypotheses regarding the impact of managerial share holdings, the net effect of the managerial shareownership on insurance purchases is ambiguous.

Size

The real services hypothesis is tested using the log of total assets. According to Mayers and Smith (1990), it is expected that small firms gain more from insurers' real services than large firms. Additionally, Warner (1977) suggests that the amount of bankruptcy costs is not proportional to firm size, which means that large companies have smaller relative bankruptcy costs. Therefore, the log of firm size measured by total assets can proxy the absolute amount of bankruptcy costs. As a result, both the real services and bankruptcy costs hypotheses would suggest a negative association between firm size and the amount of insurance purchased by the firm.

Tax Effects

The log of the ratio of tax loss carry-forwards and investment tax credits to total assets measures the level of tax shields the firm has to protect. Insurance protects against the loss of these tax shields by reducing the probability of negative income. Therefore, the ratio would be positively related to the amount of insurance purchased. Additionally, the purchase of tax-deductible property insurance permits a firm to immediately deduct the entire cost of destroyed property. However, if the same property were self-insured, its cost if destroyed would be written off gradually through depreciation deductions (see Williams et al., 1995, p. 263). Hence, demand for insurance should be greater for a firm with more accumulated depreciation of its assets. The ratio of cumulative depreciation to historical costs of fixed assets measures the magnitude of this deferral. The economic benefit would be expected to be greatest with replacement cost insurance. In fact, according to the 1990 Cost-of-Risk Survey, more than 90 percent of responding firms insure their fixed assets on a replacement-cost basis.

Bankruptcy Probability

The amount of expected bankruptcy costs can be defined as bankruptcy costs multiplied by the bankruptcy probability. The bankruptcy-related literature, most notably Altman (1968) and Ohlson (1980), suggests that a proxy that measures the probability of bankruptcy is the ratio of working capital to total assets. This proxy is believed to be negatively related to the probability of bankruptcy and, hence, is actually a

measure of the solvency probability. Since insurance reduces the probability of bankruptcy, the proxy would be expected to be negatively related to the amount of insurance the firm purchases.

Regulation

Our sample includes firms from two industries that are price- or solvency-regulated: the electric utility industry and the gas utility industry. A dummy variable indicates whether the firm is included in the utility industry. Because of contradictory hypotheses, the effect of this variable on property insurance demand is ambiguous.

Cost of Risk

Clearly, the probability of loss varies by industry. Thus, premiums cannot be compared across industries without control for such variation. The 1990 Cost-of-Risk Survey includes a control variable to reflect differences in exposure across industries. The cost of risk is defined as "the sum of net insurance premiums, unreimbursed losses and the cost of risk control, loss prevention, and administration." The 38 industries represented in our survey sample are grouped into 15 risk classes. Table 3 presents the cost of risk for the different risk classes included in our study. As a measure of exposure, we would expect the cost of risk to be positively associated with the dependent variable, relative property premiums. Additionally, the model is estimated using weighted cost of risk for the firms' top three primary SIC codes. This is done to control more precisely for cost of risk variation in firms with diverse operations.

RESULTS

An ordinary least squares (OLS) regression model is used to test the arguments concerning the relation between the amount of insurance purchased by a firm and the firm's various operating characteristics. The empirical distributions of total assets and tax shields are highly skewed. Thus, we transform these variables by taking natural logarithms to reduce potential heteroscedasticity and the impact of extreme values. No other violations of the OLS assumptions are detected.[6] The regression results of the ratio of property premiums to insured value on its hypothesized determinants are reported in Table 4.

The results for our two proxies related to the underinvestment problem hypothesis, the debt-equity ratio, our measure of leverage, and the market-to-book ratio,[7] our

[6] Three different tests are performed for detecting heteroscedasticity: Breusch-Pagan, Goldfeld-Quandt, and White. None of the tests reject the null hypothesis of constant variances of the error. The highest correlation coefficient in absolute value between the independent variables is 0.66. The variance inflation factors (VIF) and condition numbers do not indicate multicollinearity. The largest VIF in our model is 2.06, and the largest condition number produced by the model is 18.7. See Neter, Wasserman, and Kutner (1990) for a discussion of VIFs and Belsley, Kuh, and Welsch (1980) for information on condition numbers.

[7] This proxy is used by several authors (for example, Smith and Watts, 1992, and Core, 1997). Further, Gaver and Gaver (1993) showed that this same variable was the most highly correlated (over 83 percent) with a common factor that they developed from the combination of six growth opportunity measures. We also estimated the empirical model using another common measure of growth opportunities, the market value of equity to book value of equity. The results were consistent with those reported in Table 4.

measure of growth opportunities,[8] are consistent with insurance playing an important role in controlling the underinvestment problem. The coefficients on both variables are positive and statistically significant.

TABLE 3

Cost of Risk for Different Risk Classes

Risk Class	Premiums Plus Unreimbursed Losses as a Percentage of Revenues in 1989	Property Premiums as a Percentage of Insured Value in 1989
Mining	0.23	0.12
Construction	0.08	0.07
Food, textiles	0.07	0.05
Lumber, furniture	0.14	0.05
Printing, publishing	0.10	0.04
Chemicals	0.14	0.08
Primary metals and stone	0.17	0.02
Metal products	0.12	0.04
Machinery	0.06	0.07
Electric equipment and instruments	0.05	0.04
Transportation equipment	0.09	0.01
Electric utility	0.25	0.02
Natural gas utility	0.13	0.06
Wholesale	0.02	0.12
Retail	0.04	0.03

Source: The 1990 Cost-of-Risk Survey

Our measure for the alignment of incentives between managers and shareholders, (managerial shareownership), is negative and statistically significant.[9] Additionally, the coefficient on the interaction term between size and managerial share holdings is

[8] Since the capital structure literature suggests that managers of firms with relatively more growth opportunities would choose lower leverage, leverage and growth opportunities will be negatively related. See Lang et al. (1996) for a discussion of this issue. For the firms in this article, the correlation between the market-to-book ratio and the debt-equity ratio is negative and significant at the .01 level (–.66). Growth opportunities also will be related to some of the other independent variables in the model including regulatory status. Given the expected relation between growth opportunities, leverage, and regulatory status, the model also was estimated with three interaction terms: (market-to-book ratio)*(debt-equity ratio), (market-to-book ratio)*(debt-equity ratio), and (debt-equity ratio)*(regulated). The coefficient on each interaction term was not statistically significant, and the other results were qualitatively unaffected.

[9] Downs and Sommer (1999) follow an alternative specification for testing the effect of managerial share holdings on risk taking (the opposite of hedging). This specification reflects the potential nonlinearity in the relation between insider ownership and risk taking as described by Morck, Shleifer, and Vishny (1988). We estimated our model replacing the managerial shareownership and (managerial shareownership)*ln(total assets) variables with three variables that reflect managerial share holdings in the ranges 0 to 5 percent, over 5 to 45 percent, and over 45 percent. The results for these three variables were consistent with the results of Downs and Sommer (1999), and the coefficients on the other variables in the model were qualitatively unaffected.

TABLE 4

OLS Regression Results for Corporate Property Insurance Purchases

Relative property premiums = Property insurance premiums/(Property, plant, and equipment – Lands and capitalized leases + Average inventory in $ thousands)

Variable	Variable Definition	Expected Sign	Coefficient† (Adj. Std. Error)
Intercept			–0.2283 (0.4671)
Debt-equity ratio	Book value of long-term debt/ (Long-term debt + Market value of equity)	+	1.3040*** (0.4382)
Market-to-book ratio	(Market value of firm's equity + Book value of liabilities)/ Book value of total assets	+	0.3869* (0.2121)
Managerial shareownership	Percentage of shares owned by managers	+/–	–0.0133*** (0.0048)
(managerial shareownership)* ln(total assets)	Interaction term		–0.0096** (0.0044)
ln(total assets)	ln (Book value of total assets in $ billions)	–	–0.1824*** (0.0587)
ln(tax shields)	ln [(Investment tax credits + Tax loss carry-forwards)/ Total assets]	+	0.0109* (0.0056)
Cumulative depreciation	Cumulative depreciation/ Historical cost of fixed assets	+	1.9615*** (0.5771)
Solvency probability	Working capital/Total assets	–	0.0373 (0.3535)
Regulated	Dummy variable = 1 (if firm is a regulated utility)	+/–	–1.0563*** (0.2359)
Cost of risk	Property premiums + Unreimbursed property losses as a percentage of revenues	+	3.3446** (1.3486)

*significant at the .10 level
**significant at the .05 level
***significant at the .01 level

R^2 = .318
adj-R^2 = .279
F-stat. = 8.211***

† This model was re-estimated using a revised cost-of-risk variable that weighted the respective cost-of-risk values for each of a firm's top three primary SIC codes. The results were qualitatively unaffected by the use of the alternative measure. The standard errors are the asymptotically consistent standard errors. The model also was estimated using a weighted least squares approach, where the observations are weighted using the bounded influence technique described in Belsley, Kuh, and Welsch (1980). The results of that model were qualitatively similar to those presented here. Given the expected relation between growth opportunities, leverage, and regulatory status, the model also was estimated with three interaction terms: (market-to-book ratio)*(debt-equity ratio), (market-to-book ratio)*(debt-equity ratio), and (debt-equity ratio)*(regulated). The coefficient on each interaction term was not statistically significant, and the other results were qualitatively unaffected.

statistically significant with a negative sign. As a result, the impact of managerial share holdings on corporate property insurance purchases can only be interpreted by considering both terms jointly. Taking the partial derivative with respect to managerial shareownership, then setting it equal to zero and solving for the ln(total assets) suggests that managerial share holdings are negatively associated to insurance purchases. However, the association declines in magnitude with decreases in firm size, and for firms with less than $250 million in assets, increases in managerial share holdings actually increased demand for insurance. We described above two conflicting hypotheses regarding the implications of managerial share holdings. The first is an incentive alignment effect and the other is a managerial entrenchment effect. Our results are consistent with a transition from the first effect to the second effect as firm size declines.[10]

The ln(total assets) is significantly related, with a negative sign, to the dependent variable.[11] The coefficient on the interaction term, (managerial shareownership)* ln(total assets), is also negative and statistically significant. However, since managerial shareownership is strictly positive, the marginal effect of size on insurance purchases is strictly negative. Firm size is associated with corporate incentives to purchase insurance due to real services provided by insurers and the impact of bankruptcy costs. Thus, the result is consistent with the implications of both the real services hypothesis and the expected bankruptcy costs hypothesis.

Although the results for size are consistent with the expected implications of bankruptcy costs, our proxy for the likelihood of bankruptcy is not statistically significant.[12]

Tax benefits from holdings of insurance coverage increase as the amount of investment tax credits and tax loss carry-forwards or the difference between current book value of insurable assets and tax-deductible allowances for their replacement increase. We expect our proxy for tax shields, ln(tax shields), to be positively related to the dependent variable. The estimated coefficient on this variable is positive and statistically significant. The positive and statistically significant coefficient on the cumulative depreciation variable suggests that firms with relatively more accumulated de-

[10] Agrawal and Mandelker (1987) use two other proxy variables in estimating the impact of management incentives concerning corporate real investment decision. One is the ratio of the value of common stock and options held by managers to the value of total compensation. The other uses only the amount of cash compensation, instead of total compensation, as the denominator. According to Agrawal and Mandelker (1987), the former may measure the value of firm-value related wealth relative to the value of human capital, and the latter is a proxy normalized by just another variable: the value of representative noncontingent compensation. The present study calculates these two variables for a subsample stratified by the criterion of firm size. The correlation coefficients between each of the two variables and the ratio of shares owned by managers to shares outstanding are both around .7. The relation is consistent with the empirical results of Agrawal and Mandelker's study. Again, note that their empirical results are consistent, no matter which variable is employed.

[11] Substitution of the book value of debt plus market value of equity for total assets did not affect the regression results reported in Table 4.

[12] In addition, the empirical estimation also fails to provide significance of the measure, "Altman's Z value," when using it as a measure of the probability of bankruptcy. See Altman (1968) for this alternative proxy variable.

preciation purchase more insurance. The tax deferral advantages related to the replacement of destroyed depreciable property are unique to property insurance. These results are consistent with taxes playing an important role in the demand for property insurance by corporations.

To avoid unwanted attention of regulators, firms in a regulated industry might purchase more insurance than those in an unregulated industry. On the other hand, regulated firms might buy less insurance because regulators guarantee a rate of return resulting in a relatively low business risk, which lessens corporate incentives to hedge against firm-specific risks. Our results show that firms in a regulated industry consistently buy less insurance, which supports the second hypothesis. Corporate incentives to purchase property insurance appear lower if a firm is price- or solvency-regulated.

Finally, our control variable for differences in risk exposure across industries (cost-of-risk) is positively associated with our measure of property insurance purchases. This result highlights the importance of considering differences in risk exposure when attempting to measure the degree of corporate risk management.[13]

CONCLUSIONS

The empirical evidence obtained in our study supports the underinvestment problem hypothesis and the real services hypothesis and is consistent with the hypothesis that insurance purchases play a role in reducing expected bankruptcy costs. We find support for the importance of effects of conflicting interests between managers and shareholders in understanding the corporate demand for insurance. The regression results provide strong evidence of the importance of tax motivations for corporate property insurance purchases. In addition, regulated firms appear to buy less insurance than unregulated firms.

Contributions

The results of the empirical estimation of the regression model suggest that insurance is valued by the firm as a device to minimize agency problems and as a source of real services. Therefore, the empirical evidence indicates an important social role of insurance other than the pure risk transfer function. Additionally, in some important ways, the results of our study extend the empirical results of the three prior studies of corporate insurance demand (Mayers and Smith, 1990; Core, 1997; Yamori, 1999). First, none of the prior studies provides empirical results supporting the tax motivations for insurance purchases. Second, although the prior studies discuss the potential importance of the underinvestment problem in understanding insurance purchases, neither Mayers and Smith (1990) nor Core (1997) directly tests the magnitude of this problem resulting from a firm's use of leverage. Yamori (1999) finds no empirical support for his leverage measure. Further, only Core (1997) tests the importance of differences in growth opportunities to the demand for insurance. Third, the other studies of insurance purchases by general corporations, Core (1997) and

[13] An alternative measure was constructed by weighting the respective costs of risk for each firm's top three primary SIC codes. This procedure resulted in a significant change in the cost-of-risk measure (50 percent up or down) only for approximately 20 firms in the sample. The results were qualitatively unaffected by the use of the alternative measure.

Yamori (1999), could not fully distinguish between effects related to differences in risk exposure and those related to differences in incentives to purchase insurance. This leads to some interesting differences in the results between our studies. Most notable is the opposite direction on the relation between insurance purchases and the proxies for size and regulatory environment.

Limitations

The study does have several limitations. First, since the study is based on data for property insurance only, the difference in demand between property insurance and liability insurance, if any, cannot be analyzed. For example, the importance of the probability of bankruptcy might have been supported with data for liability insurance. Also, liability insurance-related arguments such as interest conflicts with employees and customers cannot be tested. Real services efficiencies are likely to be more important with liability insurance as well. However, it is very difficult to measure the exposure basis of liability insurance. Second, using time-specific data, 1989 only, limits the empirical results to some extent. If time-series data were available, the effects of time-related conditions of the insurance market, such as underwriting cycles, could have been examined.

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APPENDIX

Questionnaire

*** All questions are associated with the situation and figures for fiscal year 1989.**

Below please indicate the amount of property insurance premiums in 1989. The year 1989 refers to the fiscal year ending in 1989. However, if your insurance policy year does not coincide with the fiscal year and you cannot reasonably calculate the premium on a fiscal year basis, please give the premium for the insurance policy year ending in 1989.

Please check year used.

fiscal year ____ or policy year ____

Please separate the insurance lines as follows:

Please exclude the amount of premiums paid to a pure captive, wholly owned by your company.

Property Damage	$_____
Business Interruption	$_____
Boiler & Machinery Direct Damage and Business Interruption	$_____
Flood and Earthquake	$_____
Others (e.g., auto, fidelity/bankers, etc.)	$_____
Total Property Insurance Premium	**$**_____

If you cannot separate the lines, please give the total premiums for Property Damage and Boiler & Machinery insurance only.

$_____