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The Role of Social Responsibility on Insurers’ Investments and on Suppliers, and the Role of Internal Capital Markets on Market Entrance and Exit

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THE ROLE OF SOCIAL RESPONSIBILITY ON INSURERS' INVESTMENTS AND ON SUPPLIERS, AND THE ROLE OF INTERNAL CAPITAL MARKETS ON MARKET ENTRANCE AND EXIT

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ABSTRACT

In the first essay, we provide a new perspective on the socially responsible investment (SRI) puzzle by examining whether a motive behind investing in socially responsible stocks is to hedge against non-financial income exposure. We examine U.S. Property-Liability (P/L) insurers' equity portfolios to investigate the probability and extent of investments in socially responsible firms. We focus on one aspect of social responsibility - litigation risk. The level of litigation risk is a direct measure of social responsibility and the observable impact of litigation on P/L insurers' underwriting portfolios allows us to examine the hedging motive. We find that P/L insurers with greater litigation exposure in their underwriting portfolio are more likely to hedge by tilting their stock portfolio towards low litigation risk firms. We also find that the level of reinsurance usage and reinsurance cost affect the probability and extent of P/L insurers' investments in low litigation-risk stocks, indicating that reinsurance usage and investments in low litigation-risk stocks are substitutes in hedging against their non-financial income exposure.

The second essay examines the motivations for internal capital allocations to poorly performing insurance group members. We propose and test that internal capital markets (ICM) are used to manage the members' underwriting portfolio. Specifically, we investigate whether insurance groups use ICM to support market entries and prevent market exits. We show that a dollar increase in ICM increases insurers' likelihood of state-line market entry by 6.8%. Furthermore, we show that ICM decreases the likelihood of state-line market exits of poorly performing affiliates. Overall, we provide evidence that ICM affect insurers' underwriting portfolio management.

The third essay examines whether social responsibility of corporate customers affects the performance of suppliers. We examine the relationship in the insurance industry between reinsurers (suppliers of insurance capital) and ceding insurers (reinsurers' customers) in order to investigate the impact of ceding insurers' social responsibility on reinsurers' performance and underwriting risk. We propose and test that reinsurers' performance increases and underwriting risk decreases as reinsurers supply more to ceding insurers who are more socially responsible. Overall, we find limited evidence that social responsibility of ceding insurers affects the reinsurers' performance.

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ESSAY 1

WHY DO INSTITUTIONS INVEST IN SOCIALLY RESPONSIBLE FIRMS? EVIDENCE FROM THE INSURANCE INDUSTRY

INTRODUCTION

There are two primary strands of literature trying to solve the puzzle regarding why socially responsible investments (SRI) are increasing in volume despite the fact that socially irresponsible investments, such as investing in "sin" companies, provide higher return. One strand of literature argues that financial motives, such as higher returns and value enhancing, play a role in investors' decision to invest in socially responsible stocks. Another strand of literature argues that investors that invest in socially responsible stocks forgo financial performance in order to invest in accordance with their social preferences. In this paper, we will contribute to the study of why investors invest in socially responsible stocks by examining whether a motive behind investing in socially responsible stocks is to hedge against non-financial income exposure. To our knowledge, this paper will be the first in the literature to provide empirical evidence on the role of hedging motives in investors' SRI decisions.

The first strand of literature argues that SRI does create value for investors. Aktas, Bodt, and Cousin (2011) and Deng, Kang, and Low (2013) use a sample of US mergers and acquisitions to examine whether SRI creates value for acquiring firms' shareholders. Aktas, Bodt, and Cousin (2011) identify acquiring targets with high social and environmental performance as SRI, and find that the better the target is in the terms of social and environmental performance, the higher the gain for acquirer shareholders. Deng, Kang, and Low (2013) identify acquirers enhancing their social performance as SRI. They argue that enhancing social performance maximize shareholders' value by finding that high corporate social responsible (CSR)[1] acquirers realize higher merger announcement returns and larger increases in post-merger long-term operating performance than

[1] CSR is corporate actions that have positive social impacts, and SRI is making investments that have positive social impacts. For example, SRI is making investments in high-CSR firms.

low corporate social responsible acquirers. Lins, Servaes, Tamayo (2017) examine the difference in stock returns between high and low corporate social responsible firms during the 2008-2009 financial crisis, and find that firms with high corporate social responsibility had stock returns higher than firms with low corporate social responsibility. Pastor, Stambaugh, and Taylor (2021) create an investing model that considers SRI. They show that socially responsible assets have lower expected returns than socially irresponsible assets in equilibrium, but socially responsible assets outperform when customers' taste shifts toward social responsibility.

Another strand of literature argues that investors invest in socially responsible stocks even though those stocks provide lower return relative to other comparable stocks. Hong and Kacperczyk (2009) and Bolton and Kacperczyk (2021) provide empirical evidence that socially responsible stocks provide lower returns relative to other comparable stocks. Hong and Kacperczyk (2009) examine returns of socially irresponsible stocks and find that those stocks generate higher expected returns than other comparable stocks. Bolton and Kacperczyk (2021) compare stock returns between firms with higher and lower total carbon dioxide emissions, and find that stocks of firms with higher total carbon dioxide emissions earn higher returns. Adding to the findings, Riedl and Smeets (2017) and Hartzmark and Sussman (2019) examine why investors still decide to invest in socially responsible stocks even though those stocks provide lower return relative to other comparable stocks. By examining who holds SRI funds or conventional funds, Riedl and Smeets (2017), and find that socially responsible investors hold SRI funds knowing that SRI funds underperform relative to conventional funds. Also, Hartzmark and Sussman (2019) find empirical evidence that high sustainability funds attract greater inflows even though high sustainability funds do not outperform low sustainability funds, and conclude that nonpecuniary motives, such as altruism and social norms, influence investment decisions.

The first and second strands of literature only examine financial performance when investigating investors' motive behind SRI. However, we argue that for investors with non-financial income exposure, there is another motivation for SRI – hedging.[2]

In this paper, we explore the hedging motive by analyzing a specific type of SRI for a set of institutional investors with substantial non-financial income exposure. Specifically, we examine whether Property-Liability (P/L) insurers choose to invest in low litigation-risk stocks to hedge against non-financial income exposure from their liability underwriting portfolios. A reason why we focus on this specific type of SRI, low litigation-risk stock, is because the level of litigation risk is one of the direct measure of social responsibility. Hong and Kacperczyk (2009) show that firms with high social responsibility are less likely to get involved in litigation. In order to identify the levels of litigation risk of each stock, we use the data from Kinder, Lydenberg, Domini, & Co. (KLD). From the KLD database, we focus on categories that are related to litigation, such as product safety and quality, bribery and fraud, anti-competitive practices, and toxic emissions and wastes, and generate a litigation score for each stock. A more detailed description on how we identify the levels of litigation risk of each stock is in the methodology section.

Another reason why we focus on low litigation-risk stocks is due to the observable impact of litigation on P/L insurers' underwriting portfolios. Services provided by P/L insurers protect the insured against the financial consequences of legal liability, thus, litigation risk increases as P/L insurer grow their underwriting portfolio. For example, product liability service protect the insured against legal liability associated with the use of the insured's products, and P/L insurers' non-financial income exposure to litigation (in short, exposure to litigation) increases as they

[2] It is important to consider non-financial income exposure when analyzing portfolio allocation decisions, because non-financial income exposure greatly affects portfolio allocation decisions (Che, Liebenberg, and Lynch, 2020).

increase underwriting in product liability line. The advantage of observing P/L insurers' underwriting portfolio and stock portfolio allows us to examine whether P/L insurers hold an optimal portfolio. The optimal portfolio for P/L insurers is to create a stock portfolio that does not perfectly correlate with their underwriting portfolio (Markowitz, 1952). Additionally, investors are likely to hedge against their non-financial income risk by investing in stocks where returns are negatively correlated with investors' non-financial income risk (Bonaparte, Korniotos, and Kumar, 2014). Since P/L insurers' underwriting portfolio contains litigation risk and its loss ratio is high when litigation risk is high, a stock portfolio that does not perfectly correlate with the underwriting portfolio is a stock portfolio with low litigation-risk stocks. Low litigation-risk stocks' returns are negatively correlated with P/L insurers' underwriting portfolio, since the stock market reacts negatively to litigation news (Krüger, 2015). Thus by using P/L insurers' investment activities in low litigation-risk stocks, we are able to examine whether P/L insurers hedge against their exposure to litigation and generate an optimal portfolio by tilting their stock portfolio toward low litigation-risk stocks.

Similar to other institutional investors, P/L insurers have a goal to maximize their firm value. If hedging is value irrelevant, as suggested by the classic Modigliani and Miller (1958) model[3], then P/L insurers are indifferent on their hedging policy. However in the imperfect market where information exploitation exists (Stulz, 1984), tax, financial distress cost, and agency cost exist (Smith and Stulz, 1985; McMinn, 1987), regulatory cost exists (Cummins, Phillips, and Smith, 2001), underinvestment incentive exists (Bessembinder, 1991), and external sources of finance are more costly than internally generated funds (Froot, Scharfstein, and Stein, 1993), firms'

[3] In a perfect market, financial policy, such as hedging policy, does not affect the value of a firm.

hedging policy becomes value relevant. Therefore, hedging policy is important for P/L insurers to achieve their goal to maximize firm value.

When studying stock portfolio choices, it is essential to consider non-financial income exposure, because non-financial income exposure has impact on investors' stock portfolio choice. Furthermore, investors try to eliminate idiosyncratic risk while maintaining expected returns by allocating assets that are not perfectly correlated in their portfolio (Markowitz, 1952). Since P/L insurers have financial and non-financial assets in their total portfolio, the optimal portfolio for P/L insurers would be to tilt their stock portfolio toward stocks with low correlation with their non-financial income, in other words, hedge against their non-financial income exposure. Che, Liebenberg, and Lynch (2020) investigate industry bias in P/L insurers' common stock portfolio, and find that P/L insurers underweight their industry, and that the underweighting is larger for insurers with higher underwriting risk. They conclude that the industry bias in P/L insurers' common stock portfolio is driven by P/L insurers' motive to hedge against their underwriting risk, indicating that non-financial income exposure affects portfolio allocation decisions. By examining the portfolio decisions of Dutch households, Bonaparte, Korniotos, and Kumar (2014) also find that decisions related to portfolio allocations are influenced by income hedging motives. Both of these studies' findings indicate that hedging motives affect portfolio allocation decisions. Therefore, P/L insurers' hedging motive resulting from high exposure to litigation affect P/L insurers to allocate more low litigation-risk stocks in their equity portfolio. In other words, P/L insurers invest in equity of firms that are less likely to face litigation in order to hedge against liability risk.

Other than the observable impact of litigation on P/L insurers' underwriting portfolio, we choose to study P/L insurers because SRI is a crucial factor for P/L insurers due to a recent growth in SRI awareness. The awareness of SRI has grown from increasing news regarding climate change, and regulatory actions and litigation against socially irresponsible entities. Hodges, Leatherby, and Mehotra (2018) show that litigation against socially irresponsible entities increased significantly at year 2016. Additionally, the survey evidence suggests that insurers' awareness of SRI significantly increased recently, and that 'Products liability,' corporate governance, and climate risk are the most relevant issues for insurers (AM Best, 2020).

As mentioned earlier, our study contributes to the study of why investors invest in socially responsible stocks. To understand why value-maximizing P/L insurers invest in low litigation-risk stocks, it is essential to consider the hedging motive. A strand of literature shows that socially responsible stocks generate lower returns than other comparable stocks[4], therefore without considering the hedging motive, it is questionable why value-maximizing P/L insurers invest in low litigation-risk stocks that produce lower returns relative to other comparable stocks. In the imperfect market, hedging is value relevant[5], thus, low litigation-risk stocks are value-enhancing if P/L insurers are investing in low litigation-risk stocks to hedge against their liability underwriting risk. Our study provides evidence that P/L insurers' motive to invest in low litigation-risk stocks is to hedge against their exposure to litigation.

In order to examine whether hedging motive increases the probability of P/L insurers' investments in low litigation-risk stocks, we use Cragg's model to examine the relation between P/L insurers' exposure to litigation and investments in low litigation-risk stocks. Our main dependent variables is derived from the measure of litigation score of P/L insurers' stock portfolio,

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[4] See Hong and Kacperczyk, 2009; Riedl and Smeets, 2017; Hartzmark and Sussman, 2019; and Bolton and Kacperczyk, 2021.

[5] See Stulz, 1984; Smith and Stulz, 1985; McMinn, 1987; Cummins, Phillips, and Smith, 2001; Bessembinder, 1991; Froot, Scharfstein, and Stein, 1993

which is the value-weighted litigation score of P/L insurers' common stockholdings, and our main independent variable is the level of exposure to litigation of P/L insurers. The value-weighted litigation score of P/L insurers' common stockholdings is constructed through linking P/L insurers' common stockholdings from the NAIC database and litigation score of the stocks from the KLD database. The dependent variable used to examine the probability of investing in low litigation-risk stocks is a binary variable that equals 1 for P/L insurers where value weighted litigation score of their common stockholdings is positive, and equals 0 otherwise. When we examine the extent of P/L insurers' investments in low litigation-risk stocks, we use the value-weighted litigation score of their common stockholdings as the dependent variable.

Our main finding is that P/L insurers with greater exposure to litigation have higher probability to invest in low litigation-risk stocks, indicating that P/L insurers invest in low litigation-risk stocks to hedge against their exposure to litigation. However, results from examining the extent of P/L insurers' investments in low litigation-risk stocks show an insignificant relation between the value-weighted litigation score of their common stockholdings and P/L insurers' exposure to litigation. The results indicate that the probability of P/L insurers investing in low litigation-risk stocks increases as their exposure to litigation increases, but P/L insurers with above-median (0.0433) exposure to litigation do not extend their investments in low litigation-risk stocks as their exposure to litigation increases. These results are indicating that the relation between exposure to litigation and the investments in low litigation-risk stocks is logarithmic.

We further examine the logarithmic relation by considering reinsurance usage, since P/L insurers also use reinsurance to hedge against exposure to litigation. We analyze whether P/L insurers with above-median exposure to litigation substitute investments in low litigation-risk stocks with reinsurance. We find that, for P/L insurers with above-median exposure to litigation, an increase in reinsurance usage decreases the probability of P/L insurers investing in low litigation-risk stocks, and that a one-standard-deviation (0.3077) increase in reinsurance usage decreases the extent by 0.0666 points, indicating that P/L insurers with high exposure to litigation substitute low litigation-risk stock investments with reinsurance.

Since P/L insurers use both investments in low litigation-risk stocks and reinsurance to hedge against exposure to litigation, we examine whether reinsurance cost affects the probability and extent of investments in low litigation-risk stocks. We find evidence that reinsurance cost affects P/L insurers' decisions in investments in low litigation-risk stocks. Specifically, we find that an increase in unaffiliated reinsurance usage leads to an increase in the probability of P/L insurers investing in low litigation-risk stocks, and that a one-standard-deviation (0.4495) increase in unaffiliated reinsurance usage increases the extent by 0.0519 points. These results indicate that the probability and extent of investments in low litigation-risk stocks increases for P/L insurers that cede risk more to unaffiliated reinsurer. In other words, higher cost of reinsurance increase the probability and extent of investments in low litigation-risk stocks.

The remainder of this study is organized as follows. The "Hypotheses development" states the hypotheses that we test in this study. The "Data and Sample" describes the data sources, and the sample constructions. The "Methodology" describes the construction of the variables and the regression models used to test the hypotheses. The "Results" reports the main empirical results, and concludes the study with the "Conclusion" section.

HYPOTHESES DEVELOPMENT

In this paper, we examine the hedging motive by analyzing whether P/L insurers with higher exposure to litigation are more likely to invest in low litigation-risk stocks. Specifically, we examine the probability and extent of P/L insurers' investments in low litigation-risk stocks. P/L insurers with greater net premiums written have greater exposure to litigation, since firms with higher litigation risk have greater liability coverage (Gillan and Panasian, 2015). Moreover, P/L insurers with higher exposure to litigation have greater motivation to hedge (Bonaparte et al., 2014). Therefore, we expect that P/L insurers with higher exposure to litigation to hedge.

Furthermore, we expect the level of exposure to litigation is expected to affect P/L insurers' portfolio allocation decisions, since P/L insurers' portfolio allocation is driven by the motive to hedge against their exposure to litigation (Che et al., 2020). As suggested by Bonaparte et al. (2014), investors choose stocks which the returns are negatively correlated with the investors' income risk, indicating that P/L insurers would hedge against the exposure to litigation by investing in stocks with returns that are negatively correlated with litigation risk. In other words, P/L insurers will optimize their total portfolio by holding stocks that are not perfectly correlated to their non-financial income exposure (Markowitz, 1952). Hong and Kacperczyk (2009) and Krüger (2015), show that socially irresponsible firms face greater litigation risk, and investors react negatively to litigation news. Therefore, P/L insurers with greater exposure to litigation are expected to hedge by investing in low litigation-risk stocks. This hypothesis is described as follows,

H1: *P/L insurers with higher exposure to litigation are more likely to tilt their equity portfolio toward low litigation-risk stocks.*

Since P/L insurers use reinsurance to hedge against their exposure to litigation, we examine whether decisions to invest in low litigation-risk stocks are affected by P/L insurers' reinsurance usage. Mayers and Smith (1990) examine reinsurance purchases by P/C insurers and show that reinsurance is used to reduce underwriting risk. Therefore, the level of reinsurance usage can impact P/L insurers' decisions to invest in low litigation-risk stocks. We expect P/L insurers to consider reinsurance and investments in low litigation-risk stocks as substitutes. In other words, P/L insurers with high (low) reinsurance usage have less (greater) motive to invest in low litigation-risk stocks. This hypothesis is described as follows.

H2: *P/L insurers with greater (less) reinsurance usage are less (more) likely to tilt their equity portfolio toward low litigation-risk stocks.*

We further examine the impact of reinsurance usage on the decisions to invest in low litigation-risk stocks by considering the cost of reinsurance. High cost of reinsurance could prevent ceding insurers from using optimal reinsurance to hedge against risk. When ceding risk to reinsurers, primary insurers can cede risk either to affiliated reinsurer or unaffiliated reinsurer, or both. Due to information asymmetry and moral hazard, ceding risk to unaffiliated reinsurers is more costly than ceding risk to affiliated reinsurers (Doherty and Smetters, 2005, and Garven, Hilliard, and Grace, 2014). Doherty and Smetters (2005) find that unaffiliated reinsurers use loss-sensitive premiums to control for moral hazard. Garven, Hilliard, and Grace (2014) find that the cost of adverse selection to ceding insurers is greater when information asymmetry is greater. Therefore, we expect the usage of unaffiliated reinsurance to impact P/L insurers' decision to invest in low litigation-risk stocks. We measure unaffiliated reinsurance usage as the ratio of unaffiliated reinsurance usage to total reinsurance usage. This hypothesis is described as follows.

H3: *P/L insurers are more (less) likely to hold low litigation-risk stocks when unaffiliated reinsurance usage is high (low).*

DATA AND SAMPLE

Our sample consists of P/L insurers that hold publicly-traded common stocks with an ESG score[6] from years 2014 through 2016. The financial data of P/L insurers is obtained from the NAIC InfoPro database. For the purpose of this paper, we focus on two lines of business in insurers portfolios, 'Other liability'[7] and 'Products liability', of P/L insurers that are directly related to general corporate litigation[8]. After deleting P/L insurers that report non-positive total net premiums, the sample includes 641 insurers and 1,661 insurer-year observations.

The common stockholdings data of the sample insurers is obtained from schedule D - part 2 – section 2 of the NAIC InfoPro database. We delete stockholdings with non-positive number of shares or value. In order to examine P/L insurers' SRI activities, we focus on stocks covered by the KLD database[9], where we obtain the ESG scores of the stocks. As a result, the sample includes 174,130 insurer-stock-year observations. The detailed descriptions of the sample construction is reported in Panels A and B of Appendix A.

Since we are focusing on low litigation-risk stocks, we focus on the categories in the KLD database that are related to litigation. For example, we include 'Product quality & safety,' which measures the severity of controversies related to the quality and/or safety of a firm's products and

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[6] ESG score is provided by the KLD database, and ESG stands for environment, social, and governance. ESG score measures the level of CSR. Therefore, a firm with a high-CSR is a firm with a high ESG score, and an example of SRI is investing in the equities of the firm with a high ESG score.

[7] Includes completed operations liability, construction and alteration liability, contingent liability, contractual liability, elevators and escalators liability, errors and omissions liability, environmental pollution liability, excess and umbrella liability, liquor liability, personal injury liability, and premises and operations liability.

[8] While liability insurers also write medical professional liability policies and auto liability. We do not focus on medical professional liability because only a very small set of stocks that insurers may invest in would have medical professional liability exposure. We also do not focus on auto liability because it is likely independent of corporate social responsibility.

[9] The stocks covered by the KLD are MSCI KLD 400 social stocks, MCSI USA stocks, largest 1,000 US stocks, and MSCI USA IMI stocks.

services, in our SRI measure. Detailed descriptions of the categories related to litigation can be found in Appendix B.

Appendix A Sample construction descriptions

Screen Criteria	Number of observations
Panel A : Sample Construction	
Obtain insurers that write in liability lines from NAIC InfoPro database	4,970
Delete firms that report non-positive total net premiums written	4,953
Delete firms that do not hold any publicly-traded common stock	3,385
Delete firms that do not hold stocks identified from the KLD database	2,162
Keep firms that write in 'Other liability' and 'Products liability'	1,661
Panel B : Stockholdings	
Obtain PL insurers' stockholdings from the NAIC InfoPro database (Schedule D - Part 2 - Section 2)	265,627
Delete stocks that cannot be merged with the KLD database	174,130

Appendix B Description of categories of litigation score

Category	Strength / controversy	Description
POLLUTION & WASTE – TOXIC EMISSIONS AND WASTE	Str	Assesses how companies manage their risk of incurring liabilities associated with pollution, contamination, and the emission of toxic and carcinogenic substances
TOXIC EMISSIONS AND WASTE	Con	Measures the severity of controversies related to a firm's operational non-GHG emissions or releases to land, air, and/or water (ex. Accidental spills)
CARBON EMISSIONS	Str	Measures the management of carbon emissions
REGULATORY COMPLIANCE	Con	Identifies companies that paid a settlement, fine or penalty due to non-compliance with U.S. environmental regulations
COLLECTIVE BARGAINING & UNIONS	Con	Measures the severity of controversies related to a firm's union relations practices (ex. Strikes, alleged breaches of union contracts)
PRODUCT QUALITY & SAFETY	Con	Measures the severity of controversies related to the quality and/or safety of a firm's products and services
PRODUCT SAFETY AND QUALITY	Str	Assesses how companies manage their risk of facing major product recalls or losing customer trust through major product quality concerns
MARKETING & ADVERTISING	Con	Measures the severity of controversies related to a firm's marketing and advertising practices (ex. false or deceptive marketing or advertising)
ANTICOMPETITIVE PRACTICES	Con	Measures the severity of controversies related to a firm's anti-competitive business practices
ENERGY AND CLIMATE CHANGE	Con	Measures the severity of controversies related to a firm's climate change and energy-related impacts (ex. lawsuits over a company's alleged contribution to climate change)
EMPLOYEE HEALTH & SAFETY	Str	Identifies companies that have strong employee health and safety programs
HEALTH & SAFETY	Con	Measures the severity of controversies related to the health and safety of a firm's employees, temps and contractors, and franchisee employees
BIODIVERSITY & LAND USE	Str	Evaluates the extent to which companies may face lost market access or litigation, liabilities, or reclamation costs due to operations that damage fragile ecosystems
HUMAN RIGHTS CONCERNS	Con	Measures the severity of controversies related to the impact of a firm's operations on human rights (ex. complicity in killings, physical abuse, displacement, or other rights violations)
CHILD LABOR	Con	Measures the severity of child labor controversies in a firm's own operations or its supply chain
POLLUTION & WASTE - ELECTRONIC WASTE	Str	Assesses the extent to which companies that produce or sell electronic products may face regulatory risks associated with recycling or disposal of end-of-life electronic products

FINANCIAL PRODUCT SAFETY	Str	Assesses how companies manage the risk of incurring costs associated with unanticipated credit losses, litigation, and regulatory changes brought by offering financial products
PRIVACY & DATA SECURITY	Con	Measures the severity of controversies related to a firm's privacy and data security practices (ex. Controversial legal uses of personal data)
IMPACT OF PRODUCTS & SERVICES	Con	Assesses the severity of controversies related to the environmental impact of a firm's products and services (ex. history of involvement in environmental impact-related legal cases)
CUSTOMER RELATIONS	Con	Measures the severity of controversies related to how a firm treats its customers or potential customers (ex. Fraudulent or improper billing)
TAX DISPUTES	Con	Identifies companies that were involved in major tax disputes involving Federal, state, local or non-U.S. government authorities, or is involved in controversies over its tax obligations to the community
CORRUPTION & POLITICAL INSTABILITY	Str	Evaluates the extent to which companies may face regulatory risks or lost market access due to corruption scandals or political and social instability
FINANCIAL SYSTEM INSTABILITY	Str	Evaluates the extent to which companies may face enhanced regulatory scrutiny as a result of their contributions to systemic risk in financial markets
BRIBERY & FRAUD	Con	Assesses the severity of controversies related to a firm's business ethics practices
CONTROVERSIAL BUSINESS INVOLVEMENT INDICATORS	Con	Identifies firms that were involved in alcohol, gambling, military, firearms, nuclear, tobacco

METHODOLOGY

Stock portfolio's litigation score measure

In order to measure the litigation score of P/L insurers' stock portfolio, we use KLD database to obtain litigation score of stocks. The litigation score of a stock is constructed by adding one point for each strength category and subtracting one point for each concern category. When constructing the litigation score, we use categories that are related to litigation from the KLD database, such as product safety and quality, bribery and fraud, anti-competitive practices, and toxic emissions and wastes (refer to appendix B for details)[10]. Higher litigation scores imply less litigation risks. The overall litigation score of a stock portfolio LIT_PORT_{kt} for P/L insurer k in year t is measured as the value-weighted litigation score of its common stockholdings

$$LIT\_PORT_{kt} = \sum_{i=1}^{n} \frac{LIT\_SCORE_{kit} * VALUE_{kit}}{VALUE_{kt}}, \tag{1}$$

where i denotes the stockholdings; LIT_SCORE is the litigation score; and $VALUE$ is the book adjusted carrying stock value. Positive LIT_PORT implies P/L insurers tilting their stock portfolio to low litigation-risk stocks whereas negative LIT_PORT implies P/L insurers tilting their stock portfolio to high litigation-risk stocks.

Exposure to litigation measure

P/L insurers' exposure to litigation is measured by calculating the ratio of net premiums written in 'Other liability' and 'Products liability' lines to total net premiums written. In liability lines, 'Other liability' and 'Products liability' are the lines that most directly insure against

[10] Hong and Kostovetsky (2012) focus on KLD categories, such as community activities, diversity, employee relations, and environmental record that seem most sensitive to political values, and rate each stock by adding one point for each strength and subtracting one point for each concern. Then, they calculate mutual fund's rating as the value-weighted average of its portfolio stock components' ratings.

corporate litigation[11], thus, P/L insurers that write greater proportion in those lines have greater exposure to litigation. Therefore for a P/L insurer *k*, exposure to litigation in year *t* is given by

$$EXPOSURE_{kt} = \frac{NPW_{kjt}}{NPW_{kt}}, \quad (2)$$

where NPW_{kjt} denotes net premiums written by insurer *k* in year *t* in line *j* where *j* represents 'Other liability' and 'Products liability' lines. According to Mayers and Smith (1990), ratios that involve premiums are not bounded by zero and one due to negative net premiums resulting from returns of premiums. Thus, negative net premiums indicates that P/L insurers exited from the line. Following Mayers and Smith (1990) we convert the negative net premiums to zero in our data when generating the exposure measure, because exiting from a line should have a null effect on the exposure to litigation.

Control variables

Since we are examining the effect of exposure to litigation on P/L insurers' portfolio choice, we control for firm characteristics that affect institutional investors' portfolio choice, and for insurers' investment risk taking. Following Che et al. (2020), we include insurer age as industry experience, insurer size as gross wealth, total net premiums written as income, listing status of the investor's company, market value of stock portfolio, portfolio diversification, number of stocks in the industry, organization form, reinsurance usage, long-tail insurance, business line diversification, and geographic diversification.

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[11] Examples of insurance policies that are reported in 'Other Liability' are "construction and alteration liability; contingent liability; contractual liability; elevators and escalators liability; errors and omissions liability, environmental pollution liability; excess stop loss, excess over insured or self-insured amounts and umbrella liability; liquor liability; personal injury liability; premises and operations liability; completed operations liability, nonmedical professional liability" (NAIC P/C Insurers Annual Statement Filing Instructions, 2008: 465). There are other lines that insure corporate litigation but we argue that these two lines are most closely related to the litigation risk described in the KLD database.

Industry experience (AGE) is calculated as the natural logarithm of the number of years since commencement. Gross wealth (SIZE) is calculated as the natural logarithm of total net admitted assets. Income (NPW_SIZE) is calculated as the natural logarithm of total net premiums written. Listing status of the investor's company (PUBLIC) is generated as a dummy variable that equals 1 for publicly-traded insurer and equals 0 for private insurer. Market value of stock portfolio (PTF_MV) is calculated as the natural logarithm of total market value of common stockholdings. Portfolio diversification (PTF_DIV) is calculated as the natural logarithm of the number of stocks held by the insurer. Year-fixed effects is used in the model to control for the number of stocks in the industry. Organization form (MUTUAL) is generated as a dummy variable that equals 1 for mutual insurers and equals 0 for stock insurers. Reinsurance usage (REINSURANCE) is calculated as the ratio of premiums ceded to the sum of direct premiums written and reinsurance assumed. Since we are focusing on P/L insurers' exposure to litigation, the values of 'Other liability' lines and 'Products liability' lines are used when measuring reinsurance usage. Long-tail insurance (LONG_TAIL) is calculated as the percentage of net premiums written on long-tail lines[12]. Business line diversification (LINE_DIV) is calculated as the complement of the Herfindahl Index of net premiums written across lines of business. Geographic diversification (GEO_DIV) is calculated as the complement of the Herfindahl Index of direct premiums written across states and territories. Summary statistics for all of the variables are shown in table 2.

[12] We follow Phillips, Cummins, and Allen (1998) and identify long-tail lines as Ocean Marine, Medical Professional Liability, International, Reinsurance, Workers' Compensation, Other Liability, Products Liability, Aircraft, Boiler and Machinery, Farmowners Multiple Peril, Homeowners Multiple Peril, Commercial Multiple Peril, and Automobile Liability.

Regression model

In order to test the hedging motive hypothesis, first we use a standard OLS model to examine the relation between the exposure to litigation and extent of investments in low litigation-risk stocks.

$$LIT\_PORT_{kt} = \beta_0 + \beta_1\, EXPOSURE_{kt} + \beta_2 X_{kt} + \varepsilon_{kt}, \qquad (3)$$

where LIT_PORT_{kt} is the value-weighted litigation score of P/L insurer k's common stockholdings in year t, as defined in equation (1); *EXPOSURE* is the exposure measure defined in equation (2); and X is a vector of control variables; and ε is a random error term.

Next, we use Cragg's two-part model (Cragg, 1971). The advantage of using Cragg's model over other maximum likelihood estimation (MLE) models is that it allows us to separately examine the probability of investing in low litigation-risk stocks and the extent of investments in low litigation-risk stocks. We also conduct a likelihood ratio test to test whether the coefficient vectors in Cragg and Tobit models are equal.

The first stage of the Cragg's model is a Probit regression that will examine the probability of P/L insurers investing in low litigation-risk stocks.

$$DUMMY\_LIT\_PORT_{kt} = \beta_0 + \beta_1\, EXPOSURE_{kt} + \beta_2 X_{kt} + \varepsilon_{kt}, \qquad (4)$$

where DUMMY*_LIT_PORT* is a dummy variable that equals 1 for P/L insurers with positive *LIT_PORT* and equals 0 otherwise; *EXPOSURE* is the exposure measure defined in equation (2); and X is a vector of control variables; and ε is a random error term.

The second stage of the Cragg's model is a truncated regression that will examine the extent of investments in low litigation-risk stocks of P/L insurers with positive *LIT_PORT*,

$$LIT\_PORT_{kt} = \beta_0 + \beta_1\, EXPOSURE_{kt} + \beta_2 X_{kt} + \varepsilon_{kt}, \qquad (5)$$

As defined in equation (1), LIT_PORT_{kt} is the value-weighted litigation score of P/L insurer *k*'s common stockholdings, and the independent variable is the same as in the first stage. Variable descriptions and expected signs based on our hypotheses are shown in table 1.

A Tobit model with the specifications of equation (5) is also estimated, in order to test whether Cragg or Tobit is appropriate for the analysis. A likelihood ratio test is conducted to test the hypothesis that the coefficient vectors in Cragg and Tobit are equal. The results reject the hypothesis at the 5% level, leading to the conclusion that the Cragg model is the appropriate model to use.

In order to test whether cost of reinsurance affects P/L insurers' probability and extent of investments in low litigation-risk stocks, we add a variable that measures unaffiliated reinsurance usage of P/L insurers to equation (4) and (5), respectively.

$$DUMMY\_LIT\_PORT_{kt} = \beta_0 + \beta_1\, UNAFF\_REIN_{kt} + \beta_2\, EXPOSURE_{kt} + \beta_3\, X_{kt} + \varepsilon_{kt}, \quad (6)$$

$$LIT\_PORT_{kt} = \beta_0 + \beta_1\, UNAFF\_REIN_{kt} + \beta_2\, EXPOSURE_{kt} + \beta_3\, X_{kt} + \varepsilon_{kt}, \quad (7)$$

where $UNAFF\_REIN_{kt}$ is the ratio of unaffiliated reinsurance usage to total reinsurance usage of P/L insurer *k* in year *t*. Since *UNAFF_REIN* measures reinsurance usage, we exclude reinsurance ratio variable, *REINSURANCE*, from our control variables for this model.

Table 1 Variable descriptions

This table presents the variables, their descriptions, and predicted signs in the Cragg's two-part model.

Variable	Description	Predicted sign First stage	 Second stage
Dependent variables			
LIT_PORT	Extent of investments in low litigation-risk stocks, measured as value-weighted litigation score of its common stockholdings.		
DUMMY_LIT_PORT	Equals 1 for P/L insurers with positive *LIT_PORT* and equals 0 otherwise.		
Independent variables			
EXPOSURE	Exposure to litigation, measured as the ratio of net premiums written in 'Other liability' and 'Products liability' lines to total net premiums written.	+	+
UNAFF_REIN	Unaffiliated reinsurance usage, calculated as the ratio of unaffiliated reinsurance usage to total reinsurance usage.	+	
Control variables			
AGE	Industry experience, calculated as the natural logarithm of the number of years since commencement.	+/-	+/-
SIZE	Gross wealth, calculated as the natural logarithm of total net admitted assets.	+/-	+/-
NPW_SIZE	Income, calculated as the natural logarithm of total net premiums written.	+/-	+/-
PUBLIC	Dummy variable that equals 1 for publicly-traded insurer and equals 0 for private insurer.	-	-
PTF_MV	Market value of stock portfolio, calculated as the natural logarithm of total market value of common stockholdings.	+/-	+/-
PTF_DIV	Portfolio diversification, calculated as the natural logarithm of the number of stocks held by the insurer.	-	-
MUTUAL	Dummy variable that equals 1 for mutual insurers and equals 0 for stock insurers.	-	-
REINSURANCE	Reinsurance usage in 'Other liability' and 'Products liability' lines, calculated as the ratio of premiums ceded to the sum of direct premiums written and reinsurance assumed.	-	-
LONG_TAIL	Long-tail insurance, calculated as the percentage of net premiums written on long-tail lines.	+/-	+/-

LINE_DIV	Business line diversification, calculated as the complement of the Herfindahl Index of net premiums written across the lines of business.	+/-	+/-
GEO_DIV	Geographic diversification, calculated as the complement of the Herfindahl Index of direct premiums written across the states and territories.	+/-	+/-

Table 2 Summary statistics

	N	Mean	Median	Min	Max	Std. Dev.	1st quartile	3rd quartile
LIT_PORT	1,661	-0.5098	-0.4632	-9.0000	2.0000	0.7357	-0.7306	-0.1966
EXPOSURE	1,661	0.1691	0.0433	0.0000	1.0000	0.2724	0.0101	0.1830
UNAFF_REIN	1,661	0.5658	0.7602	0.0000	1.0000	0.4495	0.0116	1.0000
AGE	1,661	3.9839	4.0431	0.0000	5.5797	0.7686	3.4657	4.6347
SIZE	1,661	19.4158	19.4559	13.7299	25.9085	2.1307	17.9549	20.9299
NPW_SIZE	1,661	18.1028	18.2087	9.3337	24.4235	2.2783	16.5567	19.6330
PUBLIC	1,661	0.1788	0.0000	0.0000	1.0000	0.3833	0.0000	0.0000
PTF_MV	1,661	17.4804	17.4968	8.1424	25.3907	2.4914	15.7424	19.2141
PTF_DIV	1,661	3.9271	4.0073	0.0000	7.6516	1.3663	3.2581	4.7362
MUTUAL	1,661	0.3191	0.0000	0.0000	1.0000	0.4663	0.0000	1.0000
REINSURANCE	1,661	0.3993	0.3472	0.0000	1.0000	0.3077	0.1226	0.6443
LONG_TAIL	1,661	0.8712	0.9426	0.0000	1.0000	0.1913	0.8301	0.9883
LINE_DIV	1,661	0.4972	0.5799	0.0000	0.8836	0.2666	0.3184	0.7069
GEO_DIV	1,661	0.5166	0.6420	0.0000	0.9659	0.3857	0.0001	0.8958

RESULTS

Results for the analysis of the probability and extent of investments in low litigation-risk stocks are shown in table 3. The first column in table 3 shows the results from the OLS regression of equation (3) that examines the relation between the extent of investments in low litigation-risk stocks and exposure to litigation. It shows a positive relation, which indicates that as exposure to litigation increases, P/L insurers tend to increase their stock portfolio's weight towards low litigation-risk stocks. Results for the first stage Probit regression (4) of Cragg's model, which examines the probability of investing in low litigation-risk stocks, are shown in column 2 of table 3. The positive relation between *DUMMY_LIT_PORT* and *EXPOSURE* indicates that P/L insurers with higher exposure to litigation have higher probability of investing in low litigation-risk stocks, which supports our first hypothesis.

Results for the second stage (5) of the Cragg's model, which examines the extent of investments in low litigation-risk stocks of P/L insurers with positive *LIT_PORT*, are shown in column 3 of table 3. The insignificant relation between *LIT_PORT* and *EXPOSURE* indicates that, among the P/L insurers that value weight their stock portfolio more towards low litigation-risk stocks, there is no difference in the extent of investments in low litigation-risk stocks. The results of the first and second stages together indicate that P/L insurers have higher probability to invest in low litigation-risk stocks when exposure to litigation in their underwriting is high, but P/L insurers that allocate greater value weight towards low litigation-risk stocks in their stock portfolio do not increase the level of investments in low litigation-risk stocks as their exposure to litigation increases. In other words, P/L insurers are likely to hedge the exposure to litigation by investing in low litigation-risk stocks, but they do not increase their hedge level as the exposure to litigation increases.

Other noteworthy results from the OLS and Cragg model are the relation between *PUBLIC* and the dependent variables. *PUBLIC* is negatively related to the dependent variables in all of the regressions. The results indicate that the probability of investing in low litigation-risk stocks is smaller for publicly held P/L insurers than privately held P/L insurers, and that, if they do hold low litigation-risk stocks, they hold less low litigation-risk stocks in extent compared to privately held P/L insurers. This supports the agency theory from Jensen and Meckling (1976). According to the agency theory, shareholders of publicly held firms incentivize risk averse managers to take greater risk in investment. Therefore, publicly held P/L insurers are more likely to take risk in their investment, than privately held P/L insurers. In other words, publicly held P/L insurers have less motivation to hedge against their exposure to litigation by investing in low litigation-risk stocks than privately held P/L insurers.

We test whether the relation between investments in low litigation-risk stocks and exposure to litigation is non-linear by using piecewise linear regressions (e.g. Morck, Shleifer, and Vishny, 1988). We divide exposure into quartiles and use the quartile values as turning points. The results of the piecewise linear regressions are shown in table 4 where panel A examines the linearity of the probability of investing in low litigation-risk stocks, and where panel B examines the linearity of the extent of investments in low litigation-risk stocks. The results in panel A show that, as exposure to litigation increases up to the median, the probability of P/L insurers investing in low litigation-risk stocks increases, however, as exposure to litigation exceeds the median, the probability of P/L insurers investing in low litigation-risk stocks does not change, indicating a non-linear relation. The only different result from panel B is that there is a slight increase in extent of investments in low litigation-risk stocks towards the 90th percentile exposure to litigation. The results in table 5 show that P/L insurers with above-median litigation exposure have higher probability investing in low litigation-risk stocks than P/L insurers with below-median litigation exposure. Together, the results are indicating that the probability and extent of P/L insurers' investment in low litigation-risk stocks grow logarithmically as exposure to litigation increases, and around the median of exposure to litigation is where the slope becomes flat. P/L insurers with greater exposure to litigation could be hedging against the exposure to litigation by using reinsurance instead of investing in low litigation-risk stocks. This leads to the testing of our second hypothesis.

In order to test whether P/L insurers with above-median exposure to litigation substitute low litigation-risk stock investments with reinsurance, we create an interaction variable where *DUMMY_EXP_P50*[13] is interacted with *REINSURANCE*. Since the piecewise regression shows that the probability of P/L insurers investing in low litigation-risk stocks stalls after the median of exposure to litigation, we choose *DUMMY_EXP_P50* to interact with *REINSURANCE*. Also, we define high exposure to litigation as exposure to litigation greater than the median.

The model used to test this is described as follow.

$$DUMMY\_LIT\_PORT_{kt} = \beta_0 + \beta_1\, DUMMY\_EXP\_P50_{kt} * REINSURANCE_{kt} + \beta_2\, DUMMY\_EXP\_P50_{kt} + \beta_3\, REINSURANCE_{kt} + \beta_4\, X_{kt} + \varepsilon_{kt}, \quad (8)$$

$$LIT\_PORT_{kt} = \beta_0 + \beta_1\, DUMMY\_EXP\_P50_{kt} * REINSURANCE_{kt} + \beta_2\, DUMMY\_EXP\_P50_{kt} + \beta_3\, REINSURANCE_{kt} + \beta_4\, X_{kt} + \varepsilon_{kt}, \quad (9)$$

The result from table 6 is showing that the interaction variable is negatively and significantly correlated with *DUMMY_LIT_PORT* variable and the *LIT_PORT* variable. This indicates that, for P/L insurers with high exposure to litigation, reinsurance and investments in low litigation-risk

[13] DUMMY_EXP_p50 equals 1 if EXPOSURE >= P50, otherwise equals 0, where P50 (0.0433) represents 50th percentile.

stocks are substitutes for hedging against exposure to litigation. In other words, the use of reinsurance affects the probability and extent of investments in low litigation-risk stocks for P/L insurers with high exposure to litigation. This supports our second hypothesis.

Results from testing our third hypothesis, whether usage of unaffiliated reinsurance has impact on the probability and extent of investments in low litigation-risk stocks, are shown in table 7. Results from first column show a positive relation between *UNAFF_REIN* and the dependent variables *DUMMY_LIT_PORT*, indicating that the probability of P/L insurers investing in low litigation-risk stocks increases as they cede risk more to the unaffiliated reinsurers. Also, results from second column show a positive relation between *UNAFF_REIN* and the dependent variable *LIT_PORT*, indicating that value-weighted litigation score of P/L insurers' stock portfolio increase as P/L insurers cede greater risk to unaffiliated reinsurers. In other words, P/L insurers with higher unaffiliated reinsurance usage are investing more on low litigation-risk stocks. In specific, a one-standard-deviation increase in unaffiliated reinsurance usage increases value-weighted litigation score of P/L insurers' stock portfolio by 0.0519. Altogether, the results from table 7 are indicating that higher cost of reinsurance affects P/L insurers to invest more in low litigation-risk stocks.

As a robustness test, we use a different measure for identifying low litigation-risk stocks[14]. Prior literature identifies biotechnology, computers, electronics, and retailing as industries with high risk of being sued[15]. We identify high litigation-risk industries as SIC codes with 2833-2836 (biotechnology), 3570-3577 and 7370-7374 (computers), 3600-3674 (electronics), and 5200-5961 (retailing). Then we measure the overall litigation risk of a stock portfolio $SIC\_LOW\_LIT_{kt}$ for P/L insurer k in year t as follow,

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[14] We thank Evan Eastman for suggesting the alternative measure for identifying low litigation-risk stocks.
[15] See Matsumoto (2002), Field, Lowry, and Shu (2005), Rogers and Stocken (2005), Kothari, Shu, and Wysocki (2009), and Bhaskar, Schroeder, and Shepardson (2019).

$$SIC\_LOW\_LIT_{kt} = 1 - \frac{HIGH\_RISK\_VALUE_{kt}}{VALUE_{kt}} \quad (10)$$

where *HIGH_RISK_VALUE* is a sum of the book adjusted carrying value of stocks in high litigation-risk industries, and *VALUE* is the book adjusted carrying stock value. Higher value of *SIC_LOW_LIT* indicates that P/L insurers hold greater amount of stocks that are not in the high litigation-risk industries. Table 8 provides the results for the robustness test of the analysis of the probability and extent of investments in low litigation-risk stocks. The results align with our findings that P/L insurers hedge against exposure to litigation by investing in stocks in non-high litigation-risk industries, and that they do not increase their hedge level as the exposure to litigation increases. Furthermore, the significantly negative relation between *REINSURANCE* and *SIC_LOW_LIT* aligns with our findings that investing in non-high litigation-risk industries and reinsurance are substitutes.

Table 9 represents the robustness check of the relation between investments in low litigation-risk stocks and reinsurance cost, by using the alternative measure for identifying low litigation-risk stocks. The results align with our findings that the use of unaffiliated reinsurance impacts the probability of investing in low litigation-risk stocks, by showing that the use of unaffiliated reinsurance increases the probability of investing in non-high litigation-risk industries. Overall, the results using the alternative measure for identifying low litigation-risk stocks generally aligns with our original findings.

Table 3 Analysis of probability and extent of investments in low litigation-risk stocks using Cragg's model

This table presents the results from the OLS regression, and the first and second stage regressions of the Cragg's model that examines the probability and extent of investments in low litigation-risk stocks of P/L insurers. The first model is a standard OLS, and the dependent variable is the value-weighted litigation score of its common stockholdings. For the first stage of the Cragg model, a Probit model is used, and the dependent variable is a binary variable that equals 1 for P/L insurers where value weighted litigation score of their common stockholdings is positive, and equals 0 otherwise. For the second stage, a truncated regression is used, the sample includes P/L insurers where value weighted litigation score of their common stockholdings is positive, and the dependent variable is the value-weighted litigation score of its common stockholdings. Robust standard errors in parentheses.

	OLS	First stage	Second stage
	LIT_PORT	*DUMMY_LIT_PORT*	*LIT_PORT*
INTERCEPT	-1.5842***	-2.8887***	-0.5486
	(0.2167)	(0.5554)	(2.3254)
EXPOSURE	0.1802**	0.3326*	0.4966
	(0.0829)	(0.1937)	(0.5756)
AGE	0.0046	0.1791**	-0.0689
	(0.0270)	(0.0751)	(0.1723)
SIZE	0.0572	0.0436	0.0939
	(0.0402)	(0.0859)	(0.2830)
NPW_SIZE	-0.0022	0.0603	0.0174
	(0.0265)	(0.0680)	(0.2161)
PUBLIC	-0.3267***	-0.2293*	-0.7683**
	(0.0681)	(0. 1292)	(0.3770)
PTF_MV	-0.0242	-0.0071	0.0892
	(0.0226)	(0. 0392)	(0.0807)
PTF_DIV	0.0278	-0.3419***	-0.9506***
	(0.0230)	(0.0475)	(0.2231)
MUTUAL	-0.0802**	-0.3242**	0.4825
	(0.0367)	(0.1254)	(0.5158)
REINSURANCE	0.1086*	-0.1043	-0.2108
	(0.0638)	(0.1478)	(0.4089)
LONG_TAIL	-0.0289	0.3122	-0.7307
	(0.1093)	(0.2605)	(0.6224)
LINE_DIV	0.1787**	-0.0258	0.3950
	(0.0902)	(0.1885)	(0.5031)
GEO_DIV	-0.0464	-0.2988**	-0.1794
	(0.0567)	(0.1395)	(0.3617)
Year Fixed Effects	Yes	Yes	Yes
N	1,661	1,661	186
χ^2		155.983	19.5285
ADJ-R^2	0.1044		

***Means statistically significant at a 1% confidence level, ** at 5% level, and * at 10% level

Table 4 Linearity test

This table presents the results from the piecewise regression that examines the linearity of the effect of exposure to litigation on the probability and extent of investments in low litigation-risk stocks. For panel A, Probit model is used and the dependent variable is a binary variable that equals 1 for P/L insurers where value weighted litigation score of their common stockholdings is positive, and equals 0 otherwise. For panel B, OLS model is used, and the dependent variable is the value-weighted litigation score of P/L insurers' common stockholdings. EXP_0to25=EXPOSURE if EXPOSURE < P25, otherwise = P25, and EXP_over25=0 if EXPOSURE < P25, otherwise = (EXPOSURE – P25), where P25 (0.0101) represents 25th percentile. EXP_0to50=EXPOSURE if EXPOSURE < P50, otherwise = P50, and EXP_over50=0 if EXPOSURE < P50, otherwise = (EXPOSURE – P50), where P50 (0.0433) represents 50th percentile. EXP_0to75=EXPOSURE if EXPOSURE < P75, otherwise = P75, and EXP_over75=0 if EXPOSURE < P75, otherwise = (EXPOSURE – P75), where P75 (0.1830) represents 75th percentile. EXP_0to0-=EXPOSURE if EXPOSURE < P90, otherwise = P90, and EXP_over90=0 if EXPOSURE < P90, otherwise = (EXPOSURE – P90), where P90 (0.5985) represents 90th percentile. Robust standard errors in parenthesis.

Panel A Dependent variable : *DUMMY_LIT_PORT*				
INTERCEPT	-3.1173***	-3.0804***	-2.8875***	-2.8869***
	(0.5660)	(0.5717)	(0.5542)	(0.5575)
EXP_0to25	30.2532*			
	(16.2379)			
EXP_over25	0.2448			
	(0.2026)			
EXP_0to50		8.3411**		
		(3.5944)		
EXP_over50		0.0847		
		(0.2258)		
EXP_0to75			0.8597	
			(1.0212)	
EXP_over75			0.1939	
			(0.3270)	
EXP_0to90				-0.0756
				(0.3888)
EXP_over90				1.2488
				(0.8221)
AGE	0.1826**	0.1943**	0.1850**	0.1673**
	(0.0750)	(0.0757)	(0.0760)	(0.0758)
SIZE	0.0155	0.0044	0.0350	0.0507
	(0.0872)	(0.0892)	(0.0884)	(0.0862)
NPW_SIZE	0.0881	0.0972	0.0661	0.0558
	(0.0694)	(0.0732)	(0.0701)	(0.0676)
PUBLIC	-0.2228*	-0.2043	-0.2324*	-0.2140
	(0.1293)	(0.1292)	(0.1301)	(0.1314)
PTF_MV	-0.0025	-0.0014	-0.0048	-0.0074

	(0.0393)	(0.0392)	(0.0396)	(0.0392)
PTF_DIV	0.3504***	-0.3489***	-0.3441***	-0.3421***
	(0.0479)	(0.0479)	(0.0484)	(0.0471)
MUTUAL	-0.3188**	-0.2906**	-0.3137**	-0.3485***
	(0.1261)	(0.1262)	(0.1267)	(0.1259)
REINSURANCE	-0.0339	-0.0146	-0.0953	-0.1033
	(0.1533)	(0.1551)	(0.1494)	(0.1479)
LONG_TAIL	0.3393	0.3747	0.3297	0.2565
	(0.2643)	(0.2699)	(0.2632)	(0.2641)
LINE_DIV	-0.1666	-0.2919	-0.1055	0.1184
	(0.1957)	(0.2177)	(0.2373)	(0.2224)
GEO_DIV	-0.3324**	-0.3364**	-0.3036**	-0.2940**
	(0.1404)	(0.1421)	(0.1399)	(0.1396)
Year Fixed Effects	Yes	Yes	Yes	Yes
N	1,661	1,661	1,661	1,661
χ^2	158.888	160.5611	156.2395	157.2089

Panel B
Dependent variable : *LIT_PORT*

INTERCEPT	-1.6164***	-1.6444***	-1.5942***	-1.5868***
	(0.2482)	(0.2500)	(0.2515)	(0.2509)
EXP_0to25	4.9598			
	(6.4316)			
EXP_over25	0.1647*			
	(0.0861)			
EXP_0to50		2.4962*		
		(1.301)		
EXP_over50		0.1069		
		(0.0927)		
EXP_0to75			0.6611*	
			(0.3448)	
EXP_over75			0.0557	
			(0.1224)	
EXP_0to90				0.3105*
				(0.1605)
EXP_over90				-0.1062
				(0.3296)
AGE	0.0046	0.0096	0.0114	0.0089
	(0.0269)	(0.0273)	(0.0276)	(0.0273)
SIZE	0.0533	0.0470	0.0493	0.0542
	(0.0408)	(0.0409)	(0.0400)	(0.0400)
NPW_SIZE	0.0017	0.0082	0.0038	-0.0001
	(0.0273)	(0.0276)	(0.0266)	(0.0264)
PUBLIC	-0.3257***	-0.3205***	-0.3314***	-0.3335***
	(0.0682)	(0.0681)	(0.0687)	(0.0702)
PTF_MV	-0.0236	-0.0231	-0.0225	-0.0240

	(0.0227)	(0.0227)	(0.0226)	(0.0226)
PTF_DIV	0.0266	0.0258	0.0258	0.0275
	(0.0234)	(0.0232)	(0.0230)	(0.0229)
MUTUAL	-0.0783**	-0.0724**	-0.0725*	-0.0737**
	(0.0367)	(0.0368)	(0.0396)	(0.0368)
REINSURANCE	0.1197*	0.1333**	0.1174*	0.1083*
	(0.0637)	(0.0630)	(0.0633)	(0.0628)
LONG_TAIL	-0.0263	-0.0102	-0.0132	-0.0110
	(0.1089)	(0.1092)	(0.1124)	(0.1156)
LINE_DIV	0.1562*	0.1008	0.1069	0.1350
	(0.0992)	(0.1040)	(0.1052)	(0.1009)
GEO_DIV	-0.0514	-0.0588	-0.0509	-0.0473
	(0.0570)	(0.0569)	(0.0568)	(0.0567)
Year Fixed Effects	Yes	Yes	Yes	Yes
N	1,661	1,661	1,661	1,661
$ADJ\text{-}R^2$	0.1042	0.1054	0.1047	0.1043

***Means statistically significant at a 1% confidence level, ** at 5% level, and * at 10% level

Table 5 Linearity test

This table presents the results from further examination of the linearity of the effect of exposure to litigation on the probability and extent of investments in low litigation-risk stocks. Probit model is used, and the dependent variable is a binary variable that equals 1 for P/L insurers where value weighted litigation score of their common stockholdings is positive, and equals 0 otherwise. DUMMY_EXP_p25 equals 1 if EXPOSURE >= P25, otherwise equals 0, where P25 (0.0101) represents 25th percentile. DUMMY_EXP_p50 equals 1 if EXPOSURE >= P50, otherwise equals 0, where P50 (0.0433) represents 50th percentile. DUMMY_EXP_p75 equals 1 if EXPOSURE >= P75, otherwise equals 0, where P75 (0.1830) represents 75th percentile. DUMMY_EXP_p90 equals 1 if EXPOSURE >= P90, otherwise equals 0, where P90 (0.5985) represents 90th percentile. Robust standard errors in parenthesis.

Dependent variable : *DUMMY_LIT_PORT*				
INTERCEPT	-2.9375***	-2.8762***	-2.7442***	-2.8399***
	(0.5482)	(0.5540)	(0.5423)	(0.5539)
DUMMY_EXP_p25	0.2714**			
	(0.1147)			
DUMMY_EXP _p50		0.2478**		
		(0.1110)		
DUMMY_EXP _p75			0.0833	
			(0.1174)	
DUMMY_EXP _p90				0.2491
				(0.1629)
AGE	0.1737**	0.1902**	0.1683**	0.1709**
	(0.0747)	(0.0764)	(0.0747)	(0.0747)
SIZE	0.0299	0.0287	0.0688	0.0589
	(0.0840)	(0.0856)	(0.0848)	(0.0827)
NPW_SIZE	0.0682	0.0705	0.0304	0.0445
	(0.0645)	(0.0682)	(0.0654)	(0.0634)
PUBLIC	-0.1775	-0.2065	-0.2191*	-0.2127*
	(0.1290)	(0.1283)	(0.1317)	(0.1280)
PTF_MV	-0.0042	-0.0048	-0.0098	-0.0087
	(0.0391)	(0.0390)	(0.0394)	(0.0390)
PTF_DIV	-0.3473***	-0.3437***	-0.3393***	-0.3396***
	(0.0473)	(0.0476)	(0.0480)	(0.0472)
MUTUAL	-0.2979**	-0.2961**	-0.3101**	-0.3291***
	(0.1275)	(0.1261)	(0.1271)	(0.1256)
REINSURANCE	-0.0540	-0.0694	-0.1355	-0.1192
	(0.1528)	(0.1491)	(0.1462)	(0.1462)
LONG_TAIL	0.3830	0.3520	0.3502	0.3041
	(0.2609)	(0.2624)	(0.2559)	(0.2579)
LINE_DIV	-0.2156	-0.2559	-0.0644	0.0293
	(0.2013)	(0.2130)	(0.1953)	(0.1917)
GEO_DIV	-0.2895**	-0.2987**	-0.2547*	-0.2788**
	(0.1382)	(0.1404)	(0.1378)	(0.1390)
Year Fixed Effects	Yes	Yes	Yes	Yes

N	1,661	1,661	1,661	1,661
χ^2	157.63	158.313	153.42	155.09

***Means statistically significant at a 1% confidence level, ** at 5% level, and * at 10% level

Table 6 Analysis of the relation between investments in low litigation-risk stocks and reinsurance

This table presents the results from examining the impact of reinsurance usage on the probability and extent of investments in low litigation-risk stocks. Probit and OLS models are used, respectively. The dependent variables are a binary variable that equals 1 for P/L insurers where value weighted litigation score of their common stockholdings is positive, and equals 0 otherwise, and value-weighted litigation score of its common stockholdings, respectively. DUMMY_EXP_p50 equals 1 if EXPOSURE >= P50, otherwise equals 0, where P50 (0.0433) represents 50th percentile. Robust standard errors in parenthesis.

	DUMMY_LIT_PORT	*LIT_PORT*
INTERCEPT	-2.9178***	-1.6542***
	(0.5636)	(0.2586)
DUMMY_EXP_P50* REINSURANCE	-0.5744**	-0.2166*
	(0.2858)	(0.1094)
DUMMY_EXP_P50	0.4540***	0.2349***
	(0.1526)	(0.0614)
REINSURANCE	0.1490	0.2090**
	(0.1902)	(0.0826)
AGE	0.1842**	0.0152
	(0.0770)	(0.0273)
SIZE	0.0417	0.0535
	(0.0867)	(0.0401)
NPW_SIZE	0.0592	0.0019
	(0.0684)	(0.0262)
PUBLIC	-0.1883	-0.3123***
	(0.1290)	(0.0658)
PTF_MV	-0.0079	-0.0248
	(0.0395)	(0.0227)
PTF_DIV	-0.3445***	0.0272
	(0.0473)	(0.0230)
MUTUAL	-0.3010**	-0.0699*
	(0.1260)	(0.0368)
LONG_TAIL	0.3018	-0.0161
	(0.2644)	(0.1087)
LINE_DIV	-0.2399	0.0475
	(0.2125)	(0.0912)
GEO_DIV	-0.2762*	-0.0487
	(0.1409)	(0.0556)
Year Fixed Effects	Yes	Yes
N	1,661	1,661
χ^2	161.779	
ADJ-R2		0.1105

***Means statistically significant at a 1% confidence level, ** at 5% level, and * at 10% level

Table 7 Analysis of the relation between investments in low litigation-risk stocks and reinsurance cost

This table presents the results from examining the impact of unaffiliated reinsurance usage on the probability and extent of investments in low litigation-risk stocks. Probit and OLS models are used, respectively. The dependent variables are a binary variable that equals 1 for P/L insurers where value weighted litigation score of their common stockholdings is positive, and equals 0 otherwise, and value-weighted litigation score of its common stockholdings, respectively. Robust standard errors in parenthesis.

	DUMMY_LIT_PORT	*LIT_PORT*
INTERCEPT	-3.2443***	-1.6869***
	(0.5749)	(0.2649)
UNAFF_REIN	0.2325**	0.1155***
	(0.1069)	(0.0421)
EXPOSURE	0.3461*	0.1497*
	(0.1932)	(0.0778)
AGE	0.1752**	0.0041
	(0.0758)	(0.0270)
SIZE	0.0617	0.0810*
	(0.0821)	(0.0416)
NPW_SIZE	0.0453	-0.0232
	(0.0643)	(0.0282)
PUBLIC	-0.1956	-0.3191***
	(0.1281)	(0.0666)
PTF_MV	0.0005	-0.0257
	(0.0387)	(0.0224)
PTF_DIV	-0.3481***	0.0249
	(0.0494)	(0.0225)
MUTUAL	-0.3720***	-0.0950**
	(0.1280)	(0.0382)
LONG_TAIL	0.2862	-0.0064
	(0.2698)	(0.1078)
LINE_DIV	0.0383	0.2095**
	(0.1901)	(0.0947)
GEO_DIV	-0.3116**	-0.0195
	(0.1370)	(0.0536)
Year Fixed Effects	Yes	Yes
N	1,661	1,661
χ^2	159.9267	
ADJ-R2		0.1068

***Means statistically significant at a 1% confidence level, ** at 5% level, and * at 10% level

Table 8 Robustness to the analysis of probability and extent of investments in low litigation-risk stocks

This table presents the results from the OLS regression, and the first and second stage regressions of the Cragg's model that examines the robustness of the probability and extent of investments in low litigation-risk stocks of P/L insurers. The first model is a standard OLS, and the dependent variable is the value proportion of holding stocks of non-high litigation-risk industries[16]. For the first stage of the Cragg model, a Probit model is used, and the dependent variable is a binary variable that equals 1 for P/L insurers where the value proportion of holding stocks of non-high litigation-risk industries is greater than the median (0.7564), and equals 0 otherwise. For the second stage, a truncated regression is used, the sample includes P/L insurers where the value proportion of holding stocks of non-high litigation-risk industries is greater than the median, and the dependent variable is the value proportion of holding stocks of non-high litigation-risk industry. Robust standard errors in parenthesis. This is repeated in panel B, using 3rd quartile (0.8727) instead of the median.

Panel A	OLS	First stage	Second stage
	SIC_LOW_LIT	*DUMMY_SIC_LOW_LIT*	*SIC_LOW_LIT*
INTERCEPT	0.6406***	-0.3059	0.8763***
	(0.0542)	(0.4048)	(0.0449)
EXPOSURE	0.0566***	0.2340*	0.0222
	(0.0174)	(0.1413)	(0.0146)
AGE	0.0117	0.1486***	-0.0061
	(0.0079)	(0.0574)	(0.0054)
SIZE	0.0249***	0.1657**	0.0156**
	(0.0095)	(0.0702)	(0.0068)
NPW_SIZE	-0.0052	-0.0803	-0.0007
	(0.0070)	(0.0513)	(0.0056)
PUBLIC	-0.0563***	-0.2673***	-0.0456***
	(0.0146)	(0.0986)	(0.0097)
PTF_MV	-0.0142***	-0.0459	-0.0039*
	(0.0047)	(0.0340)	(0.0024)
PTF_DIV	-0.0217***	-0.2827***	-0.0569***
	(0.0048)	(0.0291)	(0.0031)
MUTUAL	-0.0005	-0.1291	0.0208**
	(0.0111)	(0.0878)	(0.0096)
REINSURANCE	-0.0145	-0.0997	-0.0286**
	(0.0138)	(0.1089)	(0.0116)
LONG_TAIL	-0.0086	-0.1981	-0.0063
	(0.0220)	(0.1732)	(0.0179)
LINE_DIV	0.0498***	0.1683	0.0346**
	(0.0195)	(0.1398)	(0.0150)
GEO_DIV	0.0187	0.1029	-0.0162
	(0.0136)	(0.1015)	(0.0113)
Year Fixed Effects	Yes	Yes	Yes

[16] Refer to equation (10).

N	1,661	1,661	831
χ^2		162.1341	341.5525
ADJ-R²	0.0587		

Panel B	OLS *SIC_LOW_LIT*	First stage *DUMMY_SIC_LOW_LIT*	Second stage *SIC_LOW_LIT*
INTERCEPT	0.6404***	-0.9864**	0.9350***
	(0.0505)	(0.4711)	(0.0243)
EXPOSURE	0.0566***	0.3445**	0.0034
	(0.0174)	(0.1574)	(0.0082)
AGE	0.0117	0.0612	-0.0019
	(0.0079)	(0.0642)	(0.0030)
SIZE	0.0249***	0.2314***	0.0054*
	(0.0094)	(0.0775)	(0.0032)
NPW_SIZE	-0.0052	-0.0591	0.0023
	(0.0070)	(0.0586)	(0.0025)
PUBLIC	-0.0563***	-0.3622***	-0.0402***
	(0.0146)	(0.1147)	(0.0056)
PTF_MV	-0.0142***	-0.0905***	-0.0002
	(0.0047)	(0.0349)	(0.0012)
PTF_DIV	-0.0217***	-0.4894***	-0.0264***
	(0.0045)	(0.0387)	(0.0019)
MUTUAL	-0.0005	0.0811	0.0054
	(0.0103)	(0.1029)	(0.0054)
REINSURANCE	-0.0145	-0.2409**	-0.0074
	(0.0141)	(0.1216)	(0.0063)
LONG_TAIL	-0.0086	-0.0454	-0.0133
	(0.0246)	(0.1924)	(0.0082)
LINE_DIV	0.0498**	0.4800***	-0.0082
	(0.0195)	(0.1556)	(0.0083)
GEO_DIV	0.0187	-0.0970	-0.0097
	(0.0136)	(0.1088)	(0.0062)
Year Fixed Effects	Yes		
χ^2	1,661	321.9169	299.175
ADJ-R²	0.0587		

***Means statistically significant at a 1% confidence level, ** at 5% level, and * at 10% level

Table 9 Robustness to the relation between investments in low litigation-risk stocks and reinsurance cost

This table presents the results from the robustness check of the impact of unaffiliated reinsurance usage on the probability and extent of investments in non-high litigation-risk industries. Probit and OLS models are used, respectively. The dependent variables are a binary variable that equals 1 for P/L insurers where the value proportion of holding stocks of non-high litigation-risk industries[17] is greater than the 3rd quartile (0.8727), and equals 0 otherwise, and the value proportion of holding stocks of non-high litigation-risk industries, respectively. Robust standard errors in parenthesis.

	DUMMY_SIC_LOW_LIT	*SIC_LOW_LIT*
INTERCEPT	-1.3486***	0.5900***
	(0.4855)	(0.0566)
UNAFF_REIN	0.2460***	0.0381***
	(0.0929)	(0.0095)
EXPOSURE	0.3683**	0.0579***
	(0.1558)	(0.0170)
AGE	0.0451	0.0101
	(0.0653)	(0.0079)
SIZE	0.2329***	0.0275***
	(0.0776)	(0.0097)
NPW_SIZE	-0.0614	-0.0072
	(0.0590)	(0.0072)
PUBLIC	-0.3362***	-0.0526***
	(0.1139)	(0.0144)
PTF_MV	-0.0749**	-0.0130***
	(0.0348)	(0.0046)
PTF_DIV	-0.4957***	-0.0220***
	(0.0394)	(0.0044)
MUTUAL	0.0302	-0.0077
	(0.1048)	(0.0104)
LONG_TAIL	-0.1070	-0.0139
	(0.1974)	(0.0245)
LINE_DIV	0.5349***	0.0588***
	(0.1579)	(0.0198)
GEO_DIV	-0.1252	0.0188
	(0.1084)	(0.0132)
Year Fixed Effects	Yes	Yes
N	1,661	1,661
χ^2	325.6835	
ADJ-R2		0.0669

[17] Refer to equation (10).

CONCLUSION

This paper examines the puzzle regarding why SRI are increasing in volume despite lower returns than socially irresponsible investments. There are two contrary views on the puzzle, where one strand of literature finds empirical evidence that SRI create value for shareholders, and where another strand of literature finds empirical evidence that SRI does not create value for shareholders and thus argues that social preferences influence SRI decisions. Through this paper, we provide a new perspective on the puzzle, which is the hedging motive. We examine whether a motive for a specific set of firms behind SRI is to hedge against non-financial income exposure.

We analyze portfolio choices of P/L insurers to examine the probability of investing in low litigation-risk stocks, and find support for the hedging motive. We find empirical evidence that exposure to litigation is positively and significantly related to the probability of P/L insurers investing in low litigation-risk stocks. In other words, P/L insurers with higher exposure to litigation have higher probability of investing in low litigation-risk stocks, indicating that P/L insurers choose to invest in low litigation-risk stocks to hedge against their exposure to litigation. In addition, the linearity of the relation between exposure to litigation and investments in low litigation-risk stocks is tested, and we find that the relation is non-linear. Specifically, we find that the relation between the probability and extent of P/L insurers investing in low litigation-risk stocks and exposure to litigation is logarithmic.

We further examine the non-linear relation by investigating whether investments in low litigation-risk stocks and reinsurance are substitutes, and find that as P/L insurers' exposure to litigation exceeds the median, P/L insurers consider investments in low litigation-risk stocks and reinsurance as substitutes when hedging against their exposure to litigation. Since both low litigation-risk stock investments and reinsurance are used as hedging tools, we examine whether decisions to invest in low litigation-risk stocks are affected by the cost of reinsurance. We find that higher cost of reinsurance impacts P/L insurers to tilt their stock portfolio towards low litigation-risk stocks. Considering that P/L insurers tilt their stock portfolio towards low litigation-risk stocks as their exposure to litigation increases, and that investments in low litigation-risk stocks and reinsurance are substitutes, we conclude that the motive behind P/L insurers' investments in low litigation-risk stocks is to hedge against their exposure to litigation.

We plan to expand our study by increasing the time span of our sample. With the increased time span, we plan to create another reinsurance cost measurement by identifying the underwriting cycle of reinsurers. Identifying the underwriting cycle of reinsurers allows us to find the hard market, where price of reinsurance is relatively high, and the soft market, where price of reinsurance is relatively low. Then, we will compare the probability and extent of investments in low litigation-risk stocks during hard markets to those during soft markets.

Furthermore, we plan to examine whether there is an optimal level of investments in low litigation-risk stocks for P/L insurers. Pedersen, Fitzgibbons, and Pomorski (2021), propose a theory on the cost and benefits of SRI. Due to the cost of SRI, optimal level of SRI for hedging against non-financial income exposure would exist. Since P/L insurers also use reinsurance to hedge against their non-financial income exposure, there would be an optimal level of SRI and reinsurance usage depending on their costs.

Moreover, we plane to examine the effectiveness of investments of low litigation-risk stocks to hedge against exposure to litigation. We will compare the volatility of cash flow and ROA of P/L insurers that hedge to that of P/L insurers that do not hedge. We expect that P/L insurers that hedge to have smaller cash flow volatility than P/L insurers that do not hedge.

Hedging is effective when it reduces cash flow volatility, since investor values small cash flow volatility. Rountree, Weston, and Allayannis (2008) find that cash flow volatility is negatively valued.

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ESSAY 2

THE IMPACT OF INTERNAL CAPITAL MARKETS ON MARKET EXIT AND ENTRY DECISIONS: EVIDENCE FROM THE INSRUANCE INDUSTRY

INTRODUCTION

How financial institutions allocate internal capital within groups is an ongoing question in the literature. The major question that the internal capital markets (ICM) literature tries to answer is why groups transfer internal capital to affiliates. Researchers have focused on factors such as the relation between CEO and divisional managers (Scharfstein and Stein, 2000; Ozbas, and Scharfstein, 2010; Gaspar and Massa, 2011; Duchin and Sosyura, 2013; Glaser, Lopez-De-Silanes, and Sautner, 2013; Graham, Harvey, and Puri, 2015), divisions' operational performance (Stein, 1997; Powell, Sommer, and Eckles, 2008; Almeida, Kim, and Kim, 2015; Carson, Eastman, Eckles, Frederick, 2022), operational management (Gopalan, Nanda, and Seru, 2007; Cremers, Huang, and Sautner, 2011; Niehaus, 2018), target capital structure (Fier, McCullough, and Carson, 2013), and regulatory scrutiny (Fier and Liebenberg, 2023).

In this paper, we examine the impact of ICM on insurers' underwriting portfolio. Specifically, we examine whether ICM affect insurers' decisions to enter or exit markets. We propose that groups use ICM to prevent poorly performing affiliates from exiting the state-line market, in order to maintain or even increase market share, or due to social responsibility and continue providing services to catastrophe-prone communities. We also propose that groups use ICM to help affiliates grow by entering a state-line market. We find that ICM affect affiliates' underwriting portfolio management. This finding contributes to the discussion on the motives for internal capital allocations. We provide evidence that internal capital is allocated to poorly performing catastrophe-prone property affiliates to prevent state-line market exits, and allocated to affiliates to enter the catastrophe-prone property line markets.

The reason why we examine the impact of ICM on insurers' decision on market exits and entries is because diversification intensity affects insurers' underwriting performance, risk, and firm value. State-line market exits decrease the size of the underwriting portfolio, however, a less diversified underwriting portfolio could lead to increase in underwriting performance (Hoyt and Trieschmann, 1991; Liebenberg and Sommer, 2008; Hund, Monk, and Tice, 2010), and ultimately in firm value (Servaes, 1996; Mitton and Vorkink, 2010).

On the other hand, state-line market entries lead to firm growth (Fier, Liebenberg, and Liebenberg, 2017). Contrary to the literature that finds that diversification destroys firm value, other studies find that diversification increases the value of the firm (Villalonga, 2004; Yan, 2006), value of diversified firms decreases less than that of focused firms during depressed capital market (Yan, Yang, and Jiao, 2010), and value of diversified firms increases significantly relative to focused firms during financial crises (Kuppuswamy and Villalonga, 2016). Additionally, studies find that business line and geographical diversification reduce underwriting risk by reducing the volatility of underwriting cash flows, since cash flows of different business lines and geographical areas are imperfectly correlated (Lewellen, 1971), and that insurers with greater underwriting portfolio diversification are able to allocate greater risk to investments (Che and Liebenberg, 2017).

The reason for studying insurance groups is due to the regulatory reporting requirements in the insurance industry that allow us to observe intra-group ICM activities for each insurer. The transparency of the regulatory data allows us to identify the impact of insurance groups' ICM activities on their decision to exit or enter the market by examining the change in their direct premiums written in business lines in different states after receiving internal capital. Thus, we can directly examine the impact of ICM on insurers' underwriting portfolio management.

In order to examine the impact of ICM on insurance groups' decisions on state-line exits and entries, we follow Born and Klimaszewski-Blettner (2013) and focus on insurers that offer coverage in catastrophe-prone property insurance lines, such as homeowners and commercial lines[18]. Insurers' underwriting risk and performance is greatly affected by unexpected losses, and catastrophic events lead to large unexpected property losses. Born and Klimaszewski-Blettner (2013) state that large unexpected losses induce insurers to make changes in premiums and coverage levels to stabilize underwriting performances. However, regulatory constraints on catastrophe-prone property lines impede insurers' flexibility to adjust premiums to changes in the risks that insurers face. Thus, Born and Klimaszewski-Blettner (2013) argue that the regulatory constraints impede insurers from geographically diversifying the catastrophe-prone property lines, and induce insurers with recent large losses to reduce their business volume or even exit the market due to restrictions on premium adjustments. Also, the reduction in reinsurance coverage following catastrophic losses increase the difficulty for the insurers to manage the catastrophic property risk, inducing catastrophe-prone property insurers to reduce business volume or exit the market after large losses. In this paper, we build on their findings to examine whether ICM can prevent catastrophe-prone property insurers with recent losses from exiting from the market. Furthermore, we examine whether ICM help catastrophe-prone property insurers to enter the market in order to geographically diversify and grow.

First, we examine whether ICM are used to prevent poorly performing insurers from reducing business volume and from exiting the state-line market. According to Born and Klimaszewski-Blettner (2013), poorly performing catastrophe-prone property insurers reduce their business and even withdraw from a state market due to regulatory interventions preventing catastrophe-prone property insurers from increasing the premiums. This loss-induced exit results in a decrease in the supply of insurance coverage for catastrophe prone insureds. In this paper,

[18] Commercial line includes fire, allied, and commercial multiple peril lines.

we suggest that ICM are used to prevent poorly performing insurers from exiting the state-line markets and thereby enable them to increase market share. According to Born and Klimaszewski-Blettner (2013), the high market share of an insurer in a certain line in a particular state increases the likelihood of obtaining approval for a rate increase, which stabilizes the underwriting portfolio. Thus, we argue that ICM are a tool for insurance groups to manage their affiliates' underwriting portfolio.

In order to test whether ICM are used to prevent market exits, we analyze how ICM affect the probability of poorly performing catastrophe-prone property insurers exiting the state-line market in the subsequent period. We identify poorly performing catastrophe-prone property insurers by using loss ratios. Then we interact the loss ratio variable with the ICM variable to examine the effect of ICM on the probability of poorly performing catastrophe-prone property insurers exiting the state-line market in the subsequent period. The test results show that ICM decrease the likelihood of poorly performing insurers exiting the state-line market. The results indicate that ICM help poorly performing insurers to maintain their current underwriting portfolio.

Moreover, we examine whether ICM are used to subsidize insurers to enter the catastrophe-prone property lines in new state markets. Since one risk management strategy for insurers is line and geographical diversification, and since regulatory requirements (ex. capital requirements, form filing rules, and agent licensing procedures) set up barriers to entry (Born and Klimaszewski-Blettner, 2013), we examine whether ICM help insurers enter a state-line market. Beside underwriting risk management, insurers enter a state-line market when they decide to expand their business and capture the demand for insurance coverage. Fier, Liebenberg, and Liebenberg (2017) show that property and casualty insurers grow by entering a state-line market. Therefore, by examining the effect of ICM on insurers' decisions to entering a state-line market, we will be able to test whether ICM help insurers to diversify and grow their underwriting portfolio.

We test this by examining property and casualty insurers that do not write in one of the catastrophe-prone property lines in the states. We analyze how ICM affect the probability of property and casualty insurers entering the state-line market in the subsequent period. We find that ICM increase the likelihood of insurers entering the state-line market.

This study contributes to the ICM literature that examines the motives and impacts of ICM on firms' operational management (Gopalan, Nanda, and Seru, 2007; Cremers, Huang, and Sautner, 2011; Fier, McCullough, and Carson, 2013). Specifically, we provide evidence on the contribution of ICM on firms' decisions on market exits and entries. We find that ICM prevent poorly performing catastrophe-prone property insurers from exiting the state-line market, and helps property and casualty insurers to enter the catastrophe-prone property lines in a state. Also, our results contribute to the literature on the determinants of ICM (Stein, 1997; Scharfstein and Stein, 2000; Powell, Sommer, and Eckles, 2008; Ozbas, and Scharfstein, 2010; Glaser, Lopez-De-Silanes, and Sautner, 2013; Almeida, Kim, and Kim, 2015; Graham, Harvey, and Puri, 2015; Niehaus, 2018; Fier and Liebenberg, 2023). In particular, our findings provide new evidence that internal capital is allocated to poorly performing affiliates to help them maintain their underwriting portfolio. Furthermore, this paper adds to the business line diversification literature (Lewellen, 1971; Hoyt and Trieschmann, 1991; Servaes, 1996; Villalonga, 2004; Yan, 2006; Liebenberg and Sommer, 2008; Hund, Monk, and Tice, 2010; Mitton and Vorkink, 2010; Yan, Yang, and Jiao, 2010; Kuppuswamy and Villalonga, 2016; Che and Liebenberg, 2017) by showing that insurers diversify in order to improve the supply of coverage capacity of catastrophe-prone property insurance.

The remainder of this study is organized as follows. The “Literature review” section reviews the prior literature on ICM and business line diversification. The “Hypotheses development” states the hypotheses that we test in this study. The “Data and Sample” describes the data sources, and the sample constructions. The “Methodology” describes the construction of the variables and the regression models used to test the hypotheses. The “Results” reports the main empirical results, and concludes the study with the “Conclusion” section.

LITERATURE REVIEW

ICM

There are prior streams of research that provide competing theories regarding ICM determinants. The winner-picking theory by Stein (1997) posits that headquarters create value by allocating capital to divisions where returns are highest, in other words, to better performing divisions. On the contrary, the rent-seeking theory by Scharfstein and Stein (2000) reflects corporate socialism and posits that divisional managers' rent-seeking behavior leads headquarters to allocate capital to poorly performing divisions rather than to strong performing divisions, thereby overinvesting in the weak divisions and underinvesting in strong divisions. Prior studies find empirical evidence for both the winner-picking theory (e.g., Powell, Sommer, and Eckles, 2008; Almeida, Kim, and Kim, 2015; Carson, Eastman, Eckles, Frederick, 2022), and rent-seeking theory (e.g., Ozbas, and Scharfstein, 2010; Glaser, Lopez-De-Silanes, and Sautner, 2013; Graham, Harvey, and Puri, 2015).

Powell, Sommer, and Eckles (2008) use data from affiliated insurance companies, and compare the relationship between ICM and investment to that between capital from other sources and investment. They find that internal capital is allocated to affiliates with the best expected performance. Almeida, Kim and Kim (2015) examine internal capital allocations within Korean business groups (*chaebol)*. They find that *chaebol* allocated internal capital to high-growth member firms, and those firms showed higher profitability and lower declines in valuation than low-growth firms following the financial crisis. Carson, Eastman, Eckles, and Frederick (2022) examine whether the "winners" perform subsequent to receiving internal capital. They find that the "winners" continue their relatively high performance, and argue that ICM are ex-post efficient.

Ozbas, and Scharfstein (2010) compares the investments of stand-alone firms and unrelated segments of conglomerate firms. They find that unrelated segments of conglomerate firms invest less than stand-alone firms in high-Q-industries, and more than stand-alone firms in low-Q-industries. Also, they find that their findings are more pronounced in conglomerate firms in which managers have small ownership stakes, and suggest that internal capital allocations within conglomerate firms is inefficient. Glaser, Lopez-De-Silanes, and Sautner (2013) examine the ICM of multinational conglomerates. They find that more powerful managers obtain larger allocations and increase investment substantially more than their less connected peers following cash windfalls, and that the firms exhibit lower ex-post performance and productivity as more powerful managers overinvest. Graham, Harvey, and Puri (2015) conduct a survey asking more than 1,000 CEOs and CFOs around the world regarding their financial decisions, and find that corporate politics and corporate socialism affect capital allocation in European and Asian firms.

Another strand of literature argues that headquarters allocate capital to weak divisions not due to divisional managers' rent-seeking behavior or corporate socialism, but in order to support the weak divisions. Gopalan, Nanda, and Seru (2007) examine the functioning of ICM in Indian Business Groups. They find that the likelihood of financially weaker firms defaulting decreases when internal capital is allocated to them. Cremers, Huang, and Sautner (2011) examine the proprietary internal capital allocation data from a large retail banking group. They find that headquarters allocate internal capital to member banks with greater demand for deposit smoothing. Niehaus (2018) examine the movement of capital within insurance groups, and find that life insurers receive internal capital when their performance decrease, but send internal capital when their performance increase. They argue that, for insurers whose capital is exogenously depleted, the marginal impact of additional capital on the insurer's franchise value is high, thus internal capital is transferred to those insurers. Fier and Liebenberg (2023) examine the internal capital allocations within the property and casualty insurance groups, and find that groups manage regulatory scrutiny risk by allocating capital towards affiliates when their pre-capital contribution IRIS ratio failures exceed three.

Beside studies that examine the two theories, extant literature on ICM efficiency examines the impact of spinoffs and acquisitions on ICM efficiency (Ahn and Denis, 2004; Doukas and Kan, 2008), the impact of the relation between CEO and divisional managers on ICM efficiency (e.g., Gaspar and Massa, 2011; Duchin and Sosyura, 2013), and the relation between target capital structure and ICM (Fier, McCullough, and Carson, 2013). Ahn and Denis (2004) examine the changes in capital allocations following 106 spinoffs between 1981 and 1996. They find that conglomerates allocated less capital to their high-Q-segments than their single-segment peers. However when conglomerates proceed a spinoff, the value of their firm increased. Thus, they argue that conglomerates allocated capital inefficiently. Doukas and Kan (2008) examine the workings of ICM in diversified firms that engage in related and unrelated corporate acquisitions. They find that internal capital is allocated to more profitable segments when firms acquire unrelated segments, and that internal capital is allocated to less profitable segments when firms acquire related segments. Gaspar and Massa (2011) examine the relation between ICM and the informal links between CEO and divisional managers. They find that having more connected managers presiding over segments with high Tobin's Q improves internal capital allocations and increases firm value. Duchin and Sosyura (2013) use a hand-collected data on divisional managers at S&P 500 firms, and examine the divisional managers' role in ICM. They find that managers' connection with the CEO increases ICM efficiency when information asymmetry is high, but the connection decreases ICM efficiency when governance is weak. Fier, McCullough, and Carson

(2013) examine ICM activities within property and casualty insurance groups, and find that internal capital is allocated to affiliates to help them reduce deviations from their target leverage ratios.

Business Line Diversification

Prior literature finds two contrary results on whether business line diversification creates or does not create value. One strand of literature shows that business line diversification does not create value. Hoyt and Trieschmann (1991) compare the risk-return of individual insurers to that of diversified insurers. They find that individual insurers provide higher risk-return relative to diversified insurers. Servaes (1996) examines the value of diversification when corporations started to diversify, and find that diversification did not create value and even led to diversification discounts. Liebenberg and Sommer (2008) use a sample of property and liability insurers, and develop and test a model that explains performance as a function of line-of-business diversification and other correlates. They find that undiversified insurers consistently outperform diversified insurers, and that the market applies a significant discount to diversified insurers. Hund, Monk, and Tice (2010) examines the source of the diversification discount. They argue that the lower uncertainty about mean profitability of diversified firms relative to focused firms explains the diversification discount. Mitton and Vorkink (2010) examine whether firms with diversification discounts have higher expected returns in order to compensate investors for offering less upside potential than focused firms. They find that stock returns of diversified firms have less variance and skewness than stock returns of focused firms.

Another strand of literature shows that business line diversification create value. Villalonga (2004) uses the Business Information Tracking Series to examine whether the finding of a diversification discount is an artifact of segment of data. The study finds that diversified firms are traded at a premium instead of a discount, and argues that diversification discount found by prior studies is due to measurement errors. Yan (2006) examines variations in the value of diversification across time under various capital market conditions. The study finds that the value of diversified firms increases relative to focused firms when external capital is more costly at the aggregate level. Adding to the Yan (2006)'s finding, Yan, Yang, and Jiao (2010) find that investment in focused firms declines relative to diversified firms when external capital becomes more castly at the aggregate level, and that the value of diversified firms decreases less than that of focused firms during depressed capital markets. Kuppuswamy and Villalonga (2016) provide additional evidence that the value of diversified firms increased relative to focused firms during the financial crises, due to financing and investment advantages of diversified firms.

Moreover, there are studies that examine the impact of business line diversification on different factors other than firm value or performance. Lewellen (1971) provides a rationale for business line diversification. The paper states that cash flows of different business lines are imperfectly correlated, and thus firms diversify in order to decrease the volatility of their cash flows. Che and Liebenberg (2017) examine the effect of business line diversification on asset risk-taking of property and liability insurers. They find that diversified insurers take more asset risk than non-diversified insurers, and that the degree of asset risk–taking is positively related to diversification extent. Fier, Liebenberg, and Liebenberg (2017) examine corporate growth strategy of U.S. property and casualty insurance industry. They find that insurers diversify when they choose to grow.

HYPOTHESES DEVELOPMENT

In this paper, we argue that catastrophe-prone property insurers use ICM to prevent affiliates with recent losses from reducing their business volume and from exiting the market. Born and Klimaszewski-Blettner (2013) find that catastrophe-prone property insurers are more likely to reduce their business volume and exit the market as their loss ratio increases. They argue that strict regulatory constraints on catastrophe-prone property lines impede insurers' flexibility in underwriting adjustments, and thus induce insurers to exit the market or reduce their business volume when rates are not adequate to maintain solvency. One reason why insurers may allocate internal capital to poorly performing affiliates is to strengthen their ability to pay customer claims and their willingness to offer coverage. Moreover, preventing poorly performing affiliates from reducing business allows them to prevent market share reductions. The benefit of getting high market share is the increased likelihood of obtaining approval for a rate increase (Born and Klimaszewski-Blettner, 2013). Furthermore, Cremers, Huang, and Saunter (2011), Niehaus (2018), and Pelletier (2018) find that insurance groups allocate internal capital to affiliates facing financial difficulties. Therefore, we expect insurance groups to allocate internal capital to poorly performing affiliates to prevent business volume reduction and even prevent market exits. These hypotheses are described as follows,

H1: Poorly performing affiliates that receive internal capital is less likely to exit the state-line market.

H2: Poorly performing affiliates that receive internal capital is less likely to reduce direct premiums written in the state-line.

Additionally, we argue that insurance groups use ICM to grow by enabling affiliates to enter a state-line market. According to Fier, Liebenberg, and Liebenberg (2017), insurers follow a general pecking order of growth strategies, where insurers grow first by entering new states, then by adding new lines of business, and finally through acquisitions. They also show that the order is consistent with firms choosing to grow in the least costly and complex manner and subsequently choosing more costly and complex methods. Thus, we expect insurance groups to support their affiliates to expand into new state-line markets via internal capital, in order to help their affiliates grow using the least costly and complex method. Since we are focusing on catastrophe-prone property lines, we suggest that insurance groups use ICM to help affiliates enter the catastrophe-prone property lines in other states.

Entering the state-line market not only increase the size of the affiliate, but also help them manage catastrophic property risk by geographically diversifying. Therefore, it is essential for insurance groups to support their affiliates to geographically diversify their catastrophe-prone property lines.

However, entering the catastrophe-prone property lines is difficult due to regulatory constraints impeding insurers' flexibility to adjust premiums for catastrophic losses, and due to regulatory requirements, such as duplication of licensing and reporting activities (Born and Klimaszewski-Blettner, 2013). Thus, regulatory requirements impede catastrophe-prone property insurers' geographical diversification, contributing to less stable coverage supply in catastrophe-prone property lines (Born and Klimaszewski-Blettner, 2013). Therefore, we expect insurance groups to allocate internal capital to help their affiliates enter the catastrophe-prone property lines in other states. This hypothesis is described as follows,

H3: ICM increase the likelihood of affiliates entering a catastrophe-prone property line in other states.

The next test that we conduct is whether the insurance groups' decision to allocate internal capital to poorly performing affiliates to help them remain, instead of exit, in the state-line market is beneficial. Supporting poorly performing affiliates to remain in the state-line market surely helps maintain their underwriting portfolio size, but remaining in the state-line market after high losses could hurt their future performance. In this case, ICM would be efficient if poorly performing affiliates that received ICM and remained in the state-line market outperforms those that exited the state-line market. In order examine the ICM ex-post efficiency[19], we compare the future performance of affiliates that exited the state-line market to those that received internal capital and did not exit the state-line market. The hypothesis is described as follows,

H4: Poorly performing affiliates that received internal capital and did not exit the state-line market perform better in the future than those that exited the state-line market.

[19] Carson, Eastman, Eckles, and Frederick (2022) examine how "winners" perform subsequent to receiving internal capital. They find that "winners" continue their relatively high performance, and argue that ICM is ex-post efficient.

DATA AND SAMPLE

We use data from the National Association of Insurance Commissioners (NAIC) InfoPro database for U.S. catastrophe-prone property insurers from year 2010 to year 2016. Catastrophe-prone property lines include homeowners line and commercial line, which includes fire, allied, and commercial multiple peril lines. Since we are interested in ICM, we focus on group insurers. We retrieve financial data on premiums written, premiums earned, and losses incurred by affiliate, line, and state. Other data include reinsurance ratio, number of lines in which the affiliate writes business, number of states in which the affiliate writes business, capacity, organization form, total assets, underwriting expense, and age.

We also use the data from SHELDUS in order to retrieve the catastrophic events by state. SHELDUS is a county-level hazard data set for the United State that captures natural disaster incidents that generated more than 50,000 dollars in damage or at least one death. SHELDUS includes crop and property damages amount caused by natural disasters, such as thunderstorms, hurricanes, floods, wildfires, and tornados. Specifically, we follow Born and Klimaszewski-Blettner (2013) and use SHELDUS to capture "catastrophes" in the following way. We calculate how severely a whole state has been affected by catastrophes in a given year by comprising state-wide sum of damages from natural disasters per year divided by all insurers' line-specific premiums written in that state in that year (*CATLOSSES*). We calculate how severely an insurer has been affected by catastrophes in a given year across different states by comprising the insurers' premiums written in catastrophe-prone property lines in states hit by a natural catastrophe divided by its total national business written in that line (*CATBUSINESS*).

For the ICM data we follow Niehaus (2018)'s method of data cleaning. According to Niehaus (2018), the ICM data require "cleaning," because some insurers aggregate all transactions with an affiliate and others do not, and as a result, some companies have multiple reports of transactions for the same affiliate. After the ICM data is retrieved from Schedule Y – Part 2 of the NAIC InfoPro database, we follow the cleaning method from Niehaus (2018) and check for consistency across the property and casualty (P/C) insurer reports within the same group[20], and check whether ICM transactions sum to zero across all affiliates in the group[21]. Then we remove redundant ICM transactions (12,148 firm-year observations). After cleaning the data, we include other P/C insurance affiliates that did not have ICM transactions in the same groups of P/C insurers with ICM transactions (22,332 firm-year observations). Additionally, we exclude P/C insurers reporting zero assets (22,330 firm-year observations).

After cleaning the ICM data, we then merge the ICM data with the financial data by state of catastrophe-prone property insurers. There are 1,204 catastrophe-prone property insurers and 155,580 insurer-state-line-year observations in the sample.

[20] If there is an inconsistent report within the same group, we change the numbers to be consistent with the majority. If a group does not have consistency for a majority, then we drop the group from the sample.
[21] When ICM transactions within the group do not sum up to zero, we either correct the error or drop the group if the error cannot be identified.

METHODOLOGY

In this paper, we test two different relations. The first relation we test is the relation between ICM and poorly performing catastrophe-prone property insurers' decision to exit the state-line market. We examine how ICM affect the likelihood of them exiting the state-line market, and reducing business volume of the state-line. The next relation that we test is the relation between ICM and property and casualty insurers' decision to enter the catastrophe-prone property lines in other states. We examine how ICM affect the likelihood of them entering the state-line market. We estimate logit models[22] that test the following relations:

$$Exit = f(ICM, Controls) \quad (1)$$

$$ENTER = f(ICM, Controls) \quad (2)$$

In both models, we include firm-state-line fixed effects and year dummies.

Exit and Enter variables

The main dependent variables for model (1), which we follow Born and Klimaszewski-Blettner (2013), are derived from the percent change in premiums from the current year to the next year, that is:

$$(Premiums_{is,t+1} - Premiums_{ist}) / Premiums_{ist} \quad (3)$$

From equation (3), Born and Klimaszewski-Blettner (2013) derive "exits" and "significant business reductions" variables. The following variables are the main dependent variables[23] for model (1): $ResponseE_{ist}$ is a binary variable that equals 1 if an affiliate exited the state-line market (i.e., the percent change in premiums is -100 percent) and equals 0 otherwise. $Reponse30_{ist}$ is a

[22] We follow Born and Klimaszewski-Blettner (2013) and estimate the models in Stata™ using the xtlogit command with fixed effects.
[23] We follow Born and Klimaszewski-Blettner (2013).

binary variable that equals 1 if an affiliate reduced business by 30 percent or more, and equals 0 otherwise. *Reponse40*$_{ist}$ is a binary variable that equals 1 if an affiliate reduced business by 40 percent or more, and equals 0 otherwise. *Reponse50*$_{ist}$ is a binary variable that equals 1 if an affiliate reduced business by 50 percent or more, and equals 0 otherwise. *Reponse60*$_{ist}$ is a binary variable that equals 1 if an affiliate reduced business by 60 percent or more, and equals 0 otherwise.

The main dependent variable for model (2) is a binary variable (*ENTER*) that equals 1 for insurers that did not underwrite in a catastrophe-prone property line in a given year but started to underwrite in the subsequent period, and equals 0 otherwise.

ICM measures

Powell, Sommer, and Eckles (2008) explains that there are three kinds of ICM transactions. Insurance groups allocate internal capital in the forms of capital contribution, shareholder dividend, and internal reinsurance. We focus on internal capital contribution and internal shareholder dividend, because these are transfers of capital that do not involve an exchange. Since internal reinsurance is used to transfer capital in exchange for a service, it is difficult to distinguish whether internal capital is allocated to financially constrained affiliates for the service or for the purpose of increasing capital (Niehaus, 2018).

In order to identify affiliates that receive ICM, we add both capital contribution and shareholder dividend transactions for each affiliate. Then we generate a binary variable (*RECEIVE*) that equals 1 if the sum of capital contribution and shareholder dividend of an affiliate is greater than zero, and equals 0 otherwise. The actual amounts of capital contribution, shareholder dividend, and ICM are standardized by total assets. With the standardized ICM amounts, we generate a continuous variable that measure the ICM amount received (*ICM*), which equals the ICM amount when the amount is greater than 0, and equals 0 when the amount is negative.

Control variables

Since we are examining the effect of ICM on catastrophe-prone property insurers' decisions on state-line exits and entries, we control for firm characteristics that affect the decisions[24]. When examining the effect of ICM on insurers' exit, we follow Born and Klimaszewski-Blettner (2013) and control for reinsurance, number of lines in which the affiliate writes business, number of states in which the affiliate writes business, capacity[25], total assets, age, year fixed effects, and firm-state-line fixed effects.

When examining the effect of ICM on insurers' entry, we follow Fier, Liebenberg, and Liebenberg (2017) and control for organization form, public status, underwriting expense[26], number of lines in which the affiliate writes business, number of states in which the affiliate writes business, capacity, total assets, age, year fixed effects, and firm-state-line fixed effects.

When comparing the subsequent performance of insurers that exited to that of insurers that received internal capital and did not exit, we follow Liebenberg and Sommer (2008) and control for the effect of firm-specific and market factors that explain performance variation across insurers. Specifically, we control for firm size, capitalization[27], ownership structure, number of lines, geographic diversifications[28], industry concentration[29], and publicly traded insurers.

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[24] Detailed descriptions of all variables are shown in appendix 1.
[25] Capacity is measured as the ratio of premiums written to surplus.
[26] Underwriting expense is measured as the ratio of underwriting expenses to premiums earned, and is winsorized at the 1st and 99th percentiles.
[27] Capitalization is the ratio of policyholder surplus to total admitted assets.
[28] Geographic diversification is equal to 1-Herfindahl index of direct premiums written across 57 geographic areas.
[29] Industry concentration is measured as the weighted sum of market share per line multiplied by line specific Herfindahl.

We follow Cole and McCullough (2006), and measure reinsurance ratio as the ratio of premiums ceded to nonaffiliates to the sum of direct premiums written and reinsurance assumed from nonaffiliates.

Summary statistics

Table 1 presents the summary statistics. The continuous variables, such as *ICM*, *LOSS_RATIO*, *PREM_SURP*, *TOTAL_LOSS_RATIO*, and REINSURANCE are winsorized at the 1st and 99th percentiles. The variables in our paper have means that are somewhat similar to those reported by Born and Klimaszewski-Blettner (2013). For example, the mean of our exit variable and business reductions by 60%, 50%, 40%, and 30% or more variables are 0.0383, 0.0934, 0.1104, and 0.1637 respectively, where those reported in Born and Klimaszewski-Blettner (2013) are 0.06, 0.15, 0.17, 0.21, and 0.25 respectively. The major difference between our sample and the sample of Born and Klimaszewski-Blettner (2013) is that Born and Klimaszewski-Blettner (2013) includes all U.S. property insurers, where we only include U.S. property insurance groups due to our purpose of examining the effect of ICM on exits and business reductions.

Table 2 and table 3 represent the summary statistics of the sample used for the analysis of ICM's impact on insurers' state-line market entries, and for the analysis of ICM ex-post efficiency respectively. *ICM*, *PREM_SURP*, *EXPENSE_RATIO*, and *TOTAL_LOSS_RATIO* continuous variables are winsorized at the 1st and 99th percentiles.

ICM Effect on Exits

First, we evaluate whether ICM prevent poorly performing catastrophe-prone property insurers from reducing business volume and from exiting the state-line market. We interact *LOSS_RATIO* and *RECEIVE* and estimate a logit model that tests the following relation:

$$Pr(Response_{ist}) = \beta_0 + \beta_1 LOSS\_RATIO_{ist} * RECEIVE_{it} + \beta_2 LOSS\_RATIO_{ist} + \beta_3 RECEIVE_{it} + \beta_4' X_{it} + \varepsilon_{ist}, \quad (4)$$

where $LOSS\_RATIO_{ist}$ is a ratio of losses incurred to premiums earned of insurer *i* in state *s* in year *t*; $RECEIVE_{k,t}$ is a binary variable that equals 1 if an insurer *i* receives internal capital in year *t*, and equals 0 otherwise; *X* is a vector of control variables; and *ε* is a random error term. Following Born and Klimaszewski-Blettner (2013), we also included *CATLOSSES* to capture whether large catastrophic losses by themselves, regardless of their effect on underwriting performance, motivate an insurer response; *CATBUSINESS* to capture whether an overall higher portion of business written in catastrophe-affected states has an impact on insurers' willingness to offer coverage; *HOIND*[30] to capture whether insurers react differently depending on the line of business considered; lagged *LOSS_RATIO, CATLOSSES, CATBUSINESS,* and *HOIND* variables to capture lingering effects on insurers' decisions; *STRICTREG*[31] and *RESIDUAL*[32] to capture whether regulatory constraints have an impact on insurers' supply decisions, since strict rate regulation adversely affects insurers' performance (Born and Klimaszewski-Blettner, 2009); *SHARE1*[33] and *SHARE2*[34] to capture the importance of that state market for the insurer; and Herfindahl Index to

[30] *HOIND* is an indicator variable that equals 1 for homeowners business, and equals 0 for commercial business.
[31] *STRICTREG* equals 1 if state has prior approval of rates and equals 0 otherwise.
[32] *RESIDUAL* equals 1 if state has a residual beach or windstorm plan and equals 0 otherwise.
[33] *SHARE1* is calculated as premiums written by line divided by total premiums written in that line by all insurers over the whole state per year.
[34] *SHARE2* is calculates as the insurer's total state premiums written in all lines of business divided by its total national premiums written in all lines.

capture the role of market concentration on insurers responses, in the vector of control variables, since we are focusing on ICM's impact on insurers' decisions.

ICM Effect on Entry

Furthermore, we test whether ICM help insurers to enter the state-line market. We use a different sample for this test. Since we are interested in insurers entering the catastrophe-prone property lines in a new state, the sample includes observations where an insurer *i* that did not write premiums in catastrophe-prone property lines in state *s* in year *t*. The sample time span is from year 2010 to year 2016. There are 1,961 insurers and 292,435 insurer-state-year observations in the sample. In order to test hypothesis 3, we estimate a logit model that tests the following relation:

$$ENTER_{is,t+1} = \beta_0 + \beta_1 ICM_{it} + \beta_2' X_{it} + \varepsilon_{ist,} \qquad (5)$$

where $ENTER_{is,t+1}$ is a binary variable that equals 1 if an insurer *i* enters either a homeowners line or a commercial line in state *s* in year *t+1*, and equals 0 otherwise; ICM_{it} equals the amount of internal capital an insurer *i* received in year *t*, and equals 0 if the insurer *i* sent internal capital to others within the group in year *t*; *X* is a vector of control variables; and *ε* is a random error term. We also include *CATLOSSES* to capture whether large catastrophic losses of that state affect insurers decisions to enter; and *STRICTREG* and *RESIDUAL* to capture whether regulatory constraints have an impact on insurers' entry decisions in the vector of control variables.

ICM Ex-post Efficiency

Finally, we test whether ICM are ex-post efficient by examining the performance in the subsequent period of receiving internal capital. We compare the performance of affiliates that exited the market to that of affiliates that received internal capital and did not exit. For this analysis, we use a sub-sample that includes catastrophe-prone property insurers that exited the state-line market, and those that received ICM and did not exit. We estimate an OLS model that tests the following relation:

$$ROA_{i,t+n} = \beta_0 + \beta 1 ResponseE_{ist} + \beta_2' X_{it} + \varepsilon_{ist}, \quad (6)$$

where $ROA_{i,t+n}$[35] is the ratio of net income in year $t+n$ (where n = 1, 2, 3, 4, and 5) to total assets in year t of an insurer i; *ResponseE* is a binary variable that equals 1 if an insurer exited the market, and equals 0 otherwise; X is a vector of control variables; and ε is a random error term.

[35] We follow Carson, Eastman, Eckles, and Frederick (2022) for measuring the ICM ex-post efficiency.

Table 1 Summary statistics of the sample for the analysis on ICM's impact on insurers' state-line market exits and business volume reductions

ResponseE equals 1 if an affiliate exited the state-line market and equals 0 otherwise. *Reponse60* equals 1 if an affiliate reduced business by 60 percent or more and equals 0 otherwise. *Reponse50* equals 1 if an affiliate reduced business by 50 percent or more and equals 0 otherwise. *Reponse40* equals 1 if an affiliate reduced business by 40 percent or more and equals 0 otherwise. *Reponse30* equals 1 if an affiliate reduced business by 30 percent or more and equals 0 otherwise. *RECEIVE* equals 1 if the sum of capital contribution and shareholder dividend of an affiliate is greater than zero, and equals 0 otherwise. *HOIND* equals 1 if observation is for homeowners line of business and equals 0 otherwise. *CATLOSSES* is the damages from catastrophes per state divided by all insurers' line-specific premiums written in that state. *CATBUSINESS* is the line-specific premiums written in states hit by a natural catastrophe divided by the affiliate's total national business written in that line. *LOSS_RATIO* is a ratio of loss incurred to premiums earned. *STRICTREG* equals 1 if state has prior approval of rates and equals 0 otherwise. *RESIDUAL* equals 1 if state has a residual beach or windstorm plan and equals 0 otherwise. *REINSURANCE* is the reinsurance business ceded to nonaffiliates divided by the sum of direct premiums written and reinsurance business assumed from nonaffiliates. *NUM_LINES* is the number of lines in which an affiliate writes business. *NUM_STATES* is the number of states in which an affiliate writes business. *PREM_SURP* is the total premiums written in all lines divided by surplus. *TOTAL_LOSS_RATIO* is the loss ratio on all business. *TOTAL_ASSETS* is the total assets. *Age* is the affiliate's age. *SHARE1* is the size of an affiliate in state, considered line (measured by premiums written). *SHARE2* is the importance of state for insurer, all lines of insurance (measured by premiums written). *HERFINDAHL* is the state Herfindahl index, based on premiums written in property lines.

	Mean	**Median**	**Std. Dev.**	**Min**	**Max**	**1st quartile**	**3rd quartile**
ResponseE	0.0383	0.0000	0.1919	0.0000	1.0000	0.0000	0.0000
Response60	0.0934	0.0000	0.2909	0.0000	1.0000	0.0000	0.0000
Response 50	0.1104	0.0000	0.3134	0.0000	1.0000	0.0000	0.0000
Response40	0.1318	0.0000	0.3383	0.0000	1.0000	0.0000	0.0000
Response30	0.1637	0.0000	0.3700	0.0000	1.0000	0.0000	0.0000
RECEIVE	0.1590	0.0000	0.3657	0.0000	1.0000	0.0000	0.0000
HOIND	0.2507	0.0000	0.4334	0.0000	1.0000	0.0000	1.0000
CATLOSSES	0.1197	0.0171	0.4724	0.0000	6.4134	0.0056	0.0595
CATBUSINESS	0.9883	1.0000	0.0669	0.0000	1.0000	0.9998	1.0000

LOSS_RATIO	0.6405	0.3595	1.1666	0.0000	10.3421	0.1198	0.6675
STRICTREG	0.2742	0.0000	0.4461	0.0000	1.0000	0.0000	1.0000
RESIDUAL	0.1871	0.0000	0.3900	0.0000	1.0000	0.0000	0.0000
REINSURANCE	0.1513	0.0386	0.2444	0.0000	1.0000	0.0000	0.1916
NUM_LINES	15.6150	16.0000	5.8666	0.0000	32.0000	11.0000	20.0000
NUM_STATES	42.4200	50.0000	14.4233	0.0000	51.0000	41.0000	51.0000
PREM_SURP	3.2564	1.5554	6.2566	0.0000	278.6950	0.7347	3.2866
TOTAL_LOSS_RATIO	0.5477	0.5394	0.2004	0.0000	1.6095	0.4439	0.6402
TOTAL_ASSETS	2,584.0513	380.5357	6,635.0286	1.1222	45,624.2309	138.4607	1,581.4862
AGE	59.7573	47.0000	40.9750	1.0000	225.0000	30.0000	83.0000
SHARE1	0.0036	0.0006	0.0121	0.0000	0.2171	0.0001	0.0026
SHARE2	0.0592	0.0129	0.1616	0.0000	1.0000	0.0044	0.0354
HERFINDAHL	0.0396	0.0374	0.0179	0.0138	0.1624	0.0289	0.0489

Table 2 Summary statistics of the sample for the analysis of ICM's impact on insurers' state-line market entries

ENTER equals 1 for affiliates that did not underwrite in a catastrophe-prone property line in a given year but started to underwrite in the subsequent period, and equals 0 otherwise. *ICM* equals the ICM amount received by an affiliate standardized by total assets. *CATLOSSES* is the damages from catastrophes per state divided by all insurers' line-specific premiums written in that state. *STRICTREG* equals 1 if state has prior approval of rates and equals 0 otherwise. *RESIDUAL* equals 1 if state has a residual beach or windstorm plan and equals 0 otherwise. *NUM_LINES* is the number of lines in which an affiliate writes business. *NUM_STATES* is the number of states in which an affiliate writes business. *PREM_SURP* is the total premiums written in all lines divided by surplus. *TOTAL_ASSETS* is the total assets. *Age* is the affiliate's age. *MUTUAL* equals 1 for affiliates of the mutual organizational form and equals 0 otherwise. *PUBLIC* equals 1 for publicly-traded insurer and equals 0 otherwise. *EXPENSE_RATIO* is the ratio of underwriting expenses to premiums earned. *TOTAL_LOSS_RATIO* is the loss ratio on all business.

	Mean	**Median**	**Std. Dev.**	**Min**	**Max**	**1st quartile**	**3rd quartile**
ENTER	0.0183	0.0000	0.1339	0.0000	1.0000	0.0000	0.0000
ICM	0.0064	0.0000	0.0309	0.0000	0.3401	0.0000	0.0000
CATLOSSES	0.1256	0.0177	0.4856	0.0000	6.4134	0.0058	0.0620
STRICTREG	0.2811	0.0000	0.4496	0.0000	1.0000	0.0000	1.0000
RESIDUAL	0.1975	0.0000	0.3981	0.0000	1.0000	0.0000	0.0000
NUM_LINES	7.5421	5.0000	6.7322	1.0000	32.0000	2.0000	12.0000
NUM_STATES	38.6074	46.0000	15.4336	1.0000	51.0000	31.0000	51.0000
PREM_SURP	1.4762	0.9003	1.9844	0.0008	24.9363	0.4150	1.7306
TOTAL_ASSETS	1,821.3768	235.5533	9,992.6953	0.1176	178,623.3276	69.9329	749.2574
AGE	44.1342	34.0000	34.7830	0.0000	225.0000	23.0000	56.0000
MUTUAL	0.0669	0.0000	0.2499	0.0000	1.0000	0.0000	0.0000
PUBLIC	0.2336	0.0000	0.4231	0.0000	1.0000	0.0000	0.0000
EXPENSE_RATIO	0.4336	0.3193	0.6327	0.0000	7.1462	0.2518	0.4171
TOTAL_LOSS_RATIO	0.6752	0.6548	0.5485	0.0000	5.7525	0.4862	0.7614

Table 3 Summary statistics of the sample for the analysis of the ex-post ICM efficiency

ROA_{t+n} is the ratio of net income at year $t+n$ to total assets in year t. *ResponseE* is a binary variable that equals 1 if an affiliate exited the state-line market (i.e., the percent change in premiums is -100 percent) and equals 0 otherwise. *SIZE* is the natural logarithm of total admitted assets. *CAP* is the ratio of policyholder surplus to total admitted assets. *MUTUAL* equals 1 for affiliates of the mutual organizational form and equals 0 otherwise. *NUM_LINES* is the number of lines in which an affiliate writes business. *GEO_DIV* is the 1-Herfindahl index of direct premiums written across 57 geographic areas. *WCONC* is the weighted sum of market share per line multiplied by line specific Herfindahl. *PUBLIC* equals 1 for publicly-traded insurer and equals 0 otherwise.

	Mean	**Median**	**Std. Dev.**	**Min**	**Max**	**1st quartile**	**3rd quartile**
ROA_{t+1}	0.0196	0.0225	0.0541	-0.6555	0.4453	0.0056	0.0400
ROA_{t+2}	0.0329	0.0267	0.0856	-1.1654	1.3610	0.0117	0.0486
ROA_{t+3}	0.0329	0.0272	0.0692	-0.7466	2.4196	0.0108	0.0465
ROA_{t+4}	0.0290	0.0220	0.0544	-0.5491	0.6354	0.0072	0.0465
ROA_{t+5}	0.0270	0.0195	0.0689	-0.5322	0.9081	0.0007	0.0448
ResponseE	0.1613	0.0000	0.3678	0.0000	1.0000	0.0000	0.0000
SIZE	20.3307	20.1391	1.8416	14.4686	24.4173	19.1014	21.5590
CAP	0.4734	0.4115	0.2091	0.0290	1.4285	0.3234	0.5788
MUTUAL	0.1539	0.0000	0.3609	0.0000	1.0000	0.0000	0.0000
NUM_LINES	16.0021	16.0000	6.4984	0.0000	31.0000	11.0000	21.0000
GEO_DIV	0.8615	0.9223	0.1629	0.0000	0.9663	0.8654	0.9440
WCONC	0.0152	0.0051	0.0299	0.0000	0.2196	0.0020	0.0151
PUBLIC	0.3262	0.0000	0.4689	0.0000	1.0000	0.0000	1.0000

Appendix 1 Variable description

Variables	Description
ResponseE	Equals 1 if an affiliate exited the state-line market and equals 0 otherwise
Response60	Equals 1 if an affiliate reduced business by 60 percent or more and equals 0 otherwise
Response 50	Equals 1 if an affiliate reduced business by 50 percent or more and equals 0 otherwise
Response40	Equals 1 if an affiliate reduced business by 40 percent or more and equals 0 otherwise
Response30	Equals 1 if an affiliate reduced business by 30 percent or more and equals 0 otherwise
ENTER	Equals 1 for affiliates that did not underwrite in a catastrophe-prone property line in a given year but started to underwrite in the subsequent period, and equals 0 otherwise
RECEIVE	Equals 1 if the sum of capital contribution and shareholder dividend of an affiliate is greater than zero, and equals 0 otherwise
ICM	Equals the ICM amount received by an affiliate standardized by total assets
HOIND	Equals 1 if observation is for homeowners line of business and equals 0 otherwise
CATLOSSES	Damages from catastrophes per state divided by all insurers' line-specific premiums written in that state
CATBUSINESS	Line-specific premiums written in states hit by a natural catastrophe divided by the affiliate's total national business written in that line
LOSS_RATIO	Ratio of loss incurred to premiums earned
STRICTREG	Equals 1 if state has prior approval of rates and equals 0 otherwise
RESIDUAL	Equals 1 if state has a residual beach or windstorm plan and equals 0 otherwise
REINSURANCE	Reinsurance business ceded to nonaffiliates divided by the sum of direct premiums written and reinsurance business assumed from nonaffiliates
NUM_LINES	Number of lines in which an affiliate writes business
NUM_STATES	Number of states in which an affiliate writes business
PREM_SURP	Total premiums written in all lines divided by surplus

TOTAL_LOSS_RATIO	Loss ratio on all business
TOTAL_ASSETS	Total assets
AGE	Affiliate's age
SHARE1	Size of an affiliate in state, considered line (measured by premiums written)
SHARE2	Importance of state for insurer, all lines of insurance (measured by premiums written)
HERFINDAHL	State Herfindahl index, based on premiums written in property lines
MUTUAL	Equals 1 for affiliates of the mutual organizational form and equals 0 otherwise
PUBLIC	Equals 1 for publicly-traded insurer and equals 0 otherwise
EXPENSE_RATIO	Ratio of underwriting expenses to premiums earned
SIZE	Natural logarithm of total admitted assets
CAP	Ratio of policyholder surplus to total admitted assets
GEO_DIV	1-Herfindahl index of direct premiums written across 57 geographic areas
WCONC	Weighted sum of market share per line multiplied by line specific Herfindahl

RESULTS

ICM Effect on Exits

The results of testing hypothesis 1 and 2, using equation (4), are shown in table 4. First, the results confirm the Born and Klimaszewski-Bletnner (2013) finding that higher loss ratios increase the probability of catastrophe-prone property insurers from exiting the state-line market and from reducing business volume. The first column examines whether ICM prevent catastrophe-prone property insurers with recent losses from exiting the state-line market. The results show that the probability of catastrophe-prone property insurers with higher loss ratios exiting the state-line market decreases when they receive ICM, which supports hypothesis 1. Specifically using marginal effects, poorly performing insurers that receive ICM are 0.3% less likely to exit the state-line market. Also, ICM in general decreases the probability of catastrophe-prone property insurers from exiting the state-line market. Altogether, these are indicating that ICM prevent catastrophe-prone property insurers from exiting the state-line market.

The following columns examine whether ICM prevent catastrophe-prone property insurers with recent losses from reducing business volume. The results are showing that catastrophe-prone property insurers are less likely to decrease business volume by at least 60% when they receive ICM. Specifically using marginal effects, poorly performing insurers that receive ICM are 0.3% less likely to decrease business volume by at least 60%. However, ICM have no impact on the probability of catastrophe-prone property insurers with recent losses from reducing business volume by at least 50%, at least 40%, and at least 30%. Overall, the results are indicating that ICM prevent catastrophe-prone property insurers from extreme business volume reductions, which partially supports hypothesis 2.

Altogether, the results are providing evidence that ICM have effect on preventing catastrophe-prone property insurers from exits and business reductions. Therefore, insurance groups use ICM to help affiliates remain in the state-line market and maintain their business volume in their state-line market.

ICM Effects on Entry

Moreover, the results of testing hypothesis 3, using equation (5) are shown in table 5. The results are showing that ICM affect insurers' decision on state-line market entry. Specifically, as insurers receive greater amount of internal capital, they are more likely to enter the catastrophe-prone property line in the other state in the subsequent period, which supports hypothesis 3. Specifically using marginal effects, a dollar increase in receiving internal capital increase the likelihood of insurers' entry into a new catastrophe-prone property line market by 6.8%. The results are indicating that ICM help insurers to overcome the difficulty in entering into catastrophe-prone property lines. Therefore, ICM help insurers to grow by entering a new state-line market, and helps catastrophe-prone property insurers to manage catastrophic property risk by geographically diversifying.

ICM Ex-post Efficiency

Finally, the results of testing hypothesis 4, using equation (6) are shown in table 6. The first column compares the subsequent year's performance (*ROA*) of insurers that exited the market to that of insurers that received ICM and did not exit. The results show that the subsequent year's *ROA* of insurers that exited is 1.0% higher relative to those that did not exit, which rejects hypothesis 4. The following columns use *t+2, t+3, t+4,* and *t+5* years' ROA as the dependent variable respectively. The results show that there is no difference between the performances of the insurers that exited and the insurers that received ICM and did not exit after the 2nd year. Overall, the results are showing that insurers that remain in the market performs worse than those that exited and indicating that ICM is inefficient in the short-term. However, the performance of the insurers that remain recovers in 2 years and perform as well as the insurers that exited the market, indicating that ICM is not inefficient in the long-term.

The results are showing that supporting affiliates via ICM to remain in the market after losses is not beneficial in the short-term. The results are questioning the insurance groups' decision on preventing exits of poorly performing affiliates. Another reason for preventing exits is social responsibility, for example, providing insurance to catastrophe-prone communities. Cornett, Erhemjamts, and Tehranian (2016) find that banks with higher social responsibility charge lower deposit fees and provide greater services to low-income communities. Additionally, Cornett, Minnick, Schorno, and Tehranian (2021) find that banks with higher social responsibility charge lower rates and fees on loans, and argue that those banks are more inclined to consider community interest rather than profit-maximizing. Therefore, for future work, we plan to examine whether socially responsible insurance groups prevent poorly performing affiliates from market exits, in order to provide services to the catastrophe-prone communities.

Table 4 Analysis of the relation between ICM and poorly performing insurers' decisions on state-line market exits

This table presents the results from examining the impact of ICM on the likelihood of poorly performing insurers' state-line market exits and business volume decrease. Logit models are used, including firm-state-line fixed effects and year dummies. Respectively, the dependent variables *ResponseE* is a binary variable that equals 1 if an affiliate exited the state-line market (i.e., the percent change in premiums is -100 percent) and equals 0 otherwise; *Reponse60* is a binary variable that equals 1 if an affiliate reduced business by 60 percent or more, and equals 0 otherwise; *Reponse50* is a binary variable that equals 1 if an affiliate reduced business by 50 percent or more, and equals 0 otherwise; *Reponse40* is a binary variable that equals 1 if an affiliate reduced business by 40 percent or more, and equals 0 otherwise; *Reponse30* is a binary variable that equals 1 if an affiliate reduced business by 30 percent or more, and equals 0 otherwise. *LOSS_RATIO* is a ratio of loss incurred to premiums earned, and *RECEIVE* is a binary variable that equals 1 if an insurer received internal capital, and equals 0 otherwise. Standard errors (in parentheses) are corrected for clustering at the insurer level. *, **, and *** denote statistical significance at the 10, 5 and 1 percent levels, respectively.

Dependent Variable	*ResponseE*	*Response60*	*Response50*	*Response40*	*Response30*
*LOSS_RATIO * RECEIVE*	-0.0921**	-0.046*	-0.0365	-0.0219	-0.0251
	(0.0364)	(0.0252)	(0.0257)	(0.0228)	(0.0223)
RECEIVE	-0.5071**	-0.2399*	-0.1946	-0.2052*	-0.1801*
	(0.2204)	(0.1451)	(0.1318)	(0.1165)	(0.1018)
LOSS_RATIO	0.1331***	0.0550***	0.0513***	0.0430***	0.0384***
	(0.0175)	(0.0121)	(0.0113)	(0.0106)	(0.0096)
*HOIND*LOSS _RATIO*	-0.0641	-0.0131	-0.026	-0.0151	-0.017
	(0.0396)	(0.0307)	(0.0288)	(0.0279)	(0.0260)
$LOSS\_RATIO_{t-1}$	0.0640***	0.0182	0.0127	0.0149	0.01
	(0.0185)	(0.0118)	(0.0106)	(0.0097)	(0.0090)
$(HOIND*LOSS\_RATIO)_{t-1}$	0.0043	0.0307	0.0269	0.0206	-0.0045
	(0.0430)	(0.0355)	(0.033)	(0.0312)	(0.0297)
CATLOSSES	-0.0488	0.0011	0.0034	-0.0148	-0.0235
	(0.0399)	(0.0255)	(0.0223)	(0.0208)	(0.0191)
*HOIND*CATLOSSES*	-0.1094	-0.1009	-0.1204*	-0.1086*	-0.0531
	(0.0993)	(0.0659)	(0.0618)	(0.0579)	(0.0487)
$CATLOSSES_{t-1}$	0.0003	-0.0222	-0.0151	-0.0109	-0.0011
	(0.0328)	(0.0239)	(0.021)	(0.0188)	(0.0178)
$(HOIND*CATLOSSES)_{t-1}$	-0.0400	0.0140	0.0266	0.0383	0.0595
	(0.0688)	(0.0582)	(0.0509)	(0.0475)	(0.0457)
CATBUSINESS	-1.6125***	-1.3850***	-1.2991***	-1.3438***	-1.3350***
	(0.6143)	(0.5089)	(0.5018)	(0.4609)	(0.4311)
*HOIND*CATBUSINESS*	0.5345**	-0.1859	-0.2779*	-0.3707**	-0.4392***

	(0.2105)	(0.1779)	(0.1664)	(0.1540)	(0.1383)
STRICTREG	0.0257	-0.0146	-0.0203	-0.0406	-0.0271
	(0.0403)	(0.0306)	(0.0283)	(0.0257)	(0.0232)
RESIDUAL	-0.1377**	-0.0829*	-0.084*	-0.0842**	-0.0783**
	(0.0640)	(0.0484)	(0.0440)	(0.0417)	(0.0365)
*RESIDUAL*LOSS_RATIO*	0.0864***	0.0257	0.0223	0.0189	0.0147
	(0.0291)	(0.0222)	(0.0208)	(0.0202)	(0.0183)
BOTHLINES	0.2774*	-0.1026	-0.1296	-0.1492	-0.1449
	(0.1572)	(0.139)	(0.1312)	(0.1214)	(0.1089)
REINSURANCE	1.3054***	1.1884***	1.1069***	0.9828***	0.8381***
	(0.315)	(0.2783)	(0.2699)	(0.2491)	(0.2214)
NUM_LINES	-0.1171***	-0.0636***	-0.0528***	-0.0437***	-0.0334**
	(0.0168)	(0.0139)	(0.0131)	(0.012)	(0.0108)
NUM_STATES	-0.0169***	-0.0038	-0.0014	0.0018	0.0037
	(0.0053)	(0.0043)	(0.0041)	(0.0039)	(0.0035)
PREM_SURP	-0.0104	-0.0165	-0.0176	-0.0189	-0.0190*
	(0.0173)	(0.0146)	(0.0136)	(0.0127)	(0.011)
TOTAL_LOSS_RATIO	0.5929*	0.5140**	0.4956**	0.4742**	0.4340**
	(0.3538)	(0.2429)	(0.2224)	(0.2011)	(0.1809)
TOTAL_ASSETS	-3.95E-11*	-4.24E-11***	-4.01E-11***	-3.77E-11***	-3.30E-11***
	(2.35E-11)	(1.59E-11)	(1.40E-11)	(1.37E-11)	(1.22E-11)
AGE	0.0015	-0.0013	-0.0015	-0.0014	-0.0013
	(0.0022)	(0.0018)	(0.0016)	(0.0015)	(0.0013)
SHARE1	-283.8651***	-154.4492***	-142.7689***	-136.4571***	-123.4942***
	(74.6373)	(30.1542)	(25.5863)	(22.4894)	(19.4219)
SHARE2	-2.0424***	-1.4558***	-1.2930***	-1.0943***	-1.0342***
	(0.3306)	(0.2456)	(0.2313)	(0.2117)	(0.1933)
HERFINDAHL	-0.4590	-0.6977	-0.4549	-0.4354	0.1439
	(1.1093)	(0.838)	(0.7634)	(0.71)	(0.629)
Year=2011	0.2131	0.2543**	0.2024*	0.1259	0.0865
	(0.1376)	(0.1175)	(0.1072)	(0.093)	(0.0774)
Year=2012	0.6757***	0.5025***	0.4771***	0.4025***	0.3251***
	(0.1871)	(0.1382)	(0.1234)	(0.1108)	(0.0977)
Year=2013	1.1923***	0.7972***	0.6754***	0.5404***	0.4498***
	(0.1973)	(0.152)	(0.1348)	(0.1181)	(0.1006)
Year=2014	1.0041***	0.5614***	0.4894***	0.3874***	0.3397***
	(0.1984)	(0.1416)	(0.125)	(0.1079)	(0.093)
Year=2015	1.0416***	0.6270***	0.5630***	0.4999***	0.4745***
	(0.2012)	(0.1508)	(0.1336)	(0.1167)	(0.1002)
Year=2016	0.8596***	0.7138***	0.6433***	0.5261***	0.4429***
	(0.2081)	(0.1557)	(0.1405)	(0.1239)	(0.1055)
CONSTANT	-1.1714*	-0.8638	-0.8096	-0.5937	-0.3713

	(0.7103)	(0.5911)	(0.5757)	(0.5250)	(0.4839)
Firm-state-line FE	Yes	Yes	Yes	Yes	Yes
N	155,580	155,580	155,580	155,580	155,580

Table 5 Analysis of the relation between ICM and insurers' decisions on state-line market entry

This table presents the results from examining the impact of ICM on the likelihood of property and casualty insurers' entry into catastrophe-prone property lines in other states. Logit models are used, including firm-state-line fixed effects and year dummies. The dependent variable *ENTER* is a binary variable that equals 1 for insurers that did not underwrite in a catastrophe-prone property line in a given year but started to underwrite in the subsequent period, and equals 0 otherwise. *ICM* equals the amount of internal capital received by an affiliate standardized by total assets. Standard errors (in parentheses) are corrected for clustering at the insurer level. *, **, and *** denote statistical significance at the 10, 5 and 1 percent levels, respectively.

	ENTER
ICM	3.8946***
	(1.1166)
CATLOSSES	0.0317
	(0.0263)
STRICTREG	-0.0073
	(0.0272)
RESIDUAL	0.0265
	(0.0464)
NUM_LINES	0.1392***
	(0.0115)
NUM_STATES	0.0060
	(0.0041)
PREM_SURP	0.0215
	(0.0293)
TOTAL_ASSETS	-3.84E-11**
	(1.67E-11)
AGE	-0.0068***
	(0.0026)
MUTUAL	-0.3906
	(0.2639)
PUBLIC	0.2297
	(0.1514)
EXPENSE_RATIO	0.2465***
	(0.0847)
TOTAL_LOSS_RATIO	0.0393
	(0.1259)
Year=2011	0.0012
	(0.1484)
Year=2012	-0.3168**
	(0.1245)
Year=2013	-0.5644***
	(0.1309)
Year=2014	-0.0266
	(0.1805)
Year=2015	-0.2696*

	(0.162)
Year=2016	-0.2355
	(0.1731)
CONSTANT	-5.7348***
	(0.2459)
Firm-state-line FE	Yes
N	292,435

Table 6 Analysis of the ex-post ICM efficiency

This table presents the results from examining the performance in the subsequent period of receiving internal capital. We compare the performance of affiliates that exited the market to that of affiliates that received internal capital and did not exit. OLS models are used, including firm-state-line fixed effects and year dummies. The dependent variable ROA_{t+n} is the ratio of net income at year $t+n$ to total assets in year t. *ResponseE* is a binary variable that equals 1 if an affiliate exited the state-line market (i.e., the percent change in premiums is -100 percent) and equals 0 otherwise. *SIZE* is the natural logarithm of total admitted assets. *CAP* is the ratio of policyholder surplus to total admitted assets. *MUTUAL* equals 1 for affiliates of the mutual organizational form and equals 0 otherwise. *NUM_LINES* is the number of lines in which an affiliate writes business. *GEO_DIV* is the 1-Herfindahl index of direct premiums written across 57 geographic areas. *WCONC* is the weighted sum of market share per line multiplied by line specific Herfindahl. *PUBLIC* equals 1 for publicly-traded insurer and equals 0 otherwise. Standard errors (in parentheses) are corrected for clustering at the insurer level. *, **, and *** denote statistical significance at the 10, 5 and 1 percent levels, respectively.

	ROA_{t+1}	ROA_{t+2}	ROA_{t+3}	ROA_{t+4}	ROA_{t+5}
ResponseE	0.0099*	-0.0097	0.0027	-0.0056	-0.0079
	(0.0056)	(0.0103)	(0.0099)	(0.0067)	(0.0078)
SIZE	0.0073***	0.0045	0.0049*	0.0006	-0.0005
	(0.0025)	(0.0032)	(0.0029)	(0.0035)	(0.0047)
CAP	0.0231	0.0376	0.0035	0.0047	0.0120
	(0.022)	(0.0327)	(0.0164)	(0.0178)	(0.0238)
MUTUAL	-0.0032	-0.0068	-0.0080	-0.0067	-0.0039
	(0.0074)	(0.0085)	(0.0086)	(0.0075)	(0.0097)
NUM_LINES	-0.0004	0.0001	-0.0006	-0.0004	0.0001
	(0.0006)	(0.0007)	(0.0006)	(0.0005)	(0.0006)
GEO_DIV	-0.0091	0.0067	-0.0116	0.0040	0.0137
	(0.0113)	(0.0174)	(0.0166)	(0.0131)	(0.0142)
WCONC	-0.0648	-0.1265	-0.0206	0.0416	-0.0797
	(0.0808)	(0.1605)	(0.1)	(0.1283)	(0.193)
PUBLIC	0.0062	0.0156*	0.0016	-0.0003	0.0016
	(0.0064)	(0.0081)	(0.0067)	(0.0063)	(0.009)
Year=2011	0.0060	0.0318*	-0.0166**	-0.0217***	-0.0063
	(0.0072)	(0.014)	(0.0066)	(0.0056)	(0.0071)
Year=2012	0.0275***	0.0115*	-0.0302***	-0.0211***	-0.0068
	(0.0048)	(0.0059)	(0.0071)	(0.0068)	(0.0092)
CONSTANT	-0.1396***	-0.1000*	-0.0308	0.0331	0.0248
	(0.0484)	(0.0599)	(0.0662)	(0.0808)	(0.1045)
R-squared	0.0757	0.0444	0.0408	0.0338	0.0072
Firm-state-line FE	Yes	Yes	Yes	Yes	Yes
N	11,927	11,927	11,927	11,927	11,927

CONCLUSION

This paper examines the effect of ICM on insurers' decisions on state-line market exits and business volume reductions. Specifically, we examine whether ICM prevent catastrophe-prone property insurers with recent losses from exiting the state-line market, and from reducing business volume. We examine this in order to provide new evidence on the determinants of ICM. The results provide evidence that ICM are allocated to poorly performing catastrophe-prone property insurers in order to prevent them from exiting the state-line market, and from extreme business volume reduction. Moreover, we show that insurers that received ICM and did not exit perform worse than those that exited in the subsequent year, but their performance recovers in the 2^{nd} year and perform as well as the insurers that exited.

Furthermore, we analyze the other side of the coin, which is whether ICM effect insurers' decision to enter a new state-line market. Since catastrophe-prone property lines are strictly regulated, it is difficult for insurers to enter into the state-line market, making it difficult for catastrophe-pone property lines to geographically diversify. We find that ICM increase the probability of insurers' entry into the catastrophe-prone property line. Our findings are suggesting that insurance groups use ICM to grow and to manage catastrophic property risk by geographically diversifying.

Overall, we are providing evidence that ICM not only prevent insurers from exiting the state-line market and from extreme business volume reduction, but also helps insurers to grow and manage catastrophic property risk by supporting them to geographically diversify. Therefore, we are suggesting that ICM affect insurers' decision makings on market exits and entries, and thus ICM help insurance groups to manage their underwriting portfolio.

For future work, we plan to examine the impact of ICM on insurers' market share, and expand the analysis of the impact of ICM on insurers' entry into any type of lines. Furthermore, we plan to propose and test whether socially responsible insurance groups prevent poorly performing affiliates from market exits, in order to provide services to the catastrophe-prone communities.

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ESSAY 3

THE EFFECT OF CEDING INSURERS' SOCIAL RESPONSIBILITY ON REINSURERS' PERFORMANCE AND UNDERWRITING RISK

INTRODUCTION

Incidents of natural disasters[36] and climate change law suits[37] are increasing, and Dlugolecki (2008) predicts that the economic cost of weather damage could reach over 1 trillion USD in a single year by 2040. Since insurers whose book of business is exposed to these risks (property losses due to natural disasters and liability lawsuits) hedge the risk through reinsurance (Doherty and Smetters, 2005), the financial strength of reinsurers is a growing concern to investors and regulators. This concern can be especially severe when reinsurance contracts encounter moral hazard, and Doherty and Smetters (2005) provide evidence for the presence of moral hazard in reinsurance contracts. Doherty and Smetters (2005) show that ceding insurers (purchasers of reinsurance) become less diligent in their claim processing and monitoring after ceding risk to reinsurers. Jean-Baptiste and Santomero (2000) and Garven, Hilliard, and Grace (2014) argue that ceding insurers have better information about the underlying risk than reinsurers since the ceding insurers control the relationship with the insured and are likely to have private information about the magnitude of potential losses. Thus, ceding insurers' moral hazard behavior and adverse selection could affect reinsurers' performance. Therefore, managing the risk of ceding insurers' moral hazard behavior is essential for reinsurers to maintain their financial stability. The objective of this paper is to investigate whether the ceding insurers' social responsibility affects reinsurers' performance.

In order to address this question, we examine the effect of ceding insurers' corporate social responsibility (CSR) on reinsurers' performance. The reason why we examine ceding insurers' CSR ratings is because they can proxy for the level of their moral hazard behavior and adverse

[36] See Insurance Information Institute (2021).
[37] See Hodges, Leatherby, and Mehotra (2018).

selection. Prior studies show that high-CSR firms have better ethical behavior (Chakraborty, Gao, and Musa, 2021), and less financial misconduct (Kim, Li, and Li, 2014; Gao and Zhang, 2015). Moral hazard is the questionable ethical practice of changing behaviors following the purchase of insurance while shifting risk for loss to the insurer (Rowell and Connelly, 2012). Moral hazard behaviors of the ceding insurers include less engagement in careful underwriting, loss mitigation, and claim settlement after using reinsurance. Thus, CSR ratings allow us to identify ceding insurers with high or low moral hazard behavior. To generate the ceding insurers' CSR ratings, we follow the prior studies (Kim, Li, and Li, 2014; Gao and Zhang, 2015; Lins, Servaes, and Tamayo, 2017[38]; Chakraborty, Gao, and Musa, 2021) and focus on community, diversity, employee relations, environment, and human rights categories[39].

To test whether ceding insurers' moral hazard behavior affects reinsurers' performance, we focus on the relationship between reinsurers and publicly traded ceding insurers[40]. First, we examine whether reinsurers include their expectation for ceding insurers' moral hazard behavior in the reinsurance price. We find that reinsurance price is not affected by ceding insurers' CSR ratings, and confirm the findings by Doherty and Smetters (2005) that reinsurance price is affected by reinsurers' use of experience ratings and monitoring cost. Then, we test the impact of the ceding insurers' moral hazard behavior on reinsurers' performance. We expected that the combined ratio and underwriting risk to be lower and ROA to be higher as reinsurers assume more from high-CSR ceding insurers, because ceding insurers' moral hazard behavior increases

[38] Lins et al (2017) do not include product category when generating the CSR ratings. They consider the elements in the product category to be outside the scope of CSR. Also, corporate governance is excluded, because they argue that governance is generally not part of a firm's CSR remit.
[39] The MSCI ESG Stats Database classifies environmental, social, and governance performance into 13 different categories. However, we follow the prior studies (Kim, Li, and Li, 2014; Gao and Zhang, 2015; Lins et al., 2017; Chakraborty, Gao, and Musa, 2021) and focus on the five categories (community, diversity, employee relations, environment, and human rights).
[40] We focus public ceding insurers, because MSCI ESG Stats database only includes CSR ratings for public firms.

unexpected losses (Doherty and Smetters, 2005). The results show that reinsurers' ROA increases as reinsurers supply more to high-CSR ceding insurers, however, the combined ratio and underwriting risk are unaffected.

There are two contradicting views on the effect of CSR activities on the economic value of firms. One strand of literature finds that CSR activities have positive impact on the economic value of firms. Specifically, CSR activities increase firm performance (Aktas, Bodt, and Cousin, 2011; Deng, Kang, and Low, 2013; Lins et al., 2017; Pastor, Stambaugh, and Taylor, 2021), lower idiosyncratic risk (Lee and Faff, 2009), mitigate agency problems (Hoi, Wu, and Zhang, 2019), reduce cost of capital (El Ghoul, Guedhami, Kowk, and Mishra, 2011; Goss and Roberts, 2011; Bae, El Ghoul, Guedhami, Kowk, and Zheng, 2019), and increase operational efficiency (Kanagaretnam, Lobo, Wang, and Whalen, 2019; Dai, Liang, and Ng, 2021; Hasan, He, and Lu, 2022). Another strand of literature finds that CSR activities have negative impact on the economic value of firms. Studies find that CSR activities do not increase firm performance (Hong and Kacperczyk, 2009; Riedl and Smeets, 2017; Hartzmark and Sussman, 2019; Bolton and Kacperczyk, 2021), are a manifestation of agency problems and increase agency cost (Brown, Helland, and Smith, 2006; Masulis and Reza 2015), and do not increase operational efficiency (Di Giuli and Kostovetsky, 2014). However, the extent to which CSR activities of corporate customers influence the performance of their suppliers is relatively unexplored in the literature. Dai, Liang, and Ng (2021) examine whether socially responsible corporate customers infuse socially responsible business behavior in suppliers, and their effect on suppliers' operational efficiency and firm valuation. They find a unilateral effect on corporate social responsibility only from customers to suppliers, and that enhanced collaborative CSR efforts help improve operational efficiency and firm valuation of both customers and suppliers. This paper contributes to the relatively sparse literature on the effect of corporate customers' CSR activities on suppliers by examining the effect of ceding insurers' CSR ratings on reinsurers' performance.

Additionally, this paper contributes to the reinsurance literature that examines the impact of moral hazard. The literature identifies moral hazard by examining the variation in the ratio of premiums to expected losses[41]. This paper provides additional analysis using a different measurement of moral hazard[42].

Furthermore, this paper contributes to the sparse literature on reinsurance supply. Griffith and Liebenberg (2021) examine the impact of the decision to supply reinsurance to unaffiliated insurers. They find that reinsurers' profitability decreases and firm risk increases as they supply greater reinsurance for unaffiliated insurers. Also, they argue that the decrease in profitability and increase in risk of reinsurers are due to manifestation of information asymmetry by the ceding insurers. In this paper, we provide additional empirical evidence that reinsurers' performance increase as they supply more reinsurance to ceding insurers with lower moral hazard behavior expectation.

The remainder of this study is organized as follows. The "Hypotheses development" states the hypotheses that we test in this study. The "Data and Sample" describes the data sources, and the sample constructions. The "Methodology" describes the construction of the variables and the regression models used to test the hypotheses. The "Results" reports the main empirical results, and concludes the study with the "Conclusion" section.

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[41] Refer to Doherty and Smetters (2005).

[42] CSR ratings measure the level of moral hazard behavior and manifestation of information asymmetry (Sacconi and Degli Antoni, 2011; Cho, Lee, and Pfeiffer, 2013; Kim, Li, and Li, 2014; Gao and Zhang, 2015; Cui, Jo, and Na, 2018; Chakraborty, Gao, and Musa, 2021)

HYPOTHESES DEVELOPMENT

In this paper, we examine whether ceding insurers' CSR ratings affect reinsurers. First, we examine whether reinsurers offer better premiums to high-CSR ceding insurers. According to Doherty and Smetters (2005), moral hazard exists in both affiliated and non-affiliated reinsurance market, and reinsurers control ceding insurers' moral hazard behavior via price incentives and monitoring. Specifically, Doherty and Smetters (2005) find that the moral hazard in the affiliated reinsurance markets is controlled via price incentives and with large amounts of monitoring, and that the moral hazard in the non-affiliated reinsurance market is controlled mainly via price incentives with little or no use of monitoring. Therefore, if ceding insurers have less moral hazard behavior, then reinsurers have less need to use price incentives to control for moral hazard. Reinsurers would hence offer lower premiums to the ceding insurers with less moral hazard behavior. Since high-CSR firms are more ethical and thus have less moral hazard behavior (Chakraborty et al., 2021; Kim et al., 2014; Gao and Zhang, 2015), we expect reinsurers to offer more favorable premiums to high-CSR ceding insurers than low-CSR ceding insurers. Also, we expect reinsurers to offer more favorable premiums as ceding insurers' moral hazard risk is mitigated. These hypotheses are described as follow,

H1: Reinsurance prices of high-CSR ceding insurers is less than those of low-CSR ceding insurers.

H2: When a ceding insurer's CSR rating increases (decreases), reinsurers offer a lower (higher) price.

Furthermore, we examine whether supplying reinsurance to high- or low-CSR ceding insurers affects the underwriting risk and profitability of reinsurers. Jean Baptiste and Santomero (2000) argue that allocation of risk between ceding insurers and reinsurers becomes more efficient as information asymmetry decreases. Adding to their argument, Griffith and Liebenberg (2021) find that reinsurers' profitability increases and underwriting risk decreases as information asymmetry between ceding insurers and reinsurers mitigates. Moreover, Doherty and Smetters (2005) argue that it is costly for reinsurers to monitor the underwriting activities of the ceding insurers and how the ceding insurers settles claims with its own policyholder, and that reinsurance relaxes the incentive for the ceding insurers to engage in careful underwriting and loss mitigation. Thus, ceding insurers' moral hazard behavior affects reinsurers' profitability. Therefore, we expect reinsurers' profitability to increase and their underwriting risk to decrease as they assume less from low-CSR ceding insurers. This hypothesis is described as follows,

H3: As reinsurers supply more reinsurance to high-CSR ceding insurers, reinsurers' profitability increases.

H4: As reinsurers supply more reinsurance to high-CSR ceding insurers, reinsurers' underwriting risk decreases.

There is a benefit that reinsurers earn from reduced underwriting risk from supplying reinsurance more to high-CSR insurers than low-CSR insurers. Reinsurers can earn economic rents[43] by transferring the reduced risk in their underwriting portfolio to asset risk. According to coordinated risk management theory by Schrand and Unal (1998), reducing homogenous risk where zero economic rent is earned allows the firm to obtain additional exposure to core-business risk where the economic rents are earned and still maintain its target level of risk. Che and Liebenberg (2017) support the coordinated risk management theory by finding that insurers with

[43] According to the Insurance Factbook from the Insurance Information Institute, 99% of insurers' profit come from investments in financial securities rather than from underwriting activities, and underwriting loss is often offset with gains from financial investments.

diversified line-of-business[44] take more asset risk than non-diversified insurers, and that the degree of asset risk-taking is positively related to diversification extent. Therefore, we expect reinsurers to transfer risk from underwriting portfolio to asset portfolio where the economic rents are mostly generated. This hypothesis is described as follows,

H5: As reinsurers supply more reinsurance to high-CSR ceding insurers, reinsurers take greater asset risk.

[44] Business line diversification reduces the underwriting cash flows by assuaging large unexpected losses and cross-subsidizing unpredictable lines, and thus, reduces underwriting risk (Che and Liebenberg, 2017).

DATA AND SAMPLE

Our sample consists of reinsurers that supply reinsurance to public ceding insurers with a CSR rating from years 2011 through 2016. Since the first two hypotheses examine whether reinsurers offer a more favorable price to ceding insurers with less expectation of moral hazard behavior, we include all observations of reinsurers' supply to public ceding insurers with CSR ratings. The final sample consists 352 reinsurers and 7,541 reinsurer-ceding-insurer-year observations (appendix 1). Table 1 presents the summary statistics of the sample used for testing hypotheses 1 and 2.

The remaining hypotheses examine the impact of reinsurance assumed from ceding insurers with moral hazard behavior on reinsurers' profitability and underwriting risk. Specifically, we examine the relation between the proportion of reinsurance assumed from ceding insurers with moral hazard behavior and reinsurers' performance. Therefore, we use a consolidated sample by the reinsurer level. The sample consists 334 reinsurers and 1,469 reinsurer-year observations. Table 4 presents the summary statistics of the sample used for examining the hypotheses 3, 4, and 5.

The financial data of reinsurers is obtained from the NAIC InfoPro database. Specifically, we obtain reinsurers' underwriting portfolio details, such as premiums paid and losses incurred by the ceding insurers, from schedule F – part 1 of the NAIC InfoPro database.

In order to identify the CSR rating of ceding insurers, we use the data from the MSCI ESG Stats database (formerly known as KLD). There are 13 different categories that measures the ESG (environmental, social, and governance) score of the firms. However, we follow the CSR literature[45] and focus on the five categories (community, diversity, employee relations, environment, and human rights) that measures the ethical behavior of the firms.

[45] Refer to Sacconi and Degli Antoni, 2011; Kim, Park, Wier, 2012; Cho, Lee, and Pfeiffer, 2013; Kim, Li, and Li, 2014; Gao and Zhang, 2015; Cui, Jo, and Na, 2018; Chakraborty, Gao, and Musa, 2021; and Lins, Servaes, and Tamayo 2017.

Table 1 Summary statistics

PRICE is the ratio of reinsured premiums paid to reinsured losses incurred by a ceding insurer. *CSR_RATING* is constructed by adding one point for each strength category and subtracting one point for each concern category (appendix 2). *DUMMY_CSR_INCREASE* is a binary variable that equals 1 when the ceding insurers' CSR rating increased from the prior year to the current year, and equals 0 otherwise. *DUMMY_CSR_DECREASE* which is a binary variable that equals 1 when the ceding insurers' CSR rating decreased from the prior year to the current year, and equals 0 otherwise. *DIR_PRC_CONTROL* is the interaction between the experience rating variable and the monitoring cost variable; *EXP_RATING* is calculated as the direct premium-to-loss ratio of the ceding insurer; *MONITOR* is calculated as the ratio of reinsured loses incurred by ceding insurer to direct losses; *SIZE* is calculated as the natural logarithm of total net admitted assets; *NPE* is calculated as the natural logarithm of net premiums earned; *AFFILIATE* is a binary variable that equals 1 if a ceding insurer is in the same group, and equals 0 otherwise; *MUTUAL* is a binary variable that equals 1 for mutual insurers and equals 0 for stock insurers. We winsorize *PRICE*, *DIR_PRC_CONTROL*, *EXP_RATING*, and *MONITOR* at the 1st and 99th percentiles.

	Mean	Median	Std. Dev.	Min	Max	1st quartile	3rd quartile
PRICE	4.4724	1.3807	13.7336	0.0007	111.9330	0.3178	2.9842
CSR_RATING	1.1296	1.0000	1.9276	-2.0000	9.0000	0.0000	2.0000
DUMMY_CSR_ INCREASE	0.3078	0.0000	0.4616	0.0000	1.0000	0.0000	1.0000
DUMMY_CSR_ DECREASE	0.2594	0.0000	0.4383	0.0000	1.0000	0.0000	1.0000
DIR_PRC_ CONTROL	0.5771	0.0268	1.6776	0.0007	12.4091	0.0043	0.2835
EXP_RATING_{t-1}	2.2206	1.9322	1.0695	1.1827	7.5812	1.6152	2.5017
EXP_RATING_{t-2}	2.2002	1.9113	1.0452	1.1726	7.6532	1.6141	2.5202
$MONITOR_{t-1}$	0.2538	0.0140	0.6002	0.0005	3.7294	0.0025	0.1430
SIZE	20.7333	20.7720	2.1329	14.1719	24.5437	19.3531	22.3860
NPE	16.1174	19.4035	7.8660	0.0000	24.0685	17.2614	21.1425
AFFILIATE	0.3746	0	0.4841	0	1	0	1
MUTUAL	0.0233	0.0000	0.1510	0.0000	1.0000	0.0000	0.0000

Appendix 1 Sample screening

Screening process	Number of observations
Supply of reinsurance to ceding insurers (Initial)	44,185
Delete reinsurance supply to private insurers	11,629
Delete ceding insurers without CSR ratings	9,946
Delete observations with missing control variables	9,170
After lagging CSR ratings	7,541

METHODOLOGY

CSR rating

In order to measure the moral hazard behaviors of the ceding insurers, we use the CSR rating as a proxy. The reason why we use CSR rating to proxy moral hazard behaviors is because the CSR literature finds that firms with high CSR ratings are more ethical. Also, Rowell and Connelly (2012) states that moral hazard is the questionable ethical practice of increasing opportunity for individual gain while shifting risk for loss to the other group.

To measure the CSR rating of ceding insurers, we use the MSCI ESG Stats database. The MSCI ESG Stats Database classifies environmental, social, and governance performance into 13 different categories: community, diversity, employee relations, environment, human rights, product, alcohol, gambling, firearms, military, nuclear, tobacco, and corporate governance. However, the literature that examines public firms' CSR ratings focuses on community, diversity, employee relations, environment, and human rights categories. The literature excludes corporate governance when measuring CSR activities of public firms. Kim, Park, and Wier (2012) states that corporate governance ensures that firm operates in the best interest of shareholders, however since CSR includes activities that improve social and environment conditions and serve interests of all stakeholders, corporate governance and CSR may or may not be two completely different constructs. They argue that corporate governance is perceived as a distinct construct from CSR, and thus exclude corporate governance to disentangle the effect of CSR and corporate governance. Also, they exclude exclusionary screen categories (alcohol, gambling, military contracting, nuclear power, and tobacco), because these categories do not pertain to firms' discretionary activities. Furthermore, Lins, Tamayo, and Servaes (2017) argue that product category contains a number of elements that are outside the scope of CSR, and thus exclude the product category when measuring

CSR. Therefore, by following the literature, we focus on community, diversity, employee relations, environment, and human rights categories to generate the CSR rating of the ceding insurers.

In each five categories (community, diversity, employee relations, environment, and human rights), there are sub categories that either indicate a strength or a concern (appendix 2). The CSR rating of ceding insurers is constructed by adding one point for each strength category and subtracting one point for each concern category. Higher CSR rating implies better ethical behavior and thus less moral hazard behavior (Chakraborty, Gao, and Musa, 2021).

Reinsurance price measure

We follow Doherty and Smetters (2005) for measuring reinsurance price. According to Doherty and Smetters (2005), reinsurance price is difficult to obtain because reinsurers' premium income combines both the quantity of insurance sold with the price per unit of coverage. In order to overcome the problem, they use the inverse loss ratio to identify the reinsurance price. Therefore, for a ceding insurer k, the reinsurance price in year t is given by

$$PRICE_{kt} = \frac{REINS\_PREM_{kt}}{REINS\_LOSS_{kt}}, \quad (1)$$

where $REINS\_PREM_{kt}$ denotes reinsured premiums paid by ceding insurer k in year t, and $REINS\_LOSS_{kt}$ denotes reinsured losses incurred by ceding insurer k in year t.

Profitability and risk measures

To analyze the impact of supplying reinsurance for high- or low-CSR insurers on reinsurers' profitability and risk, we examine the combined ratio and underwriting risk of the reinsurers. The combined ratio of reinsurer r in year t is given by

$$COMBINED\_RATIO_{rt} = LOSS\_RATIO_{rt} + EXPENSE\_RATIO_{rt}, \quad (2)$$

$$LOSS\_RATIO_{rt}=(INCURRED\_LOSS_{rt}+LOSS\_ADJ\_EXPENSE_{rt})/PREM_{rt}, \quad (3)$$

$$EXPENSE\_RATIO_{rt} = UNDER\_EXPENSE_{rt} / PREM_{rt}, \quad (4)$$

where $LOSS\_RATIO_{rt}$ is the sum of incurred losses and loss adjustment expenses divided by premiums earned by reinsurer r in year t; and $EXPENSE\_RATIO_{rt}$ is the ratio of underwriting expenses and premiums earned by reinsurer r in year t.

We follow Lamm-Tennant and Starks (1993) and measure underwriting risk the 3-year variance in loss ratio.

Asset risk measure

Following Yu, Lin, Oppenheimer, and Chen (2008) and Che and Liebenberg (2017), we define asset risk-taking (*ASSET_RISK*) as the ratio of common stock and speculative bonds[46] to total invested assets.

Control Variables

For testing the first two hypotheses, we include control variables from Doherty and Smetters (2005). We include a lag on direct price control (*DIR_PRC_CONTROL)*, two lags on the experience and retrospective rating (*EXP_RATING*), and a lag on monitoring cost (*MONITOR*). Doherty and Smetters (2005) argue that the responsiveness of premiums to prior losses increase as more reinsurance is purchased, and show that reinsurers use direct price control for moral hazard in the non-affiliated reinsurance market. Furthermore, they argue that reinsurer "experience rate" the previous direct losses of the ceding insurer, and that premiums are sensitive

[46] The speculative bonds are identified as bonds with NAIC class 3 and above.

to the monitoring signal as reinsurer use monitoring to control for moral hazard in the affiliated reinsurance market. Experience rating is calculated as the direct premium-to-loss ratio of the ceding insurer. Monitoring cost is calculated as the ratio of reinsured loses incurred by ceding insurer to direct losses. Direct price control is the interaction between the experience rating variable and the monitoring cost variable.

Other control variables that Doherty and Smetters (2005) use that we also include are firm size (*SIZE*), net premiums earned (*NPE*), and organization form (*MUTUAL*[47]) of the ceding insurers. We further control for group affiliation status (*GROUP*), since Doherty and Smetters (2005) find that the method of reinsurers' control for moral hazard is different for affiliated and non-affiliated ceding insurers. We also include ceding insurer fixed effects and year dummy variables. Firm size is calculated as the natural logarithm of total net admitted assets. The variable NPE is calculated as the natural logarithm of net premiums earned. Organization form is generated as a dummy variable that equals 1 for mutual insurers and equals 0 for stock insurers. Group affiliation status is also generated as a dummy variable that equals 1 if a ceding insurer is in the same group, and equals 0 otherwise.

For testing the next two hypotheses, we control for the determinants of insurer profitability. We follow Griffith and Liebenberg (2021) and control for firm size (*SIZE*), capitalization (*CAP*), line diversification (*LINE_DIV*), geographic diversification (*GEO_DIV*), and organization form (*MUTUAL*). Capitalization is calculated as the ratio of surplus to total admitted assets. Business line diversification is calculated as the Herfindahl index of net premiums written across 24 business lines[48]. Geographic diversification is calculated as the Herfindahl index of direct

[47] Affiliates can be mutual firms while the group that the mutual affiliate is associated with is public.
[48] We follow Griffith and Liebenberg (2021) and make the following modifications to the business line annual statutory data:

premiums written across geographic regions of all U.S. states and protectorates. Also, we include reinsurer fixed effects and year dummy variables.

For testing the last hypothesis, we control for firm characteristics that affect asset risk-taking. Following Che and Liebenberg (2017), we control for firm size (*SIZE*), line diversification (*LINE_DIV*), leverage (*LEVERAGE*), reinsurance usage (*REINSURANCE*), ownership structure (*MUTUAL*), extent of long-tail lines (*LONG_TAIL*), insolvency risk (*INSOLV_RISK*), and public status (*PUBLIC*). Leverage is calculated as the capital-to-asset ratio, which is calculated by dividing policyholder surplus by total assets. Reinsurance usage is calculated as the reinsurance ratio, which is calculated by dividing premiums ceded by sum of direct premiums written and reinsurance assumed. Extent of long-tail lines is calculated as the ratio of net premiums written in long-tail lines to total net premiums written. Insolvency risk is based on failing four or more IRIS ratios, therefore, we generated *ISOLV_RISK* as a dummy variable that equals 1 when insurers fail four or more IRIS ratios and equals 0 otherwise. Public status is generated as a dummy variable that equals 1 for public insurers and equals 0 for private insurers. We also include reinsurer fixed effects and year dummy variables.

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1. Fire and Allied Lines is defined as the sum of "fire" (line 1) and "allied lines" (line 2).
2. Medical is defined as the sum of "medical occurrence" (line 11.1) and "medical claims" (line 11.2).
3. Accident and Health is defined as the sum of "group accident and health" (line 13), "credit accident and health" (line 14), and "other accident and health" (line 15).
4. Other Liability is measured as the sum of "other liability occurrence" (line 17.1) and "other liability claims" (line 17.2)
5. Product Liability is defined as the sum of "product liability occurrence" (line 18.1) and "product liability claims" (line 18.2).
6. Auto is defined as the sum of "private auto liability" (line 19.1), "commercial auto liability" (19.2), and "auto property and damage" (line 21).

The final list of 24 lines of business is as follows: Accident and Health, Aircraft, Auto, Boiler and Machinery, Burglary and Theft, Commercial, Credit, Earthquake, Farmowners', Fidelity, Financial, Fire and Allied Lines, Homeowners', Inland, International, Medical Malpractice, Mortgage, Ocean, Other Liability, Other, Product Liability, Surety, Warranty, and Workers Compensation.

As for the winsorization of variables in the sample that we use to test the first two hypotheses, the dependent variable *PRICE* and the independent variables *DIR_PRC_CONTROL*, *EXP_RATING*, and *MONITOR* are winsorized at the 1st and 99th percentiles. For the sample that we use to test the rest of the hypotheses, we winsorize the dependent variables *COMBINED_RATIO*, *UND_RISK*, and *ASSET_RISK* at the 1st and 99th percentiles[49].

Univariate results

Table 2 presents the univariate results of the tail comparison of the reinsurance prices between high- and low-CSR ceding insurers. We perform three different tail comparisons. We compare the reinsurance prices between the ceding insurers with CSR ratings in the top and bottom percentile, ventile, and decile. Surprisingly, the univariate result that compares the top and bottom ventile shows that reinsurance price is higher for high-CSR ceding insurers. In general, the results show that there is no evidence of lower prices for cedants with higher CSR ratings.

We further compare the reinsurance prices between ceding insurers with CSR rating greater than the mean (1.1296) and those less or equal to the mean. The results show that there is no difference in prices between ceding insurers with CSR rating above and those with CSR rating below or equal to the mean. Overall, the results in table 2 are showing that reinsurers do not offer favorable prices to ceding insurers with high-CSR rating.

Next, we perform univariate analyses to compare reinsurers' performance and underwriting risk between reinsurers with *HIGH_CSR_RATIO* greater than the mean (0.3046) and less than or equal to the mean. The results in table 5 show that reinsurers that supply more to high-CSR ceding insurers in average have higher ROA, but have similar combined ratio and underwriting risk. On

[49] We follow Griffith and Liebenberg (2021).

average, reinsurers that supply more (less) to high-CSR ceding insurers have ROA of 0.0384 (0.0255). The univariate analyses show that ceding insurers' moral hazard behavior decreases reinsurers' performance.

Regression

First, we evaluate whether the CSR rating of ceding insurers influences reinsurance price. In order to test the first hypothesis, we use a simple OLS model to examine the relation between reinsurance price and ceding insurers' CSR rating.

$$PRICE_{kt} = \beta_0 + \beta_1\, CSR\_RATING_{kt} + \beta_2' X_{kt} + \varepsilon_{kt}, \quad (5)$$

where *PRICE* is the reinsurance price as defined in equation (1); *CSR_RATING* is the CSR rating of ceding insurers; *X* is a vector of control variables; and ε is a random error term.

We further evaluate the impact on reinsurance price when the expectation of ceding insurers' moral hazard behavior changes. We use a simple OLS model to compare the reinsurance prices of ceding insurers whose CSR rating increased from prior year to current year to those whose CSR rating did not increase. Also, we compare the reinsurance prices of ceding insurers whose CSR rating decreased from prior year to current year to those whose CSR rating did not decrease.

$$PRICE_{kt} = \beta_0 + \beta_1 DUMMY\_CSR\_INCREASE_{kt} + \beta_2' X_{kt} + \varepsilon_{kt}, \quad (6)$$

$$PRICE_{kt} = \beta_0 + \beta_1 DUMMY\_CSR\_DECREASE_{kt} + \beta_2' X_{kt} + \varepsilon_{kt}, \quad (7)$$

$$PRICE_{kt} = \beta_0 + \beta_1 DUMMY\_CSR\_INCREASE_{kt} + \beta_2 DUMMY\_CSR\_DECREASE_{kt} + \beta_3' X_{kt} + \varepsilon_{kt}, \quad (8)$$

where the dependent variable is the same as model (5); *DUMMY_CSR_INCREASE* is a binary variable that equals 1 when the ceding insurers' CSR rating increased from the prior year to the current year, and equals 0 otherwise; *DUMMY_CSR_DECREASE* is a binary variable that equals 1 when the ceding insurers' CSR rating decreased from the prior year to the current year, and equals 0 otherwise; *X* is a vector of control variables; and ε is a random error term.

In order to test the influence of ceding insurers' CSR rating on reinsurers' performance, we estimate an OLS model to examine the relation between ceding insurers' CSR rating and reinsurers' operational profitability and underwriting risk. We measure underwriting profitability using combined ratio, and operating performance using ROA. We estimate the following models:

$$COMBINED\_RATIO_{rt} = \beta_0 + \beta_1 HIGH\_CSR\_RATIO_{rt} + \beta_2' X_{rt} + \varepsilon_{rt}, \quad (9)$$

$$ROA_{rt} = \beta_0 + \beta_1 HIGH\_CSR\_RATIO_{rt} + \beta_2' X_{rt} + \varepsilon_{rt}, \quad (10)$$

$$UND\_RISK_{rt} = \beta_0 + \beta_1 HIGH\_CSR\_RATIO_{rt} + \beta_2' X_{rt} + \varepsilon_{rt}, \quad (11)$$

where $COMBINED\_RATIO_{rt}$ is the combined ratio of reinsurer *r* in year *t* defined in equation (2); ROA_{rt} is the ratio of net income to total assets of reinsurer *r* in year *t*; UND_RISK_{rt} is the 3 year variance in loss ratio of reinsurer *r* in year *t*; *HIGH_CSR_RATIO* is the ratio of reinsurance assumed from high-CSR ceding insurers to total reinsurance assumed, where high-CSR ceding insurers are those with CSR rating greater than the median[50]; *X* is a vector of control variables; and ε is a random error term.

Finally, we test the coordinated risk management theory[51] by examining the influence of ceding insurers' CSR rating on reinsurers' asset risk-taking. We modify model (9) and estimate a model

$$ASSET\_RISK_{rt} = \beta_0 + \beta_1 HIGH\_CSR\_RATIO_{rt} + \beta_2' X_{rt} + \varepsilon_{rt}, \quad (12)$$

where $ASSET\_RISK_{rt}$ is the ratio of risky assets[52] to total invested assets of reinsurer *r* in year *t*.

[50] The sample's CSR rating median is equal to 1.
[51] Refer to Schrand and Unal (1998).
[52] Common stock and speculative bonds.

Table 2 Univariate results: Reinsurance price comparison between high- and low-CSR ceding insurers

This table presents the univariate results of the tail comparisons of the reinsurance price between ceding insurers with high- and low-CSR ratings. Reinsurance price (*PRICE)* is the ratio of reinsured premiums paid to reinsured losses incurred by a ceding insurer. Ceding insurers' CSR rating that equals to *P1* is -2; *P99* is 8; *P5* is -1; *P95* is 5; *P10* is -1; and *P90* is 4. *, **, and *** denote statistical significance at the 10, 5 and 1 percent levels, respectively.

	Low-CSR	High-CSR	Difference	t-value
P1 vs P99				
PRICE	3.6479	3.8950	0.2473	0.21
P5 vs P95				
PRICE	3.9531	5.6394	1.6863	2.32**
P10 vs P90				
PRICE	3.9531	4.0046	0.0515	0.11
Above vs below or equal to mean				
PRICE	4.7092	4.3692	-0.3400	-0.99

Appendix 2 List of CSR rating categories

Category	Sub-Category
Environment-Strength	ENV-str-A: Environmental Opportunities – Opportunities in Clean Tech ENV-str-B: Pollution & Waste – Toxic Emissions and Waste ENV-str-C: Pollution & Waste – Packaging Materials & Waste ENV-str-D: Climate Change - Carbon Emissions ENV-str-G: Environmental Management Systems ENV-str-H: Natural Capital - Water Stress ENV-str-I: Natural Capital - Biodiversity & Land Use ENV-str-J: Natural Capital - Raw Material Sourcing ENV-str-K: Climate change - Financing Environmental Impact ENV-str-L: Environmental Opportunities – Opportunities in Green Building ENV-str-M: Environmental Opportunities – Opportunities in Renewable Energy ENV-str-N: Pollution & Waste - Electronic Waste ENV-str-O: Climate Change – Energy Efficiency ENV-str-P: Climate Change – Product Carbon Footprint ENV-str-Q: Climate Change - Climate Change Vulnerability ENV-str-X: Environment - Other Strengths
Environment-Concern	ENV-con-D: Toxic Emissions and Waste ENV-con-F: Energy & Climate Change ENV-con-H: Biodiversity & Land Use ENV-con-I: Operational Waste (Non-Hazardous) ENV-con-J: Supply Chain Management ENV-con-K: Water Stress ENV-con-X: Environment - Other Concerns
Community-Strength	COM-str-H: Community Engagement
Community-Concern	COM-con-B: Impact on Community
Human Rights-Strength	HUM-str-D: Indigenous Peoples Relations Strength HUM-str-X: Human Rights Policies & Initiatives
Human Rights-Concern	HUM-con-J: Civil Liberties HUM-con-K: Human Rights Concerns HUM-con-X: Human Rights - Other Concerns
Employee Relations-Strength	EMP-str-A: Union Relations EMP-str-C: Cash Profit Sharing EMP-str-D: Employee Involvement EMP-str-G: Employee Health & Safety

	EMP-str-H: Supply Chain Labor Standards EMP-str-L: Human Capital Development EMP-str-M: Labor Management EMP-str-N: Controversial Sourcing EMP-str-X: Human Capital – Other Strengths
Employee Relations-Concern	EMP-con-A: Collective Bargaining & Unions EMP-con-B: Health & Safety EMP-con-F: Supply Chain Labor Standards EMP –con-G: Child Labor EMP-con-H: Labor Management Relations EMP-con-X: Labor Rights & Supply Chain – Other Concerns
Diversity-Strength	DIV-str-B: Representation DIV-str-C: Board Diversity - Gender
Diversity-Concern	DIV-con-A: Discrimination & Workforce Diversity DIV-con-C: Board Diversity - Gender

RESULTS

The results of testing hypotheses 1 and 2, using models (5), (6), and (7) are shown in table 3. The first column examines whether the risk of ceding insurers' moral hazard behavior, which is measured with the CSR rating, affects reinsurance price. The results show that the CSR rating of ceding insurers does not affect the reinsurance price, indicating that reinsurers do not offer a more favorable price to the ceding insurers with less risk of moral hazard behavior. Other factors, such as experience and retrospective rating, monitoring cost, and group affiliation status, have impact on the reinsurance price. The coefficient on *EXP_RATING* is positive and significant, which aligns with the findings from Doherty and Smetters (2005). Doherty and Smetters (2005) explain the positive relation between experience rating and reinsurance price by stating that, ceding insurers whose books of business tend to be riskier would have higher premium-to-loss ratios than firms with less risky books even after controlling for scale. Lastly, the coefficient on *AFFILIATION* is negative and significant, indicating that reinsurers offer a more favorable price to their group affiliates relative than their non-affiliated ceding insurers.

The following columns in table 3 represent the results from examining the impact on reinsurance price when the CSR rating of a ceding insurer changes from the prior year to the current year, using models (6), (7), and (8) respectively. The results from column (2) are showing that reinsurance price is lower on average for ceding insurers whose CSR rating increased relative to those whose CSR rating did not increase, and the results from column (3) are show that there is reinsurance price is higher on average for ceding insurers whose CSR rating decreased relative to those whose CSR rating did not decrease. However, the results from column (4) are show that there is no difference between the reinsurance prices of ceding insurers whose CSR rating increased or decreased and those whose CSR ratings did not change. Overall, the results from table 3 show that the risk of ceding insurers' moral hazard behavior do not affect reinsurance price. The results are indicating that reinsurers do not price the expectation of ceding insurers' moral hazard behavior, but control for moral hazard using experience rating and monitoring.

We further examine whether supplying reinsurance for high- or low-CSR ceding insurers affects the risk and profitability of reinsurers by testing hypotheses 3 and 4, using models (9), (10), and (11). The first two columns of table 6 present the results of the reinsurer profitability analysis, and the last column presents the results of the reinsurer underwriting risk analysis. We expected reinsurers' underwriting expense and risk to decrease as their supply of reinsurance to high-CSR ceding insurers increases, since ceding insurers' moral hazard behavior increases unexpected losses (Doherty and Smetters, 2005). The results in table 6 partially supports hypothesis 3 by showing that increase in reinsurance supply to high-CSR ceding insurers do not affect reinsurers' combined ratio, but increases reinsurers' ROA. Moreover, table 6 shows that supplying reinsurance to high-CSR ceding insurers does not affect reinsurers' underwriting risk, which rejects hypothesis 4. These results indicate that ceding insurers' moral hazard behavior decreases reinsurers' operation performance. Notwithstanding, the results are showing limited evidence that the ceding insurers' CSR activities affect the performance of reinsurers.

Finally, the results of testing hypothesis 5, using model (12), are shown in table 7. Previous results show that supplying reinsurance to high-CSR ceding insurers has no impact on reinsurers' underwriting risk. According to coordinated risk management theory by Schrand and Unal (1998), reduction in the underwriting risk allows reinsurers to allocate additional asset risk. Therefore, we expect that increase in the reinsurance supply to high-CSR ceding insurers also do not affect reinsurers' asset risk takings. The results in table 7 show that the coefficient of

HIGH_CSR_RATIO[53] is insignificant, indicating that reinsurers do not allocate additional asset risk as they increase their supply to high-CSR ceding insurers. The results support the coordinated risk management theory by Schrand and Unal (1998) by rejecting hypothesis 5.

[53] The ratio of reinsurance assumed from high-CSR ceding insurers to total reinsurance assumed, where high-CSR ceding insurers are those with CSR rating greater than the median, which is equal to 1.

Table 3 Analysis of the relation between reinsurance price and ceding insurers' CSR rating

This table presents the results from examining the impact of ceding insurers' CSR ratings on reinsurance price. OLS models are used, including reinsurer-ceding insurer fixed effects and year dummies. The dependent variable is the reinsurance price (*PRICE)*, which is the ratio of reinsured premiums paid to reinsured losses incurred by a ceding insurer. The main independent variable of regression (1) is *CSR_RATING,* which is a proxy for measuring the risk of ceding insurers' moral hazard behavior; regression (2) is *DUMMY_CSR_INCREASE*, which is a binary variable that equals 1 when the ceding insurers' CSR rating increased from the prior year to the current year, and equals 0 otherwise; regression (3) is *DUMMY_CSR_DECREASE*, which is a binary variable that equals 1 when the ceding insurers' CSR rating decreased from the prior year to the current year, and equals 0 otherwise. The control variable *DIR_PRC_CONTROL* is the interaction between the experience rating variable and the monitoring cost variable; *EXP_RATING* is calculated as the direct premium-to-loss ratio of the ceding insurer; *MONITOR* is calculated as the ratio of reinsured loses incurred by ceding insurer to direct losses; *SIZE* is calculated as the natural logarithm of total net admitted assets; *NPE* is calculated as the natural logarithm of net premiums earned; *AFFILIATE* is a binary variable that equals 1 if a ceding insurer is in the same group, and equals 0 otherwise; *MUTUAL* is a binary variable that equals 1 for mutual insurers and equals 0 for stock insurers. Standard errors (in parentheses) are corrected for clustering at the reinsurer-ceding insurer level. *, **, and *** denote statistical significance at the 10, 5 and 1 percent levels, respectively.

	(1)	(2)	(3)	(4)
CSR_RATING	0.1180			
	(0.0755)			
DUMMY_CSR_INCREASE		-0.5237**		-0.3004
		(0.2534)		(0.3037)
DUMMY_CSR_DECREASE			0.6455*	0.4574
			(0.344)	(0.4127)
DIR_PRC_CONTROL$_{t-1}$	-0.0107	-0.0231	-0.02	-0.0237
	(0.1724)	(0.1739)	(0.1733)	(0.1739)
EXP_RATING$_{t-1}$	0.6227***	0.6415***	0.6286***	0.6360***
	(0.2206)	(0.2218)	(0.2213)	(0.2215)
EXP_RATING$_{t-2}$	0.5810**	0.5666**	0.5683**	0.5661**
	(0.2528)	(0.2527)	(0.2528)	(0.2528)
MONITOR$_{t-1}$	-1.3738***	-1.3616***	-1.3439***	-1.3446***
	(0.4191)	(0.4218)	(0.4224)	(0.4228)
SIZE	-0.4329***	-0.3916**	-0.3997**	-0.3988**
	(0.168)	(0.1609)	(0.1608)	(0.1607)
NPE	0.0476	0.0439	0.0429	0.0437
	(0.0378)	(0.0373)	(0.0374)	(0.0373)
AFFILIATE	-0.9647*	-0.8969*	-0.9601*	-0.9414*
	(0.5374)	(0.535)	(0.5362)	(0.535)
MUTUAL	0.7481	0.6589	0.6778	0.6705

	(1.9677)	(1.9693)	(1.9675)	(1.9688)
Year=2012	-0.2317	0.0921	-0.3824	-0.1697
	(0.3655)	(0.4059)	(0.3483)	(0.4144)
Year=2013	-0.2968	-0.1116	-0.3937	-0.2835
	(0.4011)	(0.4015)	(0.422)	(0.4294)
Year=2014	-0.0205	0.0069	-0.5211	-0.3337
	(0.4462)	(0.4373)	(0.5168)	(0.5702)
Year=2015	-0.7016*	-0.5108	-0.7833*	-0.6417
	(0.4213)	(0.4253)	(0.425)	(0.4527)
Year=2016	-0.6945	-0.63	-0.866*	-0.7741
	(0.4495)	(0.4523)	(0.4704)	(0.497)
Constant	11.1330***	10.4657***	10.6599***	10.6309***
	(3.275)	(3.1703)	(3.1672)	(3.1638)
R-squared	0.0319	0.0310	0.0309	0.0312

Table 4 Summary statistics

COMBINED_RATIO is the sum of loss ratio, which is the sum of incurred losses and loss adjustment expenses divided by premiums earned by the reinsurer, and the expense ratio, which is the ratio of underwriting expenses and premiums earned by the reinsurer. *ROA* is the ratio of net income and total assets of the reinsurer. *UND_RISK* is the 3-year variance in the loss ratio of the reinsurer. *ASSET_RISK* is the ratio of common stock and speculative bonds[54] to total invested assets. *HIGH_CSR_RATIO* is the ratio of reinsurance assumed from high-CSR ceding insurers to total reinsurance assumed, where high-CSR ceding insurers are those with CSR rating greater than the median, which is equal to 1. *SIZE* is the natural logarithm of total net admitted assets. *CAP* is the ratio of surplus to total admitted assets. *LINE_DIV* is the Herfindahl index of net premiums written across lines of business; *GEO_DIV* is the Herfindahl index of direct premiums written across geographic regions. *MUTUAL* is a binary variable that equals 1 for mutual insurers and equals 0 for stock insurers. *PUBLIC* is a binary variable that equals 1 for public insurers and equals 0 for private insurers. *LEVERAGE* is calculated by dividing policyholder surplus by total assets. *REINSURANCE* is calculated by dividing premiums ceded by sum of direct premiums written and reinsurance assumed. *LONG_TAIL* is the ratio of net premiums written in long-tail lines to total net premiums written. *INSOLV_RISK* is a binary variable that equals 1 when insurers fail four or more IRIS ratios and equals 0 otherwise. We winsorize *COMBINED_RATIO*, *UND_RISK*, and *ASSET_RISK* at the 1st and 99th percentiles.

	Mean	Median	Std. Dev.	Min	Max	1st quartile	3rd quartile
COMBINED_RATIO	1.5734	1.0938	3.8747	0.4620	37.3796	1.0195	1.1924
ROA	0.0296	0.0288	0.0486	-0.2667	0.7073	0.0127	0.0468
HIGH_CSR_RATIO	0.3046	0.0000	0.4382	0.0000	1.0000	0.0000	1.0000
UND_RISK	0.2362	0.0513	1.1341	0.0056	9.8820	0.0245	0.0886
ASSET_RISK	0.1416	0.0820	0.1673	0.0000	0.6901	0.0014	0.2247
SIZE	20.1465	20.0998	2.0708	14.3757	25.9085	18.8637	21.4343
CAP	0.4972	0.4624	0.1843	0.0000	1.2877	0.3631	0.5903
LINE_DIV	0.4908	0.6460	0.3324	0.0000	0.8836	0.0553	0.7754
GEO_DIV	0.5931	0.7901	0.3828	0.0000	0.9680	0.1124	0.9277
MUTUAL	0.0497	0.0000	0.2174	0.0000	1.0000	0.0000	0.0000
PUBLIC	0.6624	1.0000	0.4731	0.0000	1.0000	0.0000	1.0000
LEVERAGE	0.4102	0.3776	0.1654	0.0000	0.9963	0.2962	0.4743
REINSURANCE	0.4526	0.4747	0.3067	0.0000	1.0000	0.1633	0.7108
LONG_TAIL	0.8079	0.9298	0.2708	0.0000	1.0000	0.7731	0.9835
INSOLV_RISK	0.0871	0.0000	0.2821	0.0000	1.0000	0.0000	0.0000

[54] The speculative bonds are identified as bonds with NAIC class 3 and above.

Table 5 Univariate results: Reinsurers' performance and underwriting risk comparison between reinsurers that supply more to high-CSR ceding insurers to those that supply less

This table presents the univariate results of the comparison of performance and underwriting risk between reinsurers with *HIGH_CSR_RATIO* greater than the mean (0.3046) and those with *HIGH_CSR_RATIO* lower or equal to the mean. Reinsurers with *HIGH_CSR_RATIO* greater than the mean is denoted with 1, and denoted 0 otherwise. *HIGH_CSR_RATIO* is the ratio of reinsurance assumed from high-CSR ceding insurers to total reinsurance assumed, where high-CSR ceding insurers are those with CSR rating greater than the median, which is equal to 1. *COMBINED_RATIO* is the sum of loss ratio, which is the sum of incurred losses and loss adjustment expenses divided by premiums earned by the reinsurer, and the expense ratio, which is the ratio of underwriting expenses and premiums earned by the reinsurer. *ROA* is the ratio of net income and total assets of the reinsurer. *UND_RISK* is the 3-year variance in the loss ratio of the reinsurer. *, **, and *** denote statistical significance at the 10, 5 and 1 percent levels, respectively.

	0	1	Difference	t-value
COMBINED_RATIO	1.1605	1.5067	0.0983	0.45
ROA	0.0255	0.0384	0.0129	4.80***
UND_RISK	0.2345	0.2398	0.0053	0.08

Table 6 Analysis on the relation between the ceding insurers' CSR ratings and reinsurers' performance and underwriting risk

This table presents the results of examining the impact of ceding insurers' CSR rating on reinsurers' performance and underwriting risk. OLS models are used, including reinsurer fixed effects and year dummies. The dependent variables are the *COMBINED_RATIO*, *ROA*, and underwriting risk (*UND_RISK*), respectively. *COMBINED_RATIO* is the sum of loss ratio, which is the sum of incurred losses and loss adjustment expenses divided by premiums earned by the reinsurer, and the expense ratio, which is the ratio of underwriting expenses and premiums earned by the reinsurer. *ROA* is the ratio of net income and total assets of the reinsurer. Underwriting risk is the 3-year variance in the loss ratio of the reinsurer. The main independent variable (*HIGH_CSR_RATIO)* is the ratio of reinsurance assumed from high-CSR ceding insurers to total reinsurance assumed, where high-CSR ceding insurers are those with CSR rating greater than the median, which is equal to 1. The control variable *SIZE* is calculated as the natural logarithm of total net admitted assets; *CAP* is calculated as the ratio of surplus to total admitted assets; *LINE_DIV* is calculated as the Herfindahl index of net premiums written across lines of business; *GEO_DIV* is calculated as the Herfindahl index of direct premiums written across geographic regions; *MUTUAL* is a binary variable that equals 1 for mutual insurers and equals 0 for stock insurers. Standard errors (in parentheses) are corrected for clustering at the reinsurer level. *, **, and *** denote statistical significance at the 10, 5 and 1 percent levels, respectively.

	COMBINED_RATIO	*ROA*	*UND_RISK*
HIGH_CSR_RATIO	-0.1853	0.0065*	0.0127
	(0.2989)	(0.0039)	(0.0729)
SIZE	-0.1822	0.0035***	-0.0817
	(0.261)	(0.0013)	(0.0666)
CAP	-1.3824	0.0977***	-0.6133
	(0.9191)	(0.0208)	(0.596)
LINE_DIV	0.2774	-0.0180**	0.2874
	(2.988)	(0.007)	(0.4309)
GEO_DIV	-1.0171**	0.0170**	-0.2469**
	(0.4017)	(0.0068)	(0.1006)
MUTUAL	0.7297	-0.0051	0.209
	(1.1349)	(0.0055)	(0.2696)
Year=2012	0.1949	0.0051*	0.0146
	(0.1941)	(0.0026)	(0.028)
Year=2013	0.2147	0.0186***	0.0311
	(0.2143)	(0.0048)	(0.025)
Year=2014	0.1037	0.0182***	0.0451
	(0.1602)	(0.0037)	(0.0398)
Year=2015	0.0475	0.0112**	-0.0103
	(0.1898)	(0.0037)	(0.04)
Year=2016	0.0534	0.0137***	-0.0411*
	(0.1049)	(0.0041)	(0.0221)
Constant	6.7205	-0.1035***	2.297
	(4.0857)	(0.0273)	(1.4315)
R-squared	0.0128	0.0858	0.0013

Table 7 Analysis on the relation between the ceding insurers' CSR ratings and reinsurers' asset risk

This table presents the results of examining whether assuming greater premiums from ceding insurers with higher CSR ratings affects reinsurers' asset risk-taking level. An OLS model is used, including reinsurer fixed effects and year dummies. The dependent variable is the asset risk-taking level (*ASSET_RISK*). The main independent variable (*HIGH_CSR_RATIO)* is the ratio of reinsurance assumed from high-CSR ceding insurers to total reinsurance assumed, where high-CSR ceding insurers are those with CSR rating greater than the median, which is equal to 1. The control variable *SIZE* is calculated as the natural logarithm of total net admitted assets; *LINE_DIV* is calculated as the Herfindahl index of net premiums written across lines of business; *GEO_DIV* is calculated as the Herfindahl index of direct premiums written across geographic regions; *LEVERAGE* is calculated as the capital-to-asset ratio, which is calculated by dividing policyholder surplus by total assets; *REINSURANCE* is calculated as the reinsurance ratio, which is calculated by dividing premiums ceded by sum of direct premiums written and reinsurance assumed; *MUTUAL* is a binary variable that equals 1 for mutual insurers and equals 0 for stock insurers; *PUBLIC* is a binary variable that equals 1 for public insurers and equals 0 for private insurers; *INSOLV_RISK* is a binary variable that equals 1 when insurers fail four or more IRIS ratios and equals 0 otherwise; *LONG_TAIL* is calculated as the ratio of net premiums written in long-tail lines to total net premiums written. Standard errors (in parentheses) are corrected for clustering at the reinsurer level. *, **, and *** denote statistical significance at the 10, 5 and 1 percent levels, respectively.

	ASSET_RISK
HIGH_CSR_RATIO	0.0035
	(0.0055)
SIZE	0.0413***
	(0.0057)
LINE_DIV	-0.0045
	(0.024)
GEO_DIV	0.0338*
	(0.0156)
LEVERAGE	0.1772***
	(0.0484)
REINSURANCE	0.0063
	(0.0183)
MUTUAL	0.0742
	(0.0524)
PUBLIC	0.0016
	(0.0198)
INSOLV_RISK	0.002
	(0.0094)
LONG_TAIL	0.0369*
	(0.0185)

Year=2012	0.0089*
	(0.0036)
Year=2013	0.0192***
	(0.0043)
Year=2014	0.0269***
	(0.0061)
Year=2015	0.0238***
	(0.0064)
Year=2016	0.0176*
	(0.0077)
Constant	-0.8273***
	(0.1199)
R-squared	0.3089

CONCLUSION

This paper examines whether ceding insurers' moral hazard behavior affects reinsurers' profitability and underwriting risk. We use ceding insurers' CSR rating as a proxy for ceding insurers' moral hazard behavior. First, we examine whether reinsurers offer a more favorable price for ceding insurers with less moral hazard behavior expectation. Specifically, we examine the relation between reinsurance price and ceding insurers' CSR rating. We find that reinsurers do not offer favorable price to ceding insurers with higher CSR rating. We confirm the findings from Doherty and Smetters (2005) that reinsurers control for moral hazard by using experience rating and monitoring.

We further examine the impact of the increase in reinsurance supply to high-CSR ceding insurers on reinsurers' profitability and underwriting risk. Due to growing incidents of natural disasters[55] and climate change law suits[56], moral hazard behavior of ceding insurers could greatly affect reinsurers' profitability and underwriting risk. We find that assuming greater risk from high-CSR ceding insurers increases reinsurers' operating performance, but has no effect on reinsurers' underwriting expense and risk. The finding provides limited evidence that reinsurers' performance is affected by ceding insurers' moral hazard behavior.

As incidents of natural disasters and climate change law suits are increasing year after year (Insurance Information Institute, 2021; Hodges, Leatherby, and Mehotra, 2018), we assume that the impact of ceding insurers' moral hazard behavior on reinsurers' financials are growing as well. However, we provide evidence that reinsurers well control for ceding insurers' moral hazard

[55] See Insurance Information Institute (2021).
[56] See Hodges, Leatherby, and Mehotra (2018).

behavior with the use of experience rating and monitoring, and thus, does not have impact on reinsurers' operation performance.

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