Risk Shifting In Reinsurance Markets

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Existing literature relating to information asymmetries finds that the presence of imperfect information impacts the behavior of economic agents. We build on the risk shifting framework found in the banking and finance literature to evaluate the role that informational advantages play in the reinsurer-primary insurer contracting relationship. Using premium and loss levels transferred, we are able to assess the nature of the risk shifted from insurers to reinsurers in terms of both quantity and quality. We also are able to study to movement of risk both into and out of an organization. Overall, our results indicate that information asymmetries impact the nature of the risk shifted to reinsurers in both quantity and quality. We find that as primary insurers gain an informational advantage about the set of exposures they insure, primary insurers retain a greater quantity of risk but pass through more losses to reinsurers (or lower quality of exposures). Similarly, we find that when reinsurers gain more information about the risks of the primary insurer through longer relationships with specific insurers, they are willing to accept a greater quantity of exposures from primary insurers but take on a lower level of losses (or higher quality of risks).

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1. Introduction

Economic research indicates that informational advantages exist in the insurance marketplace and that they have a real impact on the behavior of economic agents.[1] One subset of economic research relating to information asymmetries is the risk shifting framework found in the banking and finance literature. In this setting, an agent is able to transfer more risk to another party due to informational advantages, namely frictions associated with the ability to monitor, than could be transferred in the presence of perfect information. A classic example of risk shifting is the asset substitution problem, where equity holders and managers shift risk to bondholders by investing in risky net present value (NPV) projects (e.g. Galai and Masulis, 1976; Jensen and Meckling, 1976).[2]

While the banking and finance literature has devoted a considerable amount of attention to risk shifting in financial institutions, there exists a noticeable absence of using the risk shifting framework to examine transactions between primary insurance companies and the reinsurance market. We find this omission curious because the risk shifting paradigm presents an excellent framework to analyze the impact of information asymmetries between primary insurance companies and the reinsurance market. Specifically, the risk shifting framework allows for a clear understanding of the impact that informational advantages of the primary insurer have in terms of risk shifted to the reinsurance market. The reinsurance market also provides a setting to understand risk shifting in greater detail due to the ability to monitor risk transfer both into and out of an organization.

[1] Since the works of Akerlof (1970) and others, modern economists have extensively analyzed the role that information asymmetries play in economic relationships. Other early works regarding information asymmetries, such as Shavell (1979), reinforce the notion that optimal insurance contracting is dependent on the degree to which an insurer can monitor insureds. Over time, a variety of empirical analyses have found support for the existence of information asymmetries such as adverse selection and moral hazard in different economic settings. See, for example, Finkelstein and Poterba (2004); Cutler, Finkelstein, and McGarry (2008); Gao, Powers, and Wang (2009).

[2] Prior studies also have found that informational frictions between the depositors and owners/managers of thrifts are such that stock owned thrifts exhibit riskier strategies than mutual owned thrifts, resulting in a greater amount of risk shifted to the fixed claimants of stock thrifts (Etsy, 1997). Additional studies examine risk shifting in the context of pricing structures, regulation, and pension funding and find that information asymmetries influence the nature of risk shifted from one contractual counterparty to another (e.g. Clauretie 1989; Hovakimian, Kane, and Laeven 2003; Rauh, 2008).

The purpose of this paper, therefore, is to apply the risk shifting framework found in the banking and finance literature to the reinsurer-insurer relationship in order to evaluate the role that information asymmetries play in a primary insurer's decision to shift risk to the reinsurance market. Our evaluation of risk shifting in reinsurance markets adds to the extensive body of literature relating to risk shifting by providing some of the first insight into the nature of risk shifting between primary insurance companies and reinsurance companies. In this setting, we are able to incorporate the primary insurer's efforts to reduce its information asymmetries with the customer, the primary insurer's incentives to shift risk to the reinsurer, as well as the reinsurer's efforts to reduce information asymmetries with the primary insurer. The combination provides allows us to create a multi-level view of a risk shifting transaction involving an entities ability to control risk shifting both into and out of its organization. Based on our tests, we also are able to evaluate whether the exchange of information between insurer and reinsurer varies based on the length of the relationships both in terms of the quantity of risk transferred as well as the level of losses. This not only provides an explicit test of one mechanism thought to reduce information asymmetries, but it also provides empirical insight into the theoretical predictions of Jean-Baptiste and Santomero (2000) as well as an extension of the empirical work of Garven and Grace (2011).

The economic scope of the reinsurance transaction make this an important setting to study risk shifting given the important public policy implications. Recent catastrophic events such as the Tokyo earthquake, the mid-west floods, Hurricane Katrina, and even the September 11th terrorist attacks have heightened the importance of the reinsurance market's role in economic stability. The risk shifting framework helps insurers, reinsurers, and policymakers better understand the incentives of insurers in trying to shift information into the reinsurance market. If risk shifting from the primary market to the reinsurance market is such that reinsurers' claims paying ability is adversely impacted, then risk shifting may have serious implications in terms of economic stability. The study also highlights the importance of reinsurers having solid underwriting information in order to ensure that they are not taking on a disproportionate amount of risk due to the superior information of the primary insurer. Thus, we believe

that our analysis of risk shifting in reinsurance markets is important not only to the economic literature related to information asymmetries but also to society.

Overall, our results indicate that the presence of information asymmetries impact the contracting relationship between the primary insurer and the reinsurer. We find that as the primary insurer gains more information about the exposures in their book of business relative to the reinsurer, the primary insurer retains a greater quantity of business while still passing along a larger level of losses (lower quality) to the reinsurance marketplace. This finding supports the notion of risk shifting from primary insurers to the reinsurance market in that informational advantages of the primary insurer lead to a greater level of losses shifted to the reinsurance market. We also find that as reinsurers gain informational advantages about the exposures of the primary insurer, reinsures accept a greater amounts of business (higher quantity) but lower levels of losses (higher quality) from primary insurers. Additional robustness tests indicate that reinsurers appear to continue to gain information from the primary insurers the initial years of the contracting relationship. Taken together, we find that information asymmetries impact both the quantity and quality of risk shifted in the insurance marketplace.

We organize our paper as follows. In Section 2, we provide background information on the subjects of information asymmetries, risk shifting, and reinsurance, In Section 3, we use the theoretical framework of Jean-Baptiste and Santomero (2000) to show that information asymmetries between the primary insurer and the reinsurer lead to risk shifting via the reinsurer's cost function. We develop testable hypotheses in Section 3, and in Section 5, we discuss the data that we use to test our hypotheses. In Section 6, we outline the application of the risk shifting paradigm to the reinsurer-insurer relationship and define the key variables we use in our analysis. In Section 7 we formally test our hypotheses and discuss our results. We conclude our analysis and discuss areas of future research in Section 8.

2. Background

The seminal works, such as Arrow (1963), Akerlof (1970), and Rothschild and Stiglitz (1976), which find that information asymmetries can lead to market inefficiencies and market failure, provide the

background for our study.[3] Other early works regarding information asymmetries, such as Shavell (1979), reinforce the notion that optimal insurance contracting is dependent on the degree to which an insurer can monitor insureds. Many empirical works examine issues related to information asymmetries such as moral hazard and adverse selection. The authors find that information asymmetries result in frictions which impact market operations (e.g. Finkelstein and Poterba, 2004; Cutler Finkelstein and McGarry, 2008; Gao, Powers, and Wang, 2009).[4]

Another important subset of economic research relating to information asymmetries is the risk shifting framework found in the banking and finance literature. In this setting, an agent is able to transfer more risk to another party due to informational advantages, typically frictions associated with the ability to monitor, than could be transferred in the presence of perfect information and ability to monitor. Galai and Masulis (1976) were among the first to specifically describe the problem of *risk shifting*. They consider a levered firm which is faced with two mutually exclusive projects, each with the same expected cash flows but where one project has a higher variance of returns. Galai and Masulis (1976) note that if this firm chooses the project with higher variance in returns, this will cause a rise in the systematic risk borne by the bondholders and a fall in the systematic risk borne by the stockholders (i.e. a shift of risk due to informational frictions). This classic example of risk shifting, pioneered by Galai and Masulus (1976), is more commonly referred to as the asset substitution problem where the shareholders and managers reap the benefits of the riskier projects while the bondholders are left with the downside risk (e.g. Jensen and Meckling, 1976; MacMinn 1987).

Since the works of Jensen and Meckling (1976) and Galai and Masulus (1976), a prolific body of research relating to risk shifting has emerged. Prior risk shifting studies have found that informational

[3] Of particular importance to the insurance literature is the finding of Rothschild and Stiglitz (1976) that, in a market of high risks and low risks, information asymmetries lead to a separating equilibrium (and possibly no equilibrium).
[4] We also note that many recent studies, specific to the fields of banking and finance, have examined the role of information asymmetries and moral hazard. For example, Berger, Espinosa-Vega, Frame, and Miller (2011) examine the role of information asymmetries in incidences of collateral and their results suggest that banks use technology to reduce information asymmetries and ultimately reduce required collateral needs. In addition, Liu, Miu, Chang, and Ozdemir (2012) examine whether the spreads of US debts at issuance reveal information regarding recovery rates and their results attest to the role information asymmetries play among individual firms. Another example is that of Anderson and Nyborg (2011) examine the implications of debt financing in the context of moral hazard and the results of their model indicate that growth and profitability are inversely related to leverage.

frictions between the depositors and owners/managers of thrifts are such that stock owned thrifts exhibit riskier strategies than mutual owned thrifts, resulting in a greater amount of risk shifted to the fixed claimants of stock thrifts (Etsy, 1997). Additional studies examine risk shifting in the context of pricing structures, regulation, and pension funding and find that information asymmetries influence the nature of risk shifted from one contractual counterparty to another (e.g. Clauretie 1989; Hovakimian, Kane, and Laeven 2003; Rauh, 2008). There also exists a considerable amount of literature related to capital structure decisions which finds that risk shifting incentives are related to bond characteristics, such as covenants, convertibility, or maturity (Smith and Warner, 1979; Green 1984; Barnea, Haugen, and Senbet, 1980). In addition, there is evidence that risk shifting to bondholders is correlated with firm specific factors such as cash flow volatility.[5]

The importance of the implications of risk shifting is evidenced by the numerous studies which have addressed risk shifting from varying perspectives.[6] One such perspective is that, in some cases, the potential for risk shifting exists but does not occur. For example, Rauh (2008) analyzes risk shifting in firms' defined benefit plans and finds that firms with poorly funded pension plans and weak credit ratings allocate a greater share of pension fund assets to safer securities whereas firms with well funded pension plans invest more heavily in equity. Another such example is the work of Kroszner and Strahan (1996) who show that, while insolvent thrifts increase dividends to shareholders, these increases are generally positively correlated with the financial health of the institution. In this case, the overall impact of risk

[5] For example, Eisdorfer (2008) analyzes risk shifting in financially distressed firms by analyzing the relationship between investment and volatility and finds that financially distressed firms are more likely to invest in more volatile projects

[6] For example, in their analysis of bank loans and takeover defense costs, Chava, Livdan, and Purnanadam (2009) note that risk shifting incentives could impact their result that lower takeover defense costs significantly increase the cost of loans for a firm and provide a robustness analysis to further investigate the nature of risk shifting. Demiroglu and James (2010) examine the determinants of financial covenant thresholds in bank loan agreements and find that covenants are set to be more restrictive when the borrower has fewer risk shifting opportunities. Gropp, Hakenes and Schanabel (2011) address the implications of risk shifting in their discussion of the idea that the presences of a potential government bailout of banks can lead to reduced market discipline and higher charter values. Huang, Sialm, and Zhang (2011) examine risk shifting among mutual funds and find evidence that suggests risk shifting is either an indication of substandard management ability or is prompted by agency problems. Basak, Pavlova, and Shapiro (2007) study the relation between mutual fund managers and investors and find that when informational frictions are such that investors' and mutual fund managers' risk aversion differ, the result is a loss of wealth for the investor.

shifting is somewhat mitigated. Thus, works such as Rauh (2008) and Kroszner and Strahan (1996) suggest that there are cases where risk shifting has the potential to occur but does not, or is at least mitigated.

Such findings regarding risk shifting have important ramifications for insurance market operations. The overarching theme of the research related to risk shifting is that informational frictions and/or the inability to perfectly monitor lead one party to accept a degree of downside risk. We assert that this same setting is likely to exist in the reinsurer-primary insurer contracting relationship. Here, because reinsurers cannot perfectly observe the risks of the primary insurer, primary insurers have the opportunity to shift large amounts of losses to reinsures. Cutler and Zekerhauser (1999) provide an insightful example that sheds light on the informational advantages of the primary insurer: *"…the reinsurance market may know the flood risk in a particular city, but the ceding company may know the flood risk for particular houses in the city."* The implication is that informational frictions lead to an increased cost of bankruptcy for the reinsurer via the acceptance of excessive amounts of losses.[7]

Curiously, there have been relatively few, if any, insurance specific studies of the implications of risk shifting.[8] The very nature of the insurance mechanism is to pool expected losses in such a way that the impact of losses is reduced for an individual or entity. As such, the very nature of the reinsurer-insurer relationship will fundamentally result in the intentional transfer of risk from primary insurance companies to the reinsurance market. While there is a sizable literature discussing the demand for reinsurance (e.g. Mayers and Smith (1990), Garven and Lamm-Tennant (2003), and Cole and McCullough (2006)), these studies do not specifically address the propensity of the reinsurer to accept excessive downside risk from the primary insurers due to the imperfect information or an inability to perfectly monitor. Rather, these works cite key motivations related to the demand for reinsurance

[7] See Section 3 for theoretical support of this argument.

[8] We note that the agency theory and organizational form research in the insurance literature (e.g. Mayers and Smith 1981, 1982, 1990, Lamn-Tennant and Starkes 1993) and risk shifting share a fundamentally common element. However, the risk shifting literature focuses on the relation between informational frictions related to principle agent conflicts and the degree to which a counterparty accepts risk. In contrast, much of the insurance literature related to organizational form and agency theory address the role that these conflicts play in terms of an insurer's operating characteristics or the contracting terms of the reinsurance relationship and/or impact of moral hazard.

including: the reducing probability and cost of bankruptcy, investment incentives, tax effects, and the availability of real services.[9] The set of financial and operational characteristics used to test the demand for reinsurance provide a means to control for variation in the quantities of reinsurance shifted due to the general demand for coverage rather than asymmetric information inherent in the risk shifting framework.

We also draw from studies have addressed the nature of the reinsurer – primary insurer relationship but have not expressly considered the risk shifting framework. While reinsurance significantly reduces the volatility of loss ratios, Cummins, Dionne, Gagné, and Nouira (2008) find that, reinsurance purchases significantly increase the insurer's costs and thus the ability to move risk into the reinsurance market is not costless. Capital costs and information asymmetries are source of inefficiency in reinsurance markets (Cummins and Trainar, 2009). Through a variety of techniques, insurers and reinsurers can reduce information asymmetries and their related costs. For example, Jean-Baptiste and Santomero's (2000) theoretical results indicate that, as information regarding the ceding insurance company's losses is revealed to the reinsurer over time, this new information is included into reinsurance prices as the information asymmetries are lowered. This is echoed by Cummins and Trainer (2009) who suggest that over time, by warehousing risks, the reinsurer can acquire knowledge about underwriting risk, risk management, and exposure management, which is a particular advantage to the reinsurer in decreasing information asymmetries. In the context of our analysis, this result underscores in the importance of controlling for the changes in information asymmetries as the length of the insurer-reinsurer relationship grows.[10]

3. Theoretical Analysis

The purpose of this section is to show that informational frictions between the primary insurer and the reinsurer lead to risk shifting via the reinsurer's cost function. The overview of the theoretical

[9] For a more detailed discussion of these incentives see Mayers and Smith (1990), Garven and Lamm-Tennant (2003), and Cole and McCullough (2006).

[10] Other studies, such as Doherty and Smetters (2005) and Powell and Sommer (2007), highlight the fact that informational frictions, and in particular the ability to monitor, have a direct impact on the reinsurer-insurer relationship but these studies do not emphasize the role that such factors play in the ability to transfer excessive downside risk to the reinsurer. As a result, we provide robustness testing based on internal and external reinsurance where possible.

model is as follows: The cost function of the reinsurer is dictated by the losses of the primary insurer's book of business. There are two levels of asymmetric information considered. The first is the uncertainty related to the assessment of the losses on the primary insurer's book of business (exposures). This impacts both the primary insurer and ultimately the reinsurers quality and quantity of risk accepted. The primary insurer can gain more information regarding its own book of business, through improved underwriting. This inherently reduces the primary insurer's level of information asymmetries allowing the primary insurer to accept larger quantities of risk and potentially shift away higher levels of losses (or lower quality risk). Similarly, the reinsurer can reduce its level of asymmetric information by gaining more experience with the primary insurer's book of business. This allows the reinsurer to accept larger quantities of risk as well as higher quality of risk (or lower levels of losses). Thus we are concerned with the ability of both the insurer to reduce information asymmetries in the insurer-insured relationship as well as the reinsurer's ability to reduce information asymmetries in the insurer-reinsurer relationship.

We keep in mind that the cost functions of both the insurer and reinsurer are impacted because of asymmetric information. We also note that insurers have the incentive to try to capitalize on more complete information from the insureds when determining what to transfer into the reinsurance market. This may be evidenced by higher levels losses transferred into the reinsurance market than would be in the presence of perfect information.

3.1 The Model

Jean-Baptiste and Santomero (2000) characterize the relation between the primary insurer and the reinsurer as a contracting arrangement where information asymmetries are pervasive. They note that "…*insurers control the relationship with the insured and are likely to have private information about the magnitude of potential losses, which depends on factors that are more easily observed by the insurer such as adequacy of mitigation measures"* (pp 277). As such, Jean-Baptiste and Santomero (2000) model the reinsurer's cost function as dependent on an imperfect estimate of the primary insurers' losses. More specifically, Jean-Baptiste and Santomero (2000) model the reinsurer's bankruptcy cost function as

$$\frac{R}{2}L^2 \qquad 1)$$

where L represents the part of the losses for which the reinsurer is responsible for. R converts the square of the loss rate to the cost of losses to the insurer and includes factors such as increased capital market scrutiny and regulatory pressure. Jean-Baptiste and Santomero (2000) define $L = s\Sigma X_i$ where s represents the proportion of a primary insurer's loss, X_i, that a reinsurer is responsible for repaying. Losses of the primary insurer are stochastic and are thus modeled by Jean-Baptiste and Santomero (2000) as

$$\tilde{X} = \mu + \tilde{\varepsilon} \quad \tilde{\varepsilon} \sim N(0, \sigma^2). \qquad 2)$$

Here, $\tilde{\varepsilon}$ is a random variable beyond the primary insurer's control. In addition, μ represents the intrinsic quality of the primary insurer's underwriting practices and this parameter is intended to reflect the nature of the primary insurer's decision to cede risk. We call particular attention to the parameter μ, which encompasses the risk selection process of the primary insurer, as it is the source of the information asymmetries between the reinsurer and the primary insurer.

In the model of Jean-Baptiste and Santomero (2000), the reinsurer does not observe underwriting costs, underwriting standards, and additional relevant information to the nature of the primary insurer's decision to cede risk. That is, the reinsurer does not directly observe μ due to informational frictions and instead observe the random variable $\tilde{\mu}$. Thus, Jean-Baptiste and Santomero (2000) model the losses of the primary insurer, from the perspective of the reinsurer, as[11]

$$\tilde{X} = \tilde{\mu} + \tilde{\varepsilon} \qquad 3)$$

[11] It is worth emphasizing here the nature of the informational friction between the primary insurer and the reinsurer – The reinsurer cannot observe the underwriting quality of the primary insurer and thus cannot know with certainty what the losses of the primary insurer will be. As Jean-Baptiste and Santomero (2000) show, the reinsurer can reduce this information asymmetry regarding the losses of the insurer through long-term reinsurance relationships. However, *ceteris paribus*, the greater the knowledge of the primary insurer regarding their own risks, the greater potential for information asymmetries between the primary insurer and the reinsurer regarding the primary insurer's risks.

Now, using this framework of Jean-Baptiste and Santomero (2000), we substitute $\tilde{X}$ into Equation 1 and denote n as the number of primary insurers that the reinsurer insurers. Our result is that the expected cost of bankruptcy for the reinsurer is

$$\frac{R}{2}E\left[\left(\sum_{1}^{n} s\tilde{X}_i\right)^2\right] = \frac{R}{2}s^2E\left[\left(\sum_{1}^{n}\tilde{X}_i\right)^2\right] = \frac{R}{2}s^2E\left[\left(\sum_{1}^{n}\tilde{\mu} + \tilde{\varepsilon}\right)^2\right] \quad 4)$$

We call particular attention to the fact that the bankruptcy cost of the reinsurer is directly impacted by the reinsurer's estimate of the intrinsic quality of the primary insurer's underwriting practices, $\tilde{\mu}$. In terms of the risk shifting framework, this result has two important implications, formalized in *Lemma 1* and *Lemma 2*, respectively.

Lemma 1*: As the primary insurer's informational advantage regarding its own underwriting risk increases, relative to the reinsurer, the primary insurer gains the ability to shift more risk to reinsurers.*

With all insurers, there is a certain level of uncertainty in the ultimate level of losses. However, insurers that have a better understanding of their risks also have a greater potential to knowingly try and shift disproportionate amounts of risk into the reinsurance market. Thus, these insurers may be better able to take larger retentions (higher quantity) due to less asymmetric information and/or shift more downside risk (higher levels of losses) into the reinsurance market. As a result, we would expect a positive relation between the informational advantage of the primary insurer and the propensity to shift risk.

Lemma 2: *As the reinsurer's informational advantage of the underwriting practices of the primary insurer increases, relative to the primary insurer, the reinsurer accepts fewer losses from the primary insurer.*

Lemma 2 formalizes the fact that when a reinsurer ascertains more information about the risks of the primary insurer, the reinsurer reduces the effect of risk shifted from the primary insurer. More specifically, as the reinsurer gains a more precise estimate of $\tilde{\mu}$, namely through a long-term contracting relationship with the primary insurer, the reinsurer reduces the cost of bankruptcy by accepting lower levels of losses (higher quality) from the primary insurer.

Taken together, *Lemma 1* and *Lemma 2* formalize the risk shifting relationship between the primary insurer and the reinsurer. Because the reinsurer is the party that potentially accepts the downside risk, focusing on the cost of bankruptcy for the reinsurer is essential for evaluating the role that information asymmetries play in the context of risk shifting. The theoretical evidence presented here indicates that risk shifting to the reinsurer is possible, via $\tilde{\mu}$, when the primary insurer has greater informational advantages. However, the effects of risk shifting are mitigated when the reinsurer gains informational advantages about the risks of the primary insurer because the informational advantages of the reinsurer allow for a more precise estimate of $\tilde{\mu}$.

4. Hypothesis Development

In this section, we use the risk shifting framework found in prior literature in order to develop testable hypotheses regarding the impact of information asymmetries on the reinsurer-insurer contracting relationship. We begin by noting that, per the prior literature, informational frictions are the source of the risk shifting problem (see Section 1). Drawing upon the theoretical evidence found in Section 3, we also note that information asymmetries surrounding a reinsurer's estimate of the primary insurer's risks can lead to different quality (amounts) of losses accepted from the primary insurer. With this framework in mind, we hypothesize that

H1: As the primary insurer reduces its information asymmetries regarding its own book of business (exposures), the primary insurer can retain a larger quantity of risk and transfer lesser quality risks (higher levels of losses) to the reinsurance market due to the fact that primary insurers may have a larger amount of information about their exposures and potentially larger information advantage relative to the reinsurer.

Our first hypothesis is rooted in the theoretical evidence that when primary insurers know more about the risks they insurer, relative to the reinsurer, primary insurers can pass through higher levels of losses (lower quality risks) to the reinsurance market via $\tilde{\mu}$. Evidence in support of risk shifting to reinsurers from primary insurers would be supported by both: 1) a negative relation between the degree of the informational advantage of the primary insurer and the quantity of risk ceded to the reinsurance

market[12] *and* 2) a positive relation between the degree of the informational advantage of the primary insurer with respect to its book and the quality of risks (level of losses) passed through to the reinsurance market. In other words, support for *Hypothesis 1*, and inherently risk shifting in reinsurance markets, would be found if primary insurers keep the good risks and pass through the bad risks to the reinsurance market (i.e. transferring higher quantity and lower quality risks).

However, we also must consider the level of the reinsurer's information asymmetries and the propensity to accept risk from the primary insurer. Therefore, we also hypothesize that

H2: As the reinsurer's information asymmetries regarding the primary insurer's risk decreases, the reinsurer will accept larger quantities of risk as well as higher qualities risks. Thus, there is a decrease in the amount of downside risk shifted from the primary insurer to the reinsurer based on the risk shifting framework.

Hypothesis 2 also results from the theoretical evidence presented in Section 3 and captures the idea that reinsurers can mitigate the degree of risk shifted from the primary insurer by making a more precise estimate of the parameter, $\tilde{\mu}$. Evidence in support of *Hypothesis 2* would be found by both: 1) a positive relation between the quantity of risk accepted from the primary insurer and the informational power of the reinsurer *and* 2) a negative relation between the level of losses accepted from the primary insurer and the informational power of the reinsurer.[13]

5. Data

Our data contain financial and operating information pertaining to primary insurers as well as detailed data on the reinsurance relationships of the primary insurers.[14] We utilize data from the National Association of Insurance Commissioners for the years 2004 to 2010 and we obtain the data used in our

[12] Primary insurers that know more about their own book of business can retain more business without drastically increasing their cost of bankruptcy.

[13] This note only supports the risk shifting framework, but also provides empirical support for theoretical works related to the reinsurance transaction such as Jean-Baptiste and Santomero (2000).

[14] Starting in 2004, SNL Financial provides a unique reinsurance relationship identification number for each primary insurer-reinsurer relationship. Using this relationship data, we are able to identify the length of the contracting relationship between each primary insurer and reinsurer as well as the amount of premiums the primary insurer ceded to the reinsurer.

study from SNL Financial.[15] Table 1 provides sample summary statistics. After applying filters for reporting inaccuracies and other non-logical values, our sample contains 9,331 individual (i.e. non-group level) insurer observations.[16]

[Insert Table 1: Summary Statistics]

6. Analytical Approach

Our hypotheses predict a relation between risk shifting and informational advantages among primary insurers and reinsurers. We first identify proxies for the informational advantages of both the primary insurer and the reinsurer. We also include the factors identified in prior literature that impact the demand for reinsurance in an effort to control for factors not related to the risk shifting framework. We examine the relation between the informational advantage proxies and the amount of risk shifted, in terms of both the quantity of risk transferred to the reinsurer and total losses transferred to the reinsurer while controlling for the general demand for insurance factors. Thus, our analysis of the role that information asymmetries play in the reinsuring relationship is expressed as

$$Risk\ Shifted = f(informatinoal\ advantage\ proxies | demand\ for\ reinsurance) \quad 5)$$

6.1 Informational Advantage Proxies

Recall that both *Hypothesis 1* and *Hypothesis 2* predict a relation between quantity and quality of risk shifted and the level of information asymmetries between the insured and primary insurer or the insurer and reinsurer. We choose to proxy for insurer's level of asymmetric information relative to the insured with *UWEXP*. This variable is defined as the underwriting expenses for a primary insurer in year *t.* We choose *UWEXP* as an informational advantage proxy for two reasons. First, prior studies have discussed the fact that underwriting expenses reduce information asymmetries (e.g. Ligon and Cather, 1997; Blackwell et al., 1990). In addition, an analysis the components of the underwriting expenses item

[15] One of our key variables of interest, *JBS2*, is calculated using the reinsurance relationship data with a two year lag. As such, we limit the start of our sample period to the year 2006 due to the fact that the reinsuring relationship data is not available until 2004.

[16] We omit firms with negative or missing direct premiums written, surplus or admitted assets. In addition, we omit insurers that report missing values for net premiums written. We also use the definition of a reinsurer, found in Cole and McCullough (2008) in order to identify and drop any primary insurers in our sample that may be acting as net reinsurers.

indicates that expenditures on underwriting expenses greatly increase the primary insurer's knowledge of the exposures it insures. For example, Surveys and Underwriting Expenses, a component of *UWEXP*, includes survey, credit, medical, motor vehicle, appraisal, and hazard reports acquired for risk appraisal purposes. Thus, *UWEXP* is should be related to a reduction in information asymmetries for the primary insurer with respect to the insureds.

In choosing our proxy for the informational advantage of the reinsurer, we rely on the theoretical work of Jean-Baptiste and Santomero (2000) which identifies the length of the contracting relationship of the reinsurer and the primary insurer as an indicator of the impact that information asymmetries play in the reinsurer-primary insurer relationship. The theoretical work of Jean-Baptste and Santomero (2000) indicates that primary insurers reveal information about their risks to reinsurer as the length of the contracting relationship increases. The implication is that, the longer the contracting relationship between the primary insurer and the reinsurer, the less the informational advantage of the primary insurer relative to the reinsurer regarding the primary insurer's book of business or the better the reinsurer understand the primary insurers book. At this stage of our analysis, we identify the informational proxy for the reinsurer as *JBS2* which is defined as the average length of the contracting relationship between a primary insurer and the reinsurer over the previous two years.

In order to calculate *JBS2*, we first identify all the reinsuring relationships that a primary insurer has in year *t*. Next, we identify whether that relationship existed in year $t - 1$ and year $t - 2$. Finally, we take the average of the length of all of the primary insurer's reinsuring relationships over years $t - 1$ and $t - 2$ for relationships that were present in year *t.*[17] Note that *JBS2* is increasing in informational power for the reinsurer. Given our limited sample period, we calculate *JBS2* based on a two year period. However, as robustness, we evaluate a sample of primary insurers operating in 2010 and calculate the measure with

[17] For example, assume that XYZ Primary Insurance Company had a reinsuring relationship with Reinsurer A and Reinsurer B in 2010. Also assume that this relationship existed with Reinsurer A in 2009 and 2008 but the relationship with Reinsurer B only existed in 2009. In this scenario, *JBS2* would be calculated as 2 (for the relationship with Reinsurer A) plus 1 (for the relationship with Reinsurer B) divided by 2 (taking the average) which yields a value of 1.5. Thus, *JBS2* is bounded by 0 and 2 and proxies for the length of the contracting relationship between the primary insurer and the reinsurance market.

up to 5 years of prior reinsurer-insurer relationships. These results are reported in Section 7.4. In addition, we find that results are relatively consistent even when we extend the period of reinsurer-insurer relationships beyond two years.[18]

6.2 Quantifying Risk Shifting

For the purposes of hypotheses testing, we identify two measures of the amount of risk shifted to the reinsurance market: 1) *Shift1* captures the quantity of risk the primary insurer transfers to the reinsurance market and is calculated as direct premiums written minus net premiums written.[19] *Shift1*reflects the quantity of risk transferred to the reinsurance market and allows us to examine a primary insurer's decision to retain risk or transfer risk to the reinsurance market.[20] 2) *Cededlosses* defined as the total dollar amount of losses ceded to reinsurers, as our second measure of the quality of risk shifted to the reinsurance market. As *Cededlosses* increases, so does the amount of risk shifted to the reinsurance market.[21]

6.3 Factors Impacting the Demand for Reinsurance

We recognize that a primary insurer's decision to cede losses to the reinsurer may be influenced by factors that impact the demand for reinsurance and we therefore include controls for reinsurance demand in our analysis. We use the reinsurance literature as a guide (see Section 2.2) in order to identify the following factors as controls for the demand for reinsurance: return on assets; direct business to surplus; tax exempt investment income to total investment income; size, defined as the natural logarithm of total assets; an indicator equal to one if the insurer is a member of a group; the line of business

[18] Results available from the authors upon request.

[19] In robustness testing we also use the traditional demand for reinsurance variable (see, for example, Cole and McCullough, 2006) in place of *Shift 1* and find that the results do not significantly change when the demand for reinsurance variable is used instead of *Shift1*. The results are available upon request.

[20] We acknowledge that differences between affiliated and unaffiliated reinsurance use exist (e.g. Powell and Sommer, 2007) and, in future analyses, we will test for differences in the amount of risk shifted to affiliates and unaffiliates. In preliminary tests, we find that the informational advantage of the primary insurer is positively and significantly related to the amount of business ceded to affiliated reinsurers. However, the informational advantage of the reinsurer is not significantly related to the amount of business ceded to affiliated reinsurers. The results are available upon request.

[21] We recognize that the amount of business and the amount of losses transferred to the reinsurance market may be influenced by the price of reinsurance for a particular company. In an effort to control for the impact of the cost of reinsurance on the decision to shift risk, we perform an analysis of risk shifting in 2010 alone and our results (in Section 7.3) are similar to that of a multi-period analysis.

Herfindahl index; the geographic Herfindahl index; an indicator equal to one if the organizational form of the insurer is stock; and the percent of business, relative to the total amount of business, each insurer has in each line of business.[22]

7. Methodology and Results

7.1 Seemingly Unrelated Regressions

We begin our empirical analysis by jointly testing our two hypotheses. Recall that *Hypothesis 1* predicts a positive relation between the amount of risk shifted and the level of information asymmetry the primary insurer has relative to its own book of business. *Hypothesis 2* predicts a negative relation between the amount of risk shifted to the reinsurer and the informational advantage of the reinsurer regarding the primary insurer's risk. In order to test our hypotheses, we employ the Seemingly Unrelated Regression (SUR) model.

SUR, first proposed and discussed by Zellner (1962), is a linear regression model consisting of multiple equations where the error terms are assumed to be correlated. Essentially, feasible generalized least squares (FGLS), SUR is generally more asymptotically efficient than ordinary least squares (OLS) (Wooldridge, 2002). We believe that SUR is an especially appropriate model for our analysis of risk shifting in reinsurance markets due to the fact that the decision to transfer risk to the reinsurance market and cede losses to the reinsurance market may be correlated in ways not captured by the explanatory variables included in our model, such as a common decision factor.[23]

As Greene (2008) notes, if the equations have identical explanatory variables, then OLS and SUR are equivalent. Therefore, by including the variable *CATEXP* as an explanatory variable in the *Shift1* equation but not in the *Cededlosses* equation, we satisfy this condition required by SUR.[24] Also, we

[22] For a review of the hypotheses and expected signs with respect to the demand for reinsurance see Cole and McCullough (2006).

[23] Wooldridge (2002) notes that there is a tradeoff between efficiency and robustness when choosing between two stand-alone OLS models and SUR. Thus, buy estimating both models independently (not included but available upon request) and also as SUR, we provide evidence in support of the validity and robustness of our analysis.

[24] *CATEXP* is defined as an insurer's exposure to catastrophic risk and is provided by SNL Financial. In prior studies (e.g. Powell and Sommer, 2007), *CATEXP* has been found to positively impact the external reinsurance use but we would expect that this variable would only impact losses in years with high instances of catastrophes.

employ bootstrapping methods which corrects for heteroskedasticity in our SUR model (Cameron and Trivedi, 2010). We therefore estimate the following SUR model

$$Shift1_{ij} = \alpha + \beta_1 X_{i,j-1} + \beta_2 Y_{i,j-1} + \Sigma\beta_3 Z_{i,j-1} + \Sigma\beta_4 V_{j-1} + \varepsilon_{i,j} \quad (6)$$

$$Cededlosses_{ij} = \alpha + \beta_1 X_{i,j-1} + \beta_2 Y_{i,j-1} + \Sigma\beta_3 Z_{i,j-1} + \Sigma\beta_4 V_{j-1} + \varepsilon_{i,j}$$

Where:

X = the informational advantage proxy of the primary insurer for the *i*th insurer for the *j-1* year
Y = the informational advantage proxy of the reinsurer for the *i*th insurer for the *j-1* year
Z = a vector of variables that control for the demand for reinsurance, including line of business controls, for the *i*th insurer for the *j-1* year. Note that CATEXP is included here when the dependent variable is *Shift1* but excluded when the dependent variable is *Cededlosses*.
V = a vector of year dummy variables
ε = error term of the *i*th insurer for the *j-1* year

[Insert Table 2: SUR Results]

The results of estimating Equation 6 are reported in Table 2.[25] We include year fixed effects in the model. All results are reported with standard errors corrected for heteroskedasticity based on the bootstrapping procedure. Diagnostic tests did not indicate the presence of multicolinearity. All independent variables are lagged one year to account for the fact that financial statement reporting standards are such that the contemporaneous relationship between the independent variables and the dependent variable would not reflect the actual decisions of insurers. That is, we assume the informational advantage proxy in year *t – 1* conveys information, which is then evaluated by the primary insurer and/or reinsurer, who then act on this information and this action is reflected in operational year *t*.[26]

The results of estimating Equation 6 reveal that the level of information asymmetry plays an important role in terms of shifting risk from primary insurers to reinsurers.[27] Turning first to the

[25] In unreported results, we find that the results are consistent when the equations are considered in an independent framework. These results are available upon request.
[26] Additional results, available upon request, indicate that in an independent regression framework, the results are robust when lags greater than one year are considered. In addition, we also re-estimate the Equation 6 in an independent regression framework while correcting for autocorrelation and find that our results do not change after controlling for autocorrelation.
[27] In robustness testing, we separately consider the informational advantage proxies for the insurer and reinsurers in separate models and find that our results do not change. The results are available upon request.

informational advantage of the primary insurer with respect to the knowledge of the exposures in its book of business, our results reveal that primary insurers retain a statistically significant larger quantity of premiums when they a have greater informational advantage (reduced information asymmetries) about the exposures they insure. We find that the level of losses passed to the reinsurance market is increasing in the informational advantage of the primary insurer. In other words, as the information asymmetries are reduced they are able to pass higher levels of losses (lower quality risks) into the reinsurance market. Considered together, these results covey an interesting picture of the primary insurer's use of informational advantages – it appears that primary insurers keep the "good" risks and pass through larger amounts of losses to the reinsurer. This result is consistent with the risk shifting framework that one contracting party uses informational asymmetries to transfer downside risk to a contractual counterparty.

The results of the reinsurer's efforts to reduce information asymmetries are also particularly insightful into the contracting relationship between primary insurers and reinsurers. We find that as the length of the contracting relationship between the primary insurer and the reinsurer increases, reinsurers accept a greater quantity of business from primary insurers. Further, as the reinsurers decrease levels of asymmetric information (or increase their informational advantage) about the primary insurers exposures, the level of losses passed to the reinsurance market decreases (or the quality of risk increases). The combined results of Equation 6 are important because these results are also consistent with the risk shifting paradigm that informational advantages impact the nature of the risk shifted from one contractual party to another. Here, we provide evidence that as the party with the potential for accepting excessive risk due to information asymmetries (i.e. the reinsurer) reduces the level of asymmetric information, this party can mitigate the risk shifted from the party with superior information.[28]

Our results are also important because they provide an empirical test of Jean-Baptiste and Santomero (2000). As Garven and Grace (2011) note, the comparative statics of Jean-Baptiste and Santomero (2000) suggest that, *ceteris paribus*, long-term reinsurance relationships will be associated

[28] This is akin to bondholders gaining monitoring ability by implementing covenants restricting the actions of stock holders.

with higher levels of reinsurance coverage, higher insurer profits, and lower cost of bankruptcy for the primary insurer. The positive and significant relation between the proxy for the length of the reinsuring relationship and the quantity of risk transferred to the reinsurance market provide support for the first theoretical prediction of Jean-Baptiste and Santomero (2000) – long term reinsurance contracts are associated with higher levels of reinsurance coverage.[29] To the extent that reinsurance reduces the cost of bankruptcy for the primary insurer, the positive and significant relation between *JBS2* and *Shift1* provides support for the theoretical prediction in Jean-Baptiste and Santomero (2000) that long term reinsurance contracts are associated with lower costs of bankruptcy for the primary insurer.

We respect to the control variables, we note that the exposure to catastrophic risk, *CATEXP*, is positively and significantly related to the amount of risk shifted to the reinsurance market. In other words, insurers with higher catastrophe exposure shift more risk in terms of both quality into the market. This is consistent with prior literature. Also of note is that, while size, defined as the natural logarithm of assets, is positive and significant, size does not mitigate the significance of the insurer's and reinsurer's informational advantage proxies. In addition, we find that while direct losses partially explain a primary insurer's decisions regarding risk shifting, direct losses do not subsume the effects of the informational advantage proxies. We also find that higher quantities or risk transferred are generally associated with primary insurers having lower return on assets, higher direct business to surplus, larger insurers, and lower geographic Herfindahl indices. Interestingly, we find that insurers with more tax exempt investment income relative to total investment income retain lower quantities of risk but pass through fewer losses to reinsurers. We further find that line of business Herfindahl, group membership, and organizational form all impact risk shifting in different ways. Finally, we find that many of our controls for the line of business in which the primary insurer operates are statistically significant with varying signs.[30]

7.2 The Nature of the Primary Insurer's Informational Advantage

[29] Unreported analysis of the relation between the traditional demand for reinsurance variable and the proxy for the length of the contracting relationship also provide empirical support for Jean-Baptiste and Santomero (2000).
[30] We exclude the line of business results in all tables for the sake of brevity but these results are available upon request. The reader should note that all analyses conducted in this paper include line of business controls.

For robustness, we provide two alternate measures to describe the primary insurer's efforts to reduce information asymmetries with the insured. Specifically, we consider the nature of the information gathered and analyzed directly by the primary insurer, *SURVEY*, and the nature of the information gathered by financial intermediaries, *COMSN*.

SURVEY is defined as surveys and underwriting expenses and includes survey, credit, medical, motor vehicle, appraisal, and hazard reports acquired for risk appraisal purposes. We assert that *SURVEY* quantifies the informational advantage of the primary insurer that is gathered and analyzed through internal processes. We also consider *COMSN*, defined as the commission and brokerage expenses, as a means to quantify the informational advantage of the primary insurer gathered though external processes or financial intermediaries. Cummins and Doherty (2006) state that *"In many cases…intermediaries have more information than insurer"* (pp 386) and *"The information gather by the intermediary helps improve the efficiency of insurance markets…"* (pp 386). *COMSN* therefore captures the degree to which primary insurers rely on financial intermediaries as a source of underwriting information. We believe that while *SURVEY* and *COMSN* both quantify and the informational advantage of the primary insurer regarding the risks of the primary insurer, each variable quantifies a unique type of informational advantage. Evaluating different proxies of the primary insurer's informational advantage also ensures that our results are robust to multiple measures of the primary insurer's informational advantage.

We repeat the methodology found in Section 7.1. However, instead of proxying the primary insurer's informational advantage as *UWEXP*, we now use *SURVEY* and *COMSN*. As with *UWEXP*, the informational advantage of the primary insurer is increasing in *SURVEY* and *COMSN*.[31] The estimation methods is described in Sections 7.1.

[Insert Table 3]

The results of the independent regressions with *SURVEY* and *COMSN* as proxies of the informational advantage of the primary insurer, presented in this section, are consistent with the results of

[31] Note that we do not include *SURVEY* and *COMSN* in the same model in order to mitigate any potential problems resulting from multicolinearity.

the independent regressions in Section 7.1. Thus, the findings of the regressions in this section provide robust evidence on the nature of risk shifting in reinsurance – as the informational advantage of the primary insurer increases, these insurers keep greater quantities of risk and pass through more losses to reinsurers (lesser quality risk). We present the results of the seemingly unrelated regressions in Table 3. When *SURVEY* is used to proxy for the primary insurer's informational advantage of the primary insurer, *SURVEY* has a negative and significant relation with *Shift1* and positive and significant relation with *Cededlosses*. Likewise, the same relation is found when *COMSN* is used as an informational advantage proxy for the primary insurers. Also, consistent with the main models, the informational advantage of the reinsurer, *JBS2*, is positively and significantly related to *Shift1* and negatively and significantly related to *Cededlosses*, regardless of the primary insurer's informational advantage proxy.

7.3 Additional Analyses of the Reinsurer's Informational Advantage

In this section we provide alternate measures of the reinsurer's efforts to reduce information asymmetries with the primary insurer. In previous sections, we proxied for the reinsurer's informational advantage regarding the risks of the primary insurer as the average length of the contracting relationship between a primary insurer and the reinsurance market over the previous two years. We limited the maximum relationship to be two years due to the length of our sample period. In this section, we consider the role that longer reinsuring relationships play in the reinsurance market's propensity to accept risk from the primary insurer. More specifically, we analyze potential risk shifting in the year 2010 only to allow for the reinsuring relationship to be in place for up to five years. By analyzing potential risk shifting in 2010 only, we control for market variations and this allows us to avoid differences from market shocks and other such economic phenomena. This also allows us to test the degree to which information asymmetries are reduced over time. The longer proxy allows us to be more consistent with studies such as Garven and Grace (2011) which three year proxies (although their proxies are different from our reinsurance relationship proxy) rather than our shorter two year period.

We begin by calculating four additional measures of the reinsurer's informational advantage, *JBS1, JBS3, JBS4,* and *JBS5*. These measures are calculated in the same manner as *JBS2* (described in

Section 6.1) except here, the length of the reinsuring relationship varies between one and five.[32] We then estimate the following equation

$$RiskShifted_{i,j=2010} = \alpha + \beta_1 Y_{i,n} + \Sigma\beta_2 Z_{i,j=2009} + \varepsilon_{i,j} \quad (7)$$

where,

$RiskShifted$= *Shift1* or *Cededlosses* for the *i*th insurer for the *j*th year
Y = the informational advantage proxy of the reinsurer for the *i*th insurer for the *j-1* year
Z = a vector of variables that control for the demand for reinsurance, including line of business controls, for the *i*th insurer for the *j-1* year
ε = error term of the *i*th insurer for the *j* year

Note that we evaluate the amount shifted in 2010 only and lag the controls one year to account for the non-contemporaneous nature of the reinsurer's financial statement reaction to information from the primary insurer. Such a method implies that the maximum length of time that a primary insurance company could have a relationship with the reinsurance market is five years. The results of estimating Equation 7 are given in Table 4 and all standard errors are robust, per White's procedure. Panel A reports the results when the dependent variable is the quantity of risk shifted to the reinsurance market, *Shift1*, and Panel B reports the results when the dependent variable is the amount of losses passed through to the reinsurance market, *Cededlosses*.

[Insert Table 4]

When the dependent variable is *Shift1*, we find that the same positive and significant relation holds with the informational advantage of the primary insurer. However, the results presented in Table 4, Panel A reveal that this relation holds for only the first two years of the contracting relationship. That is, in the first two year of the contracting relationship, the reinsurer gathers valuable information from the primary insurer. However, in years three, four, and five, the length of the contracting relationship does not significantly affect the quantity of risk accepted from primary insurers. As it pertains to Jean-Baptiste and

[32] For example, assume that Primary Insurance Company X has a reinsuring relationship with Reinsurer A and Reinsurer B. Suppose that the relationship with Reinsurer A was present in 2009 – 2005 but that the relationship with Reinsurer B was only present in 2009 – 2007. Here, *JBS5* would be calculated as 5 (for the previous reinsuring relationship with Reinsurer A) plus 3 (for the previous reinsuring relationship with Reinsurer B) divided by 2 (taking the average) which would give a value for *JBS5* equal to 4. *JBS4* would be calculated the same way except only relationships from 2009 – 2006 (i.e. 4 lags) would be considered and thus *JBS4* would be equal to 3.5. *JBS3*, *JBS2*, and *JBS1* are all calculated in a similar manner with three, two, and one year lags considered, respectively.

Santomero (2000), this result indicates that the first two years of the contracting relationship may be the most vital, in terms of the information revealed to the reinsure. Also of note is that the coefficients of the reinsurer's informational advantage proxy decrease as the maximum length of the contracting relationship increases. This result sheds valuable light on the nature of the rate of information diffusion in the reinsurer-insurer relationship and indicates that potentially more information is revealed to the reinsurer in the first year of the contracting relationship than the last year of the contracting relationship.

When the dependent variable is *Cededlosses*, as reported in Table 4 – Panel B, we find further confirmation of the results in Section 7.1. Specifically, we find that in the first two years of the contracting relationship, reinsurance companies accept fewer losses (higher quality risks) when they have more information about the risks of the primary insurer. Again, as it pertains to Jean-Baptiste and Santomero (2000), this provides evidence that the first two years of the contracting relationship contains the most information regarding the primary insurance company's book of business. Additionally, similar to the results when *Shift1* is the dependent variable, the coefficients of the reinsurer's informational advantage proxy decrease as the maximum length of the contracting relationship increases when *Cededlosses* is the dependent variable. Again, this provides evidence that the most information is revealed to the reinsurance company, by the primary insurer, in the first contracting period.

8. Conclusion

Many previous studies have examined the economic impact of the nature of information asymmetries and/or the inability to perfectly monitor a contractual counterparty. In particular, the banking and financial literature has dedicated a considerable amount of research toward examining the role that the informational frictions play in the context of *risk shifting*. However, few if any studies have examined the risk shifting framework in the reinsurance setting. Our study provides a robust picture of the nature of risk shifting based on two sets of information asymmetries—the primary insurer/ insured relationship and the primary insurer / reinsurer relationship. Through several measures of the ways in which these information asymmetries impact operations, we are able to provide a robust picture of the risk shifting framework for an economically significant transaction.

In our analysis, we use the theoretical analysis of Jean-Baptiste and Santomero (2000) to show that informational frictions between the primary insurer and the reinsurer are such that the reinsurer may accept excessive downside risk from the primary insurer. We then identify proxies for the level of the information asymmetries for the primary insurer and the reinsurer in order to test hypotheses related to the influence of imperfect information in primary insurers ability to shift risk to the reinsurance market.

We find that when primary insurers are able to reduce the information asymmetries related to their exposures (increase their informational advantage), they are able to retain a higher quantity of risk and cede lower quality risk (higher levels of losses) into the reinsurance market. This finding, which is robust to three measures of the primary insurer's informational advantage, is consistent with the risk shifting framework that primary insurers exercises their informational advantage in order to keep good business and transfer excess downside risk to the reinsurance market. We also find that as the reinsurer reduces information asymmetries (or increases their informational advantage), the reinsurer accepts a greater quantity of or risk from primary insurers as well as higher quality risks (lower levels of losses) from primary insurers. This result is consistent with reinsurers exercising their informational advantage to curtail the amount of poor risks accepted from primary insurers. In addition, we also provide evidence that the first two years of the contracting relationship between primary insurers and reinsurers are the most important in terms of the amount of information revealed to the reinsurer by the primary insurer.

Our findings are important for several reasons. First, few, if any, studies have applied the risk shifting framework found in the banking and finance literature to the setting of primary insurers and reinsurers. By doing so, we provide valuable insight into the role information asymmetries play in contracting relationships, and emphasize the role that such asymmetries play in the relationship between reinsurers and primary insurers. It also allows for a unique setting in which the risk shifting can be studied as risk moves into and out of a firm. Additionally, along with Garven and Grace (2011), we are among the first to provide empirical support for the theoretical predictions of Jean-Baptiste and Santomero (2000). As such, we provide empirical evidence of the role that the length of the insurer-reinsurer relationship has on the reinsurer's ability to reduce the impact of asymmetric information as risk is shifted

from the insurer to the reinsurer. We also are able to show the ways in which decreases in information asymmetries between the insured and primary insurer are able to be passed through to the reinsurance market. Taken together, our analysis also provides insight into the efficiency of information exchanges in insurance markets and is thus contributes to the literature relating to the dissemination of information in economic markets.

While our research establishes that informational advantages directly impact the nature of the risk shifting relationship between primary insurers and reinsurer, we believe that economic researchers would benefit from additional studies of risk shifting among reinsurers. For example, future researchers should examine role that a primary insurer's line of business expertise plays in the decision to shift excessive losses and risk to the reinsurance market. Also, future researchers should consider the factors, in addition to the simple demand for reinsurance, that determine the reinsuring relationship between the primary insurer and the reinsurer. Economic research related to risk shifting would also benefit from additional analyses of risk shifting among reinsurers and primary insurers.

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Table 1: Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
Shift1	36085.920	563508.200	-14200000.000	5756364.000
Cededlosses	9480.288	54284.440	-65869.000	1658423.000
UWEXP	77724.680	436478.200	-214191.600	12000000.000
JBS2	1.558	0.477	0	2
COMSN	25174.280	99029.180	-38373.470	2950206.000
Cat Exposure	101451.200	490439.800	-3194.440	14100000.000
Direct losses incurred	217265.600	1197481.000	-207378.300	36600000.000
Return on assets	2.204	5.543	-66.670	76.670
Direct business/surplus	3.487	27.342	0	1290.186
Tax-exempt inv. inc/total inv. inc	0.213	0.255	-0.084	1.161
2-yr loss development	-9926.540	157498.800	-12200000.000	2734856.000
Size	11.208	1.933	4.945	18.488
Group dummy	0.720	0.449	0	1
Line-of-business Herfindahl	0.555	0.285	0.095	1
Stock dummy	0.690	0.462	0	1
Geographic Herfindahl	0.571	0.389	0.033	1

Table 2: Seemingly Unrelated Regression Results – *UWEXP* and *JBS2*

Variable	*Shift1*	*Cededlosses*
UWEXP	-1.810***	0.027***
	(0.116)	(0.008)
JBS2	12556.300***	-1492.633***
	(3954.134)	(569.662)
Cat Exposure	1.149***	
	(0.096)	
Direct losses incurred	0.002	0.004**
	(0.008)	(0.002)
Return on assets	-660.885	-44.618
	(1037.987)	(174.289)
Direct business/surplus	1065.240***	62.405***
	(403.009)	(15.739)
Tax-exempt inv. inc/total inv. inc	48199.482***	-8475.885***
	(10781.886)	(2351.305)
2-yr loss development	0.219	0.031
	(0.246)	(0.048)
Size	14619.784**	6192.413***
	(6070.728)	(735.845)
Group dummy	3449.273	-2044.593**
	(4299.501)	(1030.860)
Line-of-business Herfindahl	-1.24e+05***	-2897.413
	(12795.427)	(3417.906)
Stock dummy	8916.315	2395.196*
	(7296.151)	(1444.267)

Geographic Herfindahl	-5.11e+04***	-3385.449***
	(8473.832)	(885.725)
N	8147	8147
R-Squared	0.720	0.196

*, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent level, respectively
Note: all control variables are lagged one period.

Table 3: Seemingly Unrelated Regression Results – *Survey* and *COMSN*

Variable	*Shift1*	*Shift1*	*Cededlosses*	*Cededlosses*
SURVEY	-80.879***		1.638***	
	(14.575)		(0.413)	
COMSN		-0.931*		0.087***
		(0.539)		(0.023)
JBS2	16359.889***	14423.756*	-1572.175***	-1531.965***
	(5839.227)	(8740.407)	(514.451)	(527.606)
Cat Exposure	0.446***	0.090		
	(0.097)	(0.181)		
Direct losses incurred	0.015	-0.009	0.004***	0.004***
	(0.010)	(0.010)	(0.001)	(0.002)
Return on assets	108.569	1287.861	-63.411	-64.877
	(1516.195)	(1226.086)	(190.458)	(216.700)
Direct business/surplus	1817.709***	2521.818***	59.645***	41.932***
	(452.073)	(859.002)	(11.439)	(10.788)
Tax-exempt inv. inc/total inv. inc	60148.049***	1.87e+05***	-7946.840***	-1.09e+04***
	(21563.929)	(32808.118)	(2493.302)	(2439.928)
2-yr loss development	0.235	0.383	0.030	0.028
	(0.449)	(0.427)	(0.045)	(0.048)
Size	-1.20e+04	-5.35e+04***	7006.160***	7295.038***
	(7998.506)	(7077.591)	(610.710)	(742.938)
Group dummy	15230.610***	42956.926***	-2325.328***	-2649.313***
	(4473.237)	(10903.298)	(829.041)	(1017.326)
Line-of-business Herfindahl	-7.44e+04***	-9.92e+04***	-3169.542	-1595.399
	(17408.080)	(25487.272)	(3878.702)	(4224.308)

Stock dummy	2803.449	52168.641**	2206.064	1323.886
	(18308.521)	(23911.699)	(1434.440)	(1542.372)
Geographic Herfindahl	-1.27e+05***	-1.45e+05***	-3061.130***	-2290.986**
	(10439.596)	(20107.413)	(983.103)	(991.356)
N	8093	7931	8093	7931
R-Squared	.445	.067	.180	.177

*, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent level, respectively
Note: all control variables are lagged one period.

Table 4, Panel A: Results with Additional Contracting Years

Variable	Shift1	Shift1	Shift1	Shift1	Shift1
JBS1	47262.169*				
	(28434.316)				
JBS2		26368.418*			
		(15999.165)			
JBS3			16694.826		
			(10443.283)		
JBS4				11736.095	
				(7814.663)	
JBS5					9072.855
					(6669.675)
Cat Exposure	-0.038	-0.038	-0.038	-0.038	-0.038
	(0.220)	(0.220)	(0.220)	(0.220)	(0.220)
Direct losses incurred	-0.005	-0.005	-0.005	-0.005	-0.005
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Return on assets	1946.887	1870.416	1861.868	1865.180	1871.703
	(1630.333)	(1659.481)	(1662.760)	(1663.380)	(1671.539)
Direct business/surplus	2278.955**	2273.431**	2270.915**	2269.309**	2267.698**
	(1044.848)	(1042.034)	(1041.170)	(1040.872)	(1040.403)
Tax-exempt inv. inc/total inv. inc	1.04e+05***	1.02e+05***	1.02e+05***	1.02e+05***	1.02e+05***

	(37820.399)	(38012.398)	(38104.444)	(38129.158)	(38136.217)
2-yr loss development	0.806	0.804	0.804	0.805	0.805
	(0.862)	(0.863)	(0.863)	(0.863)	(0.863)
Size	-4.71e+04***	-4.72e+04***	-4.72e+04***	-4.73e+04***	-4.73e+04***
	(13287.835)	(13312.810)	(13331.077)	(13355.045)	(13370.096)
Group dummy	42889.961**	41231.556**	40269.808**	39979.433**	39691.003**
	(18478.617)	(18048.572)	(17959.623)	(18088.383)	(18022.374)
Line-of-business Herfindahl	-8.74e+04**	-8.73e+04**	-8.71e+04**	-8.65e+04**	-8.60e+04**
	(40361.949)	(40554.960)	(40604.202)	(40667.135)	(40798.045)
Stock dummy	46689.189	47931.747	47972.861	47833.899	47759.350
	(37163.359)	(36950.984)	(36963.222)	(36986.813)	(36890.236)
Geographic Herfindahl	-1.29e+05***	-1.28e+05***	-1.28e+05***	-1.28e+05***	-1.28e+05***
	(29890.102)	(29782.963)	(29781.062)	(29768.215)	(29712.772)
N	2090	2090	2090	2090	2090
R-Squared	0.055	0.055	0.055	0.055	0.055

*, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent level, respectively
Note: all control variables are lagged one period.

Table 4, Panel B: Results with Additional Contracting Years

Variable	Cededlosses	Cededlosses	Cededlosses	Cededlosses	Cededlosses
JBS1	-4760.128**				
	(2034.124)				
JBS2		-2032.136**			
		(1007.079)			
JBS3			-1030.292		
			(627.801)		
JBS4				-496.757	
				(460.352)	
JBS5					-378.279
					(349.644)
Direct losses incurred	0.005	0.005	0.005	0.005	0.005
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Return on assets	-565.192***	-562.576***	-565.347***	-569.842***	-570.252***
	(192.782)	(193.217)	(193.042)	(193.789)	(193.279)
Direct business/surplus	55.741**	55.943**	55.868**	55.602**	55.656**
	(21.776)	(21.878)	(21.846)	(21.718)	(21.747)
Tax-exempt inv. inc/total inv. inc	-5717.032**	-5617.646**	-5637.981**	-5688.221**	-5697.539**
	(2603.417)	(2595.861)	(2602.121)	(2604.899)	(2606.990)
2-yr loss development	-0.108	-0.108	-0.108	-0.109	-0.109

	(0.108)	(0.108)	(0.108)	(0.108)	(0.108)
Size	7106.415***	7130.872***	7141.654***	7152.732***	7153.707***
	(1291.735)	(1292.328)	(1293.317)	(1293.954)	(1294.243)
Group dummy	-2924.498	-2856.675	-2861.684	-2949.601	-2941.017
	(1893.704)	(1911.929)	(1912.988)	(1931.954)	(1915.987)
Line-of-business Herfindahl	-4405.451	-4339.236	-4300.896	-4255.191	-4273.677
	(6625.536)	(6621.463)	(6620.213)	(6608.465)	(6610.244)
Stock dummy	602.539	575.611	636.948	723.505	729.211
	(3456.417)	(3475.097)	(3469.996)	(3477.357)	(3463.860)
Geographic Herfindahl	-4673.932**	-4669.764**	-4653.975**	-4639.863**	-4646.884**
	(1881.374)	(1884.428)	(1884.129)	(1885.405)	(1885.916)
N	2090	2090	2090	2090	2090
R-Squared	0.148	0.148	0.148	0.148	0.148

*, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent level, respectively
Note: all control variables are lagged one period.