INTERNAL VERSUS EXTERNAL CAPITAL MARKETS IN THE INSURANCE INDUSTRY: THE ROLE OF REINSURANCE

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ABSTRACT

This study compares internal and external sources of capital in the insurance industry by analyzing reinsurance activity between affiliated and unaffiliated insurers. Tests are performed using data from a large sample of property-liability insurers that are affiliated with at least one other property-liability insurer. Results indicate that while demands for internal and external reinsurance have some factors in common, there are also cost-based differences in internal and external capital, as well as structural differences in demand for internal and external reinsurance. Results are consistent with previous theories related to internal versus external capital markets.

I. INTRODUCTION

Reinsurance is a critically important part of the insurance industry. In 1997, insurers paid $198 billion in reinsurance premiums. Many reinsurance transactions take place between insurers and unaffiliated reinsurers, but the bulk of reinsurance transactions actually occur between affiliated insurers. Insurance firms are often affiliated as members of an insurance group. In 1997, 1724 out of 2740 U.S. property casualty insurance companies were affiliated with insurance groups. These 1724 group members accounted for ninety-one percent of industry direct written premiums in that year. Reinsurance activity within insurance groups is a common practice. In 1997, almost $157 billion were ceded within property casualty insurance groups as reinsurance premiums. Roughly eighty percent of reinsurance activity (by premium volume) occurs within groups rather than between insurers and unaffiliated external reinsurers. The use of reinsurance contracts among affiliated insurers may represent an extremely active internal capital market.

Some previous studies have tried to determine factors influencing the demand for reinsurance. Mayers and Smith (1982, 1990) propose hypotheses about the demand for insurance and subsequently test these hypotheses using data from the insurance industry. They contend the purchase of reinsurance by an insurance company is comparable to the purchase of insurance by firms in other industries. They hypothesize that demand for reinsurance may be a function of the structure of the tax code, expected costs of financial distress, the insurer's ownership structure, investment incentives, information asymmetry, and comparative advantages in real service production, among other factors. In their study, internal and external reinsurance are not separated.[1] As will be discussed in the next section, it is not clear that all of the hypotheses of Mayers and Smith (1982, 1990) regarding the demand for reinsurance would apply equally to intra-group reinsurance as to reinsurance with unaffiliated reinsurers. Garven and Lamm-Tennant (2000) examine the demand for reinsurance from a capital-structure perspective, but only include unaffiliated insurers in their sample, which represent a small, unrepresentative segment of the industry. Jean-Baptiste and Santomero (2000) examine the effect of asymmetric information on the trading of underwriting risk between insurers and reinsurers, concluding that such information asymmetry affects both the cost of reinsurance and the amount of reinsurance purchased. Their analysis does not consider the reduced level of information asymmetry involved when the insurer and reinsurer are part of the same affiliated group, and how that might influence the amount of reinsurance transacted.

Purchasing reinsurance is essentially a capital structure decision, with equity capital and reinsurance acting as substitutes (Berger, Cummins and Tennyson, 1992; Garven and Lamm-Tennant, 2000). Extensive work in the corporate finance literature seeks to explain how

[1] As a robustness check, Mayers and Smith (1990) use a subsample of single unaffiliated insurers.

corporations choose their capital structure. Many studies focus on capital sources that are external to the firm such as debt and equity. Some focus on the single firm's preferences among various sources of capital used to fund projects (Myers, 1984, Myers and Majluf, 1984, Greenwald, Stiglitz, and Weiss, 1984). Fazzari, Hubbard, and Petersen (1988) show that information asymmetries between recipients and providers of capital increase the cost of external capital relative to the cost of internal capital. As mentioned above, Jean-Baptiste and Santomero (2000) argue that information asymmetry increases the cost of reinsurance. In contrast to studies focusing on external capital, another line of research investigates internal capital markets in which a corporate headquarters allocates capital among members of a conglomerate. Several studies present hypotheses of costs and benefits of internal capital markets. Alchian (1969), Williamson (1975), and Gertner, Scharfstein, and Stein (1994) progress to a theory where consequences of internal and external capital markets differ by relative effects of asymmetric information and agency problems. More specifically, internal capital markets may be associated with decreased information asymmetries, increased monitoring incentives, decreased managers' entrepreneurial incentives, and more efficient redeployment of assets.

This study simultaneously examines demand for internal and external reinsurance, using both traditional reinsurance demand theory and internal capital markets theory to develop hypotheses. The paper makes a number of contributions. First, it will serve as a test of whether the results of previous literature, which treated internal and external reinsurance the same or looked only at single unaffiliated insurers, are supported when the data is refined so that internal and external reinsurance are disaggregated. Second, this paper will examine whether the factors that influence internal reinsurance purchases differ from those factors that influence external

reinsurance purchases. In so doing, the paper will shed light on the dynamics of internal versus external capital markets, an issue that is only beginning to be explored in the insurance industry.

This research is of potential interest to parties both inside and outside of the insurance industry. The importance of reinsurance in the industry is without question. However, despite the fact that the majority of reinsurance transactions occur between group members rather than with external reinsurers, previous research has not explored the topic of intra-group reinsurance. More broadly, analyzing internal reinsurance along with external reinsurance provides a unique opportunity to explore issues related to the general finance topic of internal capital markets.

The remainder of this paper is organized as follows. Section II provides a very basic framework for looking at the reinsurance purchase decision, drawing from the insights of Jean-Baptiste and Santomero (2000). Section III develops empirical hypotheses related to demand for internal and external reinsurance and describes the variables used in the empirical analysis. Section IV describes the data and empirical tests. Section V discusses results and Section VI concludes.

II. THE REINSURANCE PURCHASE DECISION

Consider the situation of an insurer attempting to decide how much of a particular type of reinsurance to purchase. As described in detail in the next section, the purchase of reinsurance can yield a number of benefits. Among other things, the purchase of reinsurance can reduce expected taxes, reduce expected costs of bankruptcy, and allow access to real services of the reinsurer where the reinsurer has a comparative advantage over the ceding insurer in the provision of these services (Mayers and Smith, 1982, 1990; Berger, Cummins and Tennyson, 1992; Garven and Lamm-Tennant, 2000). Obviously, the purchase of reinsurance also involves costs for the ceding insurer. In the model of Jean-Baptiste and Santomero (2000), the premium

for reinsurance reflects both the true riskiness of the primary insurer's policies that are being reinsured, as well as the noisiness of the reinsurer's signal regarding the true quality of the reinsured business. This noisiness arises as a result of asymmetric information between the insurer and the reinsurer. The insurer has more information than the reinsurer regarding the risk being transferred, as well as more control over the ultimate outcome of the risk (through claims settlement processes). Jean-Baptiste and Santomero (2000) demonstrate that this asymmetric information leads to higher reinsurance premiums, lower expected profit by the ceding insurer, and a lower quantity of reinsurance being purchased compared to the first-best outcome.

The Jean-Baptiste and Santomero (2000) analysis implicitly assumes that reinsurance transactions occur between entities with no affiliation to each other aside from the reinsurance arrangement itself. As stated earlier, however, the majority of reinsurance premiums involve transactions between insurers that are affiliated as part of the same insurer group. Assuming the individual companies within an insurer group are being managed to maximize the value of the group as a whole, reinsurance transactions among group members should involve dramatically lower (perhaps even zero) asymmetric information costs compared to transactions between an insurer and an unaffiliated reinsurer. Without the noise created by asymmetric information, internal reinsurance (i.e., reinsurance between affiliates of the same group) should be cheaper than external reinsurance.

The story does not end there, of course. While internal reinsurance may have a lower cost than external reinsurance due to reduced asymmetric information, internal and external reinsurance may have different levels of benefit as well. For example, a key benefit to external reinsurance, as mentioned earlier, is the ability to access certain expertise in real services possessed by the reinsurer. Within a group being managed to maximize the group's overall

value, such expertise (to the extent it exists within the group) would be shared among members without the need for reinsurance deals. Alternatively, the required expertise may simply not exist within the group, making external reinsurance the only option for accessing the expertise. As another example, if an insurer's motivation for reinsurance is to reduce the probability of bankruptcy, but the rest of the insurer group has no better capacity for holding the risk than the insurer that currently holds the risk, there may be no benefit (to the group) of reinsuring within the group. In such a case, external reinsurance would be the more beneficial option. The key point is simply that both the cost and benefit of any particular reinsurance transaction may differ between internal and external reinsurance. Thus, there may be some cases where internal reinsurance dominates external reinsurance, and other cases where external reinsurance dominates internal reinsurance. Within a particular insurer with multiple lines of business and multiple motivations for purchasing reinsurance, it may well be optimal to simultaneously purchase some internal reinsurance and some external reinsurance.

With this general framework in mind, the next section describes specific hypotheses related to quantities of internal and external reinsurance purchased by insurers, as well as the variables to be used in the empirical analysis to test the hypotheses. While for expositional convenience and comparability to previous studies the hypotheses generally are worded to focus on the demand for reinsurance, note that the analysis implicitly considers supply factors as well, because it is assumed that the decision to purchase reinsurance is based on the equilibrium price available to the insurer, which will depend on things such as the level of information asymmetry between the parties. In addition, the empirical model includes variables to control for the capacity constraints applying to internal reinsurance transactions.

III. HYPOTHESES DEVELOPMENT AND DESCRIPTION OF VARIABLES

Reinsurance Activity. The dependent variables to be used in the analysis are discussed first. The measure of external reinsurance activity (*External Reinsurance*) is consistent with that used by Mayers and Smith (1990) and Garven and Lamm-Tennant (2000); namely, the ratio of reinsurance ceded externally to premiums written (direct and assumed). The measure of internal reinsurance activity (*Internal Reinsurance*) is a net reinsurance measure. Net internal reinsurance ceded (reinsurance ceded net of reinsurance assumed) is used in the numerator. The adjustment is necessary because this study is concerned with how capital is shared among members within a group. A net measure of external reinsurance activity would not be appropriate because unaffiliated companies do not share the common goal of maximizing a group's value.[2] The independent variables used in the study, and their associated hypotheses, are explained below.

Taxes. Provisions in the United States Tax Code may play a role in an insurer's decision to purchase reinsurance. Insurance firms are likely to be on the convex portion of the tax schedule.[3] Mayers and Smith (1982, 1990) point out that the purchase of reinsurance can lower the volatility of an insurer's pretax earnings thereby decreasing its expected tax liability. Garven and Louberge (1996) develop a model that implies that insurers use reinsurance to achieve the optimal allocation of tax shield benefits. To empirically test the tax motivation for purchasing reinsurance, Garven & Lamm-Tennant (2000) offer the following testable hypothesis: "Other

[2] Hoerger, Sloan and Hassan (1990), studying demand for external reinsurance, use a net measure of reinsurance in the numerator of their dependent variable similar to the one used here for internal reinsurance (i.e., reinsurance ceded – reinsurance assumed). However, for external reinsurance, we believe the measure of Mayers and Smith (1990) and Garven and Lamm-Tennant (2000) is more appropriate. As a robustness test, all empirical models presented were re-estimated using net measures of both internal and external reinsurance. Results were qualitatively similar to those presented here.

[3] According to IRS form 1120pc the federal income tax schedule for property-casualty insurers becomes a linear function for income in excess of $18,333,333. This number must be considered a rough estimate because it does not fully account for implications of the Alternative Minimum Tax introduced in 1986.

things equal, the demand for reinsurance will be greater for firms that concentrate their investments in tax favored assets." Insurers may deduct incurred losses from pre-tax income. Large unexpected losses may more than offset an insurer's earned premium income. In this case the insurer would not be able to fully recognize the tax shield provided by the tax-favored asset. Because after-tax certainty-equivalent returns must be equal across all securities, the chance of not being able to recognize the tax shield reduces the value of tax-favored securities. The purchase of reinsurance reduces the probability of experiencing a large unexpected loss. Garven and Lamm-Tennant (2000) do not find evidence to support the hypothesis that investment in tax favored assets increases demand for external reinsurance.

The Garven and Lamm-Tennant tax hypothesis is now expanded as follows: if internal reinsurance costs less than external reinsurance, this difference may be great enough to make the cost of internal reinsurance less than the expected cost of not realizing the tax shield on these investments even if the cost of external reinsurance is greater than the expected tax savings. This result would support Mayers and Smith's more general hypothesis that provisions in the tax code affect insurers' demand for reinsurance, even if the impact is only large enough to affect internal reinsurance purchases. Furthermore, it would be consistent with Jean-Baptiste and Santomero's (2000) prediction that information asymmetry increases the cost of reinsurance, and that information and agency problems increase the cost of external capital relative to internal capital (Myers and Majluf, 1984; Fazzari, *et al*., 1988).

The ratio of tax-exempt investment income to total investment income (*Tax-Exempt Investment Income*) is estimated as follows. Tax-exempt investment income equals bond interest exempt from federal taxes plus seventy percent of dividends on common and preferred stock. This calculation is similar to that used by D'Arcy and Garven (1990) and Garven and Lamm-

Tennant (2000), but it is adjusted to reflect changes in the tax code since 1987. The seventy percent multiplier for dividends is a conservative estimate because, according to IRS form 1120pc, property-casualty insurers may deduct eighty percent of dividend income received from a company of which it owns at least twenty percent. The seventy percent figure is chosen because the data provides limited information about insurers' ownership share of non-insurance firms, and the lower percentage biases against the hypothesized result. This method also partially mitigates the unobservable cost of the Alternative Minimum Tax. Similar results were calculated by assuming dividends from affiliates were in the twenty percent ownership classification.

Expected cost of bankruptcy. If the loading costs in a reinsurance agreement are less than the expected transaction costs involved in bankruptcy, an insurer can increase its value by shifting risk to a reinsurer to decrease its probability of insolvency. Warner (1977) provides evidence that bankruptcy costs are less than proportional to firm size. Mayers and Smith (1990) and Garven and Lamm-Tennent (2000) find evidence of an inverse relationship between firm size and the demand for external reinsurance, consistent with the bankruptcy cost hypothesis, the same result would be expected here. Firm size is measured by the natural logarithm of total admitted assets gross of reinsurance transactions.

Default risk. The quality of insurance products is a negative function of the insurer's default risk. Sommer (1996) finds evidence that policyholders will pay higher premiums to be insured by less risky insurers. This provides an additional incentive for insurers to reduce default risk by purchasing reinsurance. Mayers and Smith (1990) use A.M. Best insurer ratings as a proxy for default risk. However, because A.M. Best considers reinsurance in their financial strength rating, and thus the rating already reflects reinsurance transactions, alternative measures of

default risk are used here. All else equal, insurers with more assets and less financial leverage are less likely to become insolvent. Sommer (1996) finds evidence that consumers pay higher prices to be insured by companies with more total assets and less financial leverage. Cummins, Harrington, and Klein (1995) find that smaller insurers are more likely to become insolvent. BarNiv and Hershbarger (1990) and Carson and Hoyt (1995) find that insurers with higher financial leverage have greater risk of insolvency. Size and leverage measures gross of reinsurance transactions are used as measures of default risk prior to reinsurance transactions. The above arguments imply a positive relation between an insurer's default risk and demand for reinsurance.

Investment incentives. Myers (1977) shows that some firms may have incentives to forego valuable investment opportunities. In some circumstances, with risky debt in the capital structure, taking a positive net present value (NPV) project makes stockholders worse off because the benefits accrue to the bondholders. Bondholders anticipate the owner's incentive and factor this situation into the rate of return they demand for debt. Both parties can be made better off if the owner can bond itself against such investment activity. Mayers and Smith (1987) show that the purchase of insurance can control this underinvestment problem by softening the impact of large unexpected losses.

Policyholders have a claim to the insurance company's assets similar to debt-holders in other firms. Large unexpected losses may cause equity-holders of an insurance company to reject a positive NPV project because the benefits would accrue primarily to the policyholders. By purchasing reinsurance an insurer can transfer the risk of large unexpected losses, reducing the expected cost of foregoing valuable projects. In an insurance company with higher leverage, policyholders have a proportionally greater claim to the company's assets. This increases the

probability of foregoing valuable projects because returns will primarily benefit policyholders rather than owners. Thus, insurers with higher leverage are expected to demand more reinsurance because of investment incentives. Insurer financial leverage (*Leverage*) is measured as the ratio of total liabilities to total assets, gross of reinsurance transactions. Recall that this same variable was discussed above in the context of default risk. Both the default risk hypothesis and the investment incentives hypothesis lead to the same expected positive relation with reinsurance demand.

Number of affiliates. In the sample used for this study, the number of affiliated property-liability insurers in a given group ranges from two to fifty-two. The number of affiliates may affect the amount of internal reinsurance ceded by a company in at least three ways. First, if each affiliate specializes in a different type or types of insurance (based on line of business, geographic location, or commission schedule) then the companies might reinsure internally to spread the risks evenly across the group based on financial capacity. Second, a group of insurers represents a portfolio of options, while an unaffiliated insurer represents an option on a portfolio. From the insurer's standpoint an option on a portfolio is worth less than a portfolio of options because in the latter case the insurer has the ability to exercise each option individually (Cummins and Sommer, 1996). In this case individual exercise would be allowing one company to fail while the others remain solvent. Through put-call parity it can be shown that this decreases the value of insurance to the insured and, all else equal, the insured will prefer the same coverage written by an unaffiliated insurer. Therefore, the insurance group has an incentive to bond itself not to exercise its options individually. One way this can be accomplished is by linking the survival of the group's members via a nexus of internal reinsurance contracts. Finally, it may be the case that an insurer with more affiliates faces a

greater supply of internal reinsurance. For all these reasons, the hypothesis is that insurers with a greater number of affiliates will tend to cede more internal reinsurance. The variable used to test this hypothesis (*Number of Affiliates*) is the number of affiliates in the insurer's group.

Real service efficiencies. Mayers and Smith (1982, 1990) offer comparative advantages in real service production as a factor influencing the demand for reinsurance. They measure the benefit of real services by the geographic concentration and line of business concentration of risks insured. If risks covered by an insurer are spread across regions and lines of business they may benefit more from a reinsurer's expertise or infrastructure in a given area or line. If a reinsurer has valuable expertise in real services such as claims handling or insurance pricing, an insurer may choose to enter into a reinsurance contract to gain access to those services. This argument obviously applies to external reinsurance, but not to internal reinsurance. If sharing these services can add value to the group, these services should be shared among members of the group without need for a reinsurance contract.

Mayers and Smith also note other possible implications of geographic and line of business concentration pertaining to expected bankruptcy costs and taxes. If an insurer's exposures are concentrated geographically they are more likely to be affected by the same catastrophic event, resulting in a large unexpected loss. Thus the two arguments pertaining to concentration lead to conflicting expected signs. Mayers and Smith (1990) find geographic concentration and line of business concentration to be negatively related to demand for external reinsurance. They conclude that the real-services incentive for purchasing reinsurance is quantitatively more important than the reduction in expected tax payments and bankruptcy costs to be gained through geographic diversification. If this is true, then the same result for geographic concentration would be anticipated in the equation for external reinsurance. However, this result would not be

expected in the equation for internal reinsurance, where the real services argument should not apply. The measure of geographic concentration (*Geographic Concentration*) is the Herfindahl index of direct premiums written in each state. The measure line-of-business concentration (*Line-of-Business Concentration*) is the Herfindahl index of premiums written across lines of business.

An alternative explanation of Mayers and Smith's result is that insurers writing business in a concentrated area participate in lines of insurance with less exposure to a common catastrophic loss. For example, geographic concentration will present substantial catastrophe exposure if the insurer is writing property coverage; however, the same is not as true for an insurer writing liability coverage. Geographic concentration as a measure of catastrophe risk may also depend on the region in which the coverage is concentrated. Eastern coastal states face a significant risk from hurricanes, not realized by land-locked regions. Also, regions located on a fault line are subject to increased earthquake exposure. Except for the losses related to September 11, 2001, damage from hurricanes and earthquakes represent the largest insured losses in history (Insurance Information Institute, 1997). Exposure to catastrophic losses (*Catastrophe Exposure*) is measured as the ratio of each insurer's direct premiums written for property coverage in eastern coastal states and earthquake coverage in California to total direct premiums (Gron, 1999). Demand for both internal and external reinsurance should be positively related to catastrophe exposure, but only demand for external reinsurance should be related to geographic concentration due to the real services argument, especially when controlling for catastrophe exposure.

Information asymmetry. Information asymmetry between recipients and providers of capital will increase the cost of capital in the presence of incentive conflicts between the two parties.[4] Such asymmetric information is likely to increase transaction costs involved in correctly assessing the recipient's characteristics. One way to mitigate this agency cost is to remove the incentive conflict by combining the two parties, as is the case with internal capital markets. To the extent that affiliation reduces information and agency costs, these factors are already incorporated in the model by separating the dependent variables. The external reinsurance equation contains an explicit proxy for asymmetric information regarding external reinsurance. It is a dummy variable, *Publicly Traded*, equal to one if the insurer is publicly traded, or belongs to a group or holding company that is publicly traded. It may be that information asymmetry between the insurer and an external party is lower for publicly traded firms due to disclosure requirements and the efforts of analysts who follow these firms (Pottier and Sommer, 1999). While each firm does not have its own ticker symbol, it should be examined by analysts in the process of assessing the publicly traded entity. It is important to note that although *Publicly Traded* is used here to proxy for improved information, Mayers and Smith (1982, 1990) hypothesize that a widely held firm is less averse to nonsystematic risk because its owners can hold diversified portfolios. Publicly traded firms are likely to be widely held. This argument implies a negative relation between *Publicly Traded* and *External Reinsurance*.

Relative size within group. The size of member companies is not consistent within groups. While the absolute size of a company, as has been discussed, may affect its *demand* for reinsurance, the size of the company relative to the rest of its group may affect the *supply* of internal reinsurance available to the company. In the case of internal reinsurance, supply may be

[4]Jean-Baptiste and Santomero (2000) apply this argument directly to the cost of reinsurance. See also Myers and Majluf (1984) and Fazzari *et al*. (1988).

dictated by capacity. If the company is large relative to the rest of its group, its affiliates may not be able to reinsure a large percentage of the company's direct written premiums. Size differences within groups are controlled for in the equation for internal reinsurance with the ratio of the company's total assets to the total assets of the group (*Company-to-Group Size Ratio*).

Organizational form. Mayers and Smith (1990) find organizational form is an important factor in the demand for reinsurance. The sample used below includes mutuals, stocks, reciprocals, and Lloyd's associations. The owners of mutual and reciprocal companies are their policyholders. Equity holders retain the residual rights to a stock company. Lloyd's associations are made up of individuals, called names, who in many cases retain unlimited personal liability for risks insured.[5] Dummy variables are included to classify insurers as stock, mutual, reciprocal, or Lloyd's associations.

Lines of business. Some lines of insurance present significantly different risks based on expected size, timing, and volatility of cash flows. It follows that these differences among lines would affect an insurer's demand for reinsurance. Mayers and Smith (1990) note significant improvement in their model's explanatory power when they control for the insurer's business mix. Similar to Mayers and Smith (1990) business mix is controlled for by including the percentage of direct premiums written in each line for each insurer.[6] Mayers and Smith (1990) comment that one limitation of their data is that direct premiums written by line of business do not account for within-line policy heterogeneity. For example, NAIC data does not differentiate among homeowners policies, even though the risk insured by a homeowners policy (from wind and hail) in Florida is significantly greater than a policy insuring an identical home in Minnesota.

[5] In recent years some Lloyd's associations have included corporate capital.
[6] One line, commercial multiple peril, is omitted to avoid singularity in the model. This line is chosen arbitrarily. Results do not change significantly when other lines are omitted.

These differences are partially accounted for by adding the proxy for catastrophe exposure discussed above.

IV. DATA AND EMPIRICAL TESTS

A. Description of Sample and Summary Statistics

Table 1 displays descriptive statistics for the sample used in the empirical analysis. Company level data for insurers for data years 1996 through 1999 are from the National Association of Insurance Commissioners (NAIC). 9728 observations of active insurance companies were reported to the NAIC during the four-year sample period. 6456 were affiliated with at least one other property-casualty insurer. The ideal sample for this study includes active insurers that write direct business and then have the opportunity to cede some portion of direct premiums to another insurer that may be in its group. Insurers that reported non-positive numbers for direct written premiums or total assets are excluded. Another step in the sample selection process was to exclude insurers reporting extraordinary or incomplete figures for the dependent variables. Some insurers report a value greater than one for one of the dependent variables, indicating premiums ceded were greater than the sum of premiums written and assumed. Mayers and Smith (1990) attribute this phenomenon to an insurer's decision to exit from a line of business, or a geographic region, because it has stopped issuing new policies, but reinsures policies still in force. These observations are excluded because they represent extraordinary operating characteristics. The final sample includes 5501 affiliated insurer observations. These insurers wrote eighty-nine percent of the industry's total premiums written during the sample period.

Table 1: Description of Sample

Descriptive Statistics:

	Mean	Median	Standard Deviation
Internal Reinsurance	0.2037	0.0329	0.5042
External Reinsurance	0.1143	0.0234	0.1916
Publicly-Traded	.4605	0.0000	.4985
Company to Group Size Ratio	0.2140	0.0557	0.2993
Company Size	18.698	18.569	1.827
Leverage	0.6787	0.7317	0.2167
Tax-Exempt Investment Income	0.2625	0.1882	0.2633
Line-of-Business Concentration	0.4601	0.3950	0.2649
Geographic Concentration	0.5229	0.4502	0.3728
Catastrophe Exposure	0.0431	0.0000	0.1527
Number of Affiliates	13.433	7	13.052

Company Form	Observations
Mutual	710
Reciprocal	104
Lloyd's	163
Stock	4524
Total	5501

Table 2 displays a summary of the reinsurance activity in the sample. The occurrence of reinsurance transactions among insurers is quite common. Seventy-nine percent of the observations in the sample cede some reinsurance to affiliates, and sixty-eight percent cede reinsurance outside of their groups. Only two percent of the observations do not cede any reinsurance. Some insurers cede reinsurance only to their affiliates, while others cede premiums only to insurers outside of their groups. Almost half of the insurers in the sample cede reinsurance both internally and externally. It is also common for insurers to assume reinsurance from both their affiliates and other insurers.

Table 2: Reinsurance Activity
Sample includes 5501 observations.

	Ceded	Assumed
Only Internal[1]	1639	1481
Only External[2]	1046	596
Both Internal and External[3]	2688	1792
None[4]	128	1632

1: Number of companies that executed reinsurance transactions with affiliated insurers only.

2: Number of companies that executed reinsurance transactions with non-affiliated insurers only.

3: Number of companies that executed reinsurance transactions with both affiliated and non-affiliated insurers.

4: Number of companies that did not execute reinsurance transactions.

B. Regression Analysis:

The following system of simultaneous equations is estimated for the sample:

$$\textit{Internal Reinsurance}_j = \alpha 0_j + \alpha 1_j \textit{ External Reinsurance}_j + \alpha 2_j \textit{ Number of Affiliates}_j + \alpha 3_j \textit{ Company-to-group Size Ratio}_j + \sum_{i=3}^{35} \alpha_{ij} X_{ij} + \varepsilon_j$$

$$\textit{External Reinsurance}_j = \beta_{0j} + \beta_{1j} \textit{ Internal Reinsurance}_j + \beta_{2j} \textit{ Publicly Traded}_j + \sum_{i=3}^{35} \beta_{ij} X_{ij} + \delta_j$$

where,

Internal Reinsurance$_j$ = (RCTA – RAFA) / (DPW+RA) for insurer *j*.
RCTA = reinsurance ceded to affiliates
RAFA = reinsurance assumed from affiliates
DPW = direct premiums written
RA = total reinsurance assumed

External Reinsurance$_j$ = RCTNA / (DPW+RA) for insurer j.
RCTNA = reinsurance ceded to non-affiliates

Number of Affiliates$_j$ = The number of affiliates in the same group as insurer j.

Publicly Traded$_j$ = Binary indicator equal to 1 if insurer j is affiliated with a publicly traded entity and 0 otherwise.

X$_{ij}$'s:

Size$_j$ = The natural logarithm of insurer j's size, measured as total admitted assets gross of reinsurance transactions.

Leverage$_j$ = (Liabilities / assets) [gross of reinsurance ceded] for insurer j.[7]

Tax-Exempt Investment Income$_j$ = Estimate of the ratio of tax-exempt investment income to total investment income. Tax-exempt investment income = [bond interest exempt from federal taxes + .70 * (dividends on common and preferred stock)]

Line-of-Business Concentration$_j$ = Herfindahl index of line of business concentration using direct premiums written in each line by insurer j.

Geographic Concentration$_j$ = Herfindahl index of geographic concentration using direct premiums written in each state by insurer j.

[7] Assets and liabilities gross of reinsurance ceded are reported in schedule F part 8 of the NAIC Annual Statement for property-casualty insurers.

Catastrophe Exposure$_j$ =	Proportion of direct premiums written by insurer j in property insurance lines in coastal states and earthquake coverage in California.
Company-to-Group Size Ratio$_j$ =	Ratio of insurer j's assets to the sum of the group's assets.[8]
Mutual$_j$ =	Binary indicator =1 if insurer j is organized as a mutual.
Lloyds$_j$ =	Binary indicator =1 if insurer j is organized as a Lloyd's association.
Reciprocal$_j$ =	Binary indicator =1 if insurer j is organized as a reciprocal.
Year 1997 =	Binary indicator =1 if the observation is from 1997.
Year 1998 =	Binary indicator =1 if the observation is from 1998.
Year 1999 =	Binary indicator =1 if the observation is from 1999.
$X_{13j} - X_{35j}$ =	Proportion of DPW in 23 lines of insurance by insurer j.

[8] Stocks of affiliates are subtracted from insurers within the group before aggregating to prevent double counting.

V. EMPIRICAL RESULTS

Results for the simultaneous equations regression appear in Table 3. Some of the results in this study are similar to those of Mayers and Smith (1990) and Garven and Lamm-Tennant (2000) with respect to demand for both internal and external reinsurance. This is an important contribution to the literature because it shows that several results from previous studies of demand for reinsurance hold true for both internal and external reinsurance. As anticipated, the coefficient on *Size* is significant and negative in both equations, implying that larger firms cede less reinsurance. Consistent with hypotheses regarding investment incentives and expected cost of bankruptcy, the coefficient on *Leverage* is significant and positive in both equations. Coefficients on the *Size* and *Leverage* variables are consistent with the hypothesis that insurers with greater default risk will cede more reinsurance.

Table 3: Results from Two-Stage Least Squares Regression*

	External			Internal		
Variable	E(+/-)	Estimate	Pvalue	E(+/-)	Estimate	Pvalue
Intercept		0.8020	<.0001		1.4637	<.0001
Internal Reinsurance	-	-0.3488	<.0001		N/A	N/A
External Reinsurance		N/A	N/A	-	0.5115	0.7352
Publicly Traded	+/-	-0.0163	0.0128		N/A	N/A
Number of Affiliates		N/A	N/A	+	0.0033	0.2137
Company-to-Group Size Ratio		N/A	N/A	-	-0.5188	0.0141
Size	-	-0.0409	<.0001	-	-0.0712	0.0002
Leverage	+	0.2148	<.0001	+	0.2806	0.0721
Tax-Exempt Investment Income	+	0.0142	0.2268	+	0.0948	0.0192
Geographic Concentration	+/-	-0.0507	<.0001	+/-	-0.0465	0.3169
Line-of-Business Concentration	+/-	-0.0082	0.5618	+/-	-0.2383	0.0192
Catastrophe Exposure	+	0.2054	<.0001	+	0.1959	0.2904
Mutual		0.0226	0.0161		0.1204	<.0001
Reciprocal		-0.0409	0.0637		0.0702	0.4333
Lloyds		-0.0149	0.5472		0.3714	0.0562
Year 1997		0.0062	0.4578		0.0127	0.4896
Year 1998		0.0108	0.1897		0.0110	0.5998
Year 1999		0.0189	0.0227		0.0164	0.5438
R^2			0.1243			0.2211
Adjusted R^2			0.1184			0.2157

* Results for 23 line-of-business variables are available from the authors. One line of business (commercial multiple peril), one year dummy (1996), and one organization form dummy (stock) are omitted to avoid singularity in the regression matrix.

The coefficient on *Geographic Concentration* is significant and negative in the external reinsurance equation, but not significant in the internal reinsurance equation. This result supports the hypothesis that insurers cede external reinsurance to utilize a reinsurer's

comparative advantage in real service production. If sharing these real services among group members adds value to the group it should occur regardless of internal reinsurance contracts. Mayers and Smith (1990) point out that insurers with geographically concentrated exposure may systematically concentrate in areas or lines of business with less exposure to catastrophic loss. This would also explain a negative relationship between geographic concentration and reinsurance ceded. Therefore, controlling for exposure to catastrophic losses adds support for the real services interpretation of this result.

The coefficient on *Line-of-Business Concentration* is not significant in the external reinsurance equation; however, it is significant and negative in the internal reinsurance equation. This result may show that insurers with exposure concentrated in few lines of business choose to write insurance in lines of business with less volatile expected losses. While the measure of catastrophe exposure used in this article is well suited to address the issue of geographic concentration, it may be less applicable to line of business concentration. The measure is primarily concerned with exposure to natural disasters such as hurricanes and earthquakes. Such exposure is a major concern to many insurers, but insurers also realize differences in loss volatility across states and lines of insurance based on factors such as differences in tort laws and exposure to asbestos claims. NAIC data does not provide this level of detail.

The coefficient on the proxy for information costs in external reinsurance transactions, *Publicly Traded*, is significant and negative in the external reinsurance equation. This result does not support the hypothesis that additional monitoring efforts on the part of investment analysts, and additional reporting requirements imposed by the Securities and Exchange Commission, decrease information asymmetries between publicly traded groups and external reinsurers. The result is consistent with Mayers and Smith's (1990) hypothesis that widely-held

stock insurers demand less reinsurance because individual investors can hedge firm-specific risk by holding a diversified portfolio.

The coefficient for the measure of an insurer's concentration of invested assets in tax-favored securities is not significant in the external reinsurance equation, consistent with Garven and Lamm-Tennant (2000). However, in the equation for internal reinsurance the coefficient on *Tax-Exempt Investment Income* is significant and positive. These results are consistent with internal reinsurance costing less than external reinsurance. They are also consistent with Jean-Baptiste and Santomero's (2000) prediction that information asymmetry increases the cost of reinsurance. The cost of internal reinsurance may be less than the expected cost of not realizing the tax shield on tax-favored securities; however, information and agency problems may raise the cost of external reinsurance above the expected cost of not realizing tax shields.

The *Company-to-Group Size Ratio* variable is significantly negatively related to *Internal Reinsurance*. This result is consistent with the argument that insurers that are large relative to the rest of their group may face supply-side constraints on internal capital. If, say, one company represents two-thirds of the total assets of the group, there is likely to be limited capacity among the rest of the group to assume a significant portion of the larger insurer's written premiums. For an insurer that represents only a small fraction of the group's total assets, the opposite would be true.

Finally, internal reinsurance ceded (*Internal Reinsurance*) is significant and negative in the equation for external reinsurance, but external reinsurance ceded (*External Reinsurance*) is not significant in the internal reinsurance equation. If internal and external reinsurance are perfect substitutes, then an increase in demand for one should cause a decrease in demand for the other. The results found here are not surprising in light of the structural and cost-based differences in

demand for internal and external reinsurance discussed above. These results are consistent with the cost of internal reinsurance being less than the cost of external reinsurance, and with insurers demanding external reinsurance in order to take advantage of the reinsurer's comparative advantage in real services such as claims settlement and rate making.

One potential limitation of this study is manifest in the observed cyclical behavior of the insurance industry, and the duration of the sample period. The period is from 1996 to 1999. Historically, the insurance industry has exhibited hard market and soft market periods. A hard market is characterized by decreasing capacity to write insurance and increasing premiums. In a soft market, premiums are decreasing and capacity is increasing. While the cause of changes in market conditions has not been resolved in the insurance literature, the effect of these changes on the capital structure decisions of insurers is likely to follow a distinct pattern. During a hard market, the cost of external reinsurance capital is likely to increase relative to that of internal capital due to the industry-wide decrease in underwriting capacity.

Ultimately, one would like to use data that spans an entire market cycle. However, because data from prior reporting periods does not contain the necessary level of detail, and more recent data is not yet available, the study analyzes data from a period completely contained in a soft market. The most recent shift from a hard market to a soft market occurred in the late 1980's. Many industry experts agree that only now, in the wake of the September 11, 2001 World Trade Center tragedy, are insurance markets beginning to harden again.

Fortunately, the sample period employed is such that any bias introduced by changes in market conditions would decrease the likelihood of finding the results discussed in this study. Evidence is presented that is consistent with internal capital costing less than external capital during a period when the difference between the two should be minimized.

IV. CONCLUSIONS

The empirical results of this article provide evidence that internal and external reinsurance are not perfect substitutes for affiliated insurance companies. Some of the results also apply to the more general hypothesis that internal and external sources of capital are not perfect substitutes. It appears that there are both structural and cost differences between internal and external reinsurance. The results also reaffirm many of the findings of previous studies of demand for external reinsurance.

The amounts of both internal and external reinsurance ceded are affected by expected costs of bankruptcy and investment incentives. Smaller insurers are more concerned with expected costs of bankruptcy. All else equal, highly levered insurers are more likely to default, and more susceptible to the underinvestment problem. Consistent with these hypotheses, results indicate that insurers with more total assets cede less reinsurance, and insurers with higher financial leverage cede more reinsurance.

Insurers may purchase external reinsurance to take advantage of the reinsurer's comparative advantage in real service production. If sharing real service expertise adds value to the group then affiliates may benefit from each other's real service efficiencies regardless of internal reinsurance contracts. Consistent with this argument, geographic concentration displays a significant and negative relationship with external reinsurance ceded, but is not significantly related to internal reinsurance ceded. Following Mayers and Smith (1990), these results can be attributed to the reinsurer's potential advantage in real service production.

The hypothesis that internal and external reinsurance are not perfect substitutes cannot be rejected. This result is apparent explicitly in the results from the empirical model, and may also

be inferred from the structural differences in demand discussed above. Evidence is presented that is consistent with internal reinsurance costing less than external reinsurance. Concentration of assets in tax-favored securities is positively related to demand for internal reinsurance, but not external reinsurance. One explanation of this result is that the cost of internal reinsurance is less than the expected cost of not realizing the tax shield on tax-favored investments, while information and agency problems raise the cost of external reinsurance above that of wasted tax shields.

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