Reinsurance and sustainability: Evidence from international insurers

Abstract

Reinsurance is an integral transaction to the insurance business and carries real economic consequences. While the previous literature on risk management has examined the effects from reinsurance, in more recent years there is a growing interest on the topic of sustainability and its consequences on corporate risk taking. In this article we analyze a sample of international insurers between 2013 and 2022. We show that the purchase of reinsurance is negatively related to their sustainability, as measured by environmental, social, and governance (ESG) scores. Furthermore, we illustrate that insurers' losses decrease in higher levels of reinsurance and sustainability. However, while reinsurance brings down insurers' profitability, sound ESG scores are related to lower expenses and increasing profitability. Our interpretation is that strong ESG profiles may serve as a cheaper alternative to reinsurance in order to mitigate claim risk. These findings support the previous views that sustainability has a positive impact on financing costs and valuation.

Keywords: ESG, reinsurance, sustainability

JEL classification: G22

Declaration of conflicting interests: The Author declares that there is no conflict of interest.

1 Introduction

Boards of insurance companies are increasingly aware of the importance of incorporating environmental, social, and governance (ESG) considerations in business decisions. As consumers become more conscious about sustainability issues, sustainable practices become key differentiators in an increasingly competitive insurance landscape. The continued growth of "green" and sustainable funds means insurers must actively monitor and promote their ESG ratings to retain full access to capital and manage the potential impacts on their stock price.

Insurance supervisors and regulators across jurisdictions have incorporated sustainability into the instructions and guidelines to the sector. Launched at the 2012 United Nations Conference on Sustainable Development, the United Nations Environment Programme Finance Initiative Principles for Sustainable Insurance (UNEP FI PSI) serve as a global framework for the insurance industry to address environmental, social and governance risks and opportunities. The principles underlying the concept of sustainable insurance have the objectives to reduce risk, develop innovative solutions, improve business performance, and contribute to environmental, social and economic sustainability (UNEP FI, 2012). Scordis et al. (2014) suggest that pursuing the PSI in order to manage emerging perils and challenges in insurance operations would contribute to expand the practice of risk management. The implementation of the PSI has spurred insurance supervisors and regulators to incorporate sustainability into the way they oversee the sector. For example, the Prudential Regulation Authority (PRA) in the UK and the European Union's European Insurance and Occupational Pensions Authority (EIOPA) have made it explicitly clear that they expect insurance companies to model and quantify the impact of ESG factors in their regular Solvency II stress-testing exercises and to report on the results (PRA, 2019; EIOPA, 2019). The US Securities and Exchange Commission (SEC) has released updates on its climate disclosure requirements (SEC, 2022), while the National Association of Insurance Commissioners (NAIC) released an updated climate risk disclosure (NAIC, 2022a).

Despite the growing attention from regulators and leaders in the industry towards the topic of sustainability, the academic literature on ESG practices in insurance is scarce,

and many aspects related to ESG performance lack of interpretation. Arguably, corporate sustainability is likely to influence several strategic decisions of insurers. In this article we focus on reinsurance. As insurers' claim payments are highly stochastic, the residual claim risk that remains on insurers after diversification and other risk management tools is considerable. Therefore, an insurer uses reinsurance to transfer part of its risk to a third-party, while at the same time benefiting from advantages like for example the access to real services or tax advantages.[1]

We ask whether the primary insurer's purchase of reinsurance is affected by its sustainability. In fact, both reinsurance and sustainability contribute to determine the insurer's risk profile and access to capital markets. Therefore, our goal is to test the relationship between these two aspects. We analyze a sample of world-wide insurers during the period 2013-2022 using the ESG scores provided by Standard and Poor's Capital IQ as an indicator for corporate sustainability. We show that the purchase of reinsurance decreases in the ESG score. Furthermore, we illustrate that loss ratios decrease in ESG scores and in reinsurance, i.e. both sustainability and reinsurance make primary insurers more stable. However, these two aspects sort opposite effects on profitability: While the return on assets correlate positively with ESG ratings, we show that a huge purchase of reinsurance increases operating expenses lowering profitability. We interpret these findings arguing that primary insurers can exploit sustainability as a cheaper alternative to reinsurance for risk management. Sustainable insurers would obtain funds at cheaper costs and would have a lower incentive to shift their claim risk to third-party reinsurers. This implies that sustainable insurers benefit from savings on capital expenses, while at the same time they are less exposed to the risk that reinsurers have troubles in fulfilling the contractual obligations.

Our results deliver new knowledge about sustainable insurance. In fact, only in recent years the topic of sustainability has become a growing concern for academics, regulators,

[1]Reinsurance, often referred to as "insurance for insurance companies", is a contract between a reinsurer and an insurer. In this contract, the insurance company – the cedent – transfers risk to the reinsurance company, and the latter assumes all or part of one or more insurance policies issued by the cedent. Reinsurance contracts may be negotiated with a reinsurer or arranged through a third party; i.e., a reinsurance broker or intermediary. Insurers may buy reinsurance for the following motives: 1) expanding the insurance company's capacity, 2) stabilizing underwriting results, 3) financing, 4) providing catastrophe protection, 5) withdrawing from a line or class of business, 6) spreading risk, and 7) acquiring expertise (NAIC, 2022b).

and practitioners in the industry. As a consequence, the data on corporate sustainability are quite limited and empirical researchers face the challenge of providing robust results. By analyzing world-wide insurers during the period 2013-22 we show results for alternative measures of reinsurance, also testing their relationship to the three separate environmental, social, and governance pillars.

The literature has examined more often the impact of ESG scores inside non financial companies than inside financial companies, primarily because financial intermediaries present considerable differences in the accounting systems and regulation, therefore it seems appropriate to analyze them separately. Nonetheless, the more recent literature focused on the financial sector examines mainly banking firms, whereas the evidence for insurance firms is still much narrow. Therefore, this article contributes to explain sustainable insurance, showing that sustainable practices may have an important impact on reinsurance, i.e. a transaction which is integral to the insurance business and carries real economic consequences. For all these reasons this article delivers important insights to risk managers and regulators.

The article is organized as follows. Section 2 reviews the literature and states the working hypothesis. Section 3 describes the data and the variables that we use in the analysis. Section 4 shows the results. Section 6 concludes.

2 Literature and working hypothesis

The demand for reinsurance is often explained with an expected bankruptcy costs argument: Reinsurance purchases may protect the insurer from huge unexpected losses and therefore reduce the probability of insolvency. Lowering the insurer's underwriting risk, reinsurance would ultimately bring relieves to capital levels and financing costs.[2] Several

[2]Hoerger et al. (1990) provide a theoretical framework that explains why risk-neutral insurers purchase reinsurance even though it reduces their expected profit. In the model the level of excess loss reinsurance is chosen to maximize the discounted value of policyholders' and stockholders' claims against the insurance company. The optimal amount of reinsurance purchased results to be the highest excess loss reinsurance level that guarantees that the insurer will not go bankrupt. This maximizes the value of policyholders' claims at the minimum cost in terms of stockholders' value due to the reinsurance premium. As regarding the impact of reinsurance on capital, Gurenko and Itigin (2013) show that increasing their reinsurance protection, European insurers would reduce their net retained risk exposure while restoring the solvency capital requirements back to the level of that required under Solvency I, which was replaced in 2016 by the more stringent capital requirements of Solvency II.

studies support this argument showing evidence that corporate demand for insurance increases in bankruptcy costs using size as a proxy (Garven and Lamm-Tennant, 2003; Weiss and Chung, 2004; Cole and McCullough, 2006). Prior research shows that other factors contribute to determine the demand of reinsurance, like taxes (D'Arcy and Garven, 1990; Mayers and Smith Jr, 1990; Garven and Lamm-Tennant, 2003), investment incentives (Mayers and Smith Jr, 1990; Cole and McCullough, 2006; Powell and Sommer, 2007), and the availability of real services (Cole and McCullough, 2006). Finally, the literature has related the purchase of reinsurance also to the cedent company's organizational form, business mix, and group affiliation (Mayers and Smith Jr, 1990; Cole and McCullough, 2006; Powell and Sommer, 2007).[3]

However, scholars have pointed out that reinsurance would be expensive, as primary insurers need to trade off costs and benefits from reinsurance.[4] For example, in the model proposed by Jean-Baptiste and Santomero (2000) the premium for reinsurance reflects both the true riskiness of the primary insurer's policies that are being reinsured, as well as the noisiness of the reinsurer's signal regarding the true quality of the reinsured business. This noisiness arises as a result of asymmetric information between the insurer and the reinsurer. The insurer has more information than the reinsurer regarding the risk being transferred, and also more control over the final outcome of the risk. This asymmetric information ultimately results into high reinsurance premiums. Froot (2001) argues that reinsurance prices often deviate widely from their fair value, i.e. from the actuarial price for the risk undertaken, and that this gap is likely due to market imperfections in the supply-side of capital and to reinsurers' exercise of market power. In line with this argument, Cummins et al. (2021) show that huge amounts of reinsurance increase significantly the costs for producing insurance services while reduce the volatility of losses inside US insurers. Likewise, Lei (2019) finds that the return on equity of US insurers decreases in the utilization of reinsurance. Finally, Powell and Sommer (2007) use data from US

[3] Mayers and Smith Jr (1990) contend that the purchase of reinsurance by an insurance company is comparable to the purchase of insurance by firms in other industries. They show that the factors driving the demand for reinsurance include expected costs of financial distress, the tax code, the insurer's ownership structure, investment incentives, information asymmetry, and comparative advantages in real service production.

[4] Upreti et al. (2022) show that use of reinsurance lowers the cost of equity capital but in a non-linear way, and that the magnitude of this effect varies with the company's exposure to financial distress risk.

insurers to separate companies that are affiliated to groups versus stand-alone companies, and test reinsurance costs for the two groups. The authors show that stand-alone insurers face high costs for external reinsurance which reflect information and agency problems. In contrast, affiliated insurers can buy internal reinsurance at cheaper prices.

In this article we raise the question whether insurers' purchase of reinsurance is explained by their sustainability. In fact, the global interest in sustainability suggests that ESG practices contribute to determine the corporate risk taking, thereby affecting capital costs and valuation. Gianfrate et al. (2015) provide a review of the literature on the relationship between sustainability and the cost of capital. The results vary with the data sets and methodologies, yet the majority of the studies finds a negative and significant correlation between the two. A recent study based on the Morgan Stanley Capital International (MSCI) ratings during 2015-2019 shows that companies with high ESG scores, on average, experienced lower costs of capital compared to companies with poor ESG scores in both developed and emerging markets (MSCI, 2020).[5] Friede et al. (2015) survey about 2,200 empirical papers on the topic of corporate valuation, concluding that in the large majority of the articles better performances relate to sound ESG characteristics.

Overall, the previous research suggests that sustainability lowers the cost of capital thereby increasing corporate valuations. According to Giese et al. (2019) the positive transmission of ESG into company valuation and performance follows two channels. The first channel is a reduction of idiosyncratic risk: Sustainability gives to the company a competitive advantage which enhances cash flows and profitability, and makes risk management more efficient also reducing exposure to tail risk. The second channel follows

[5] Edmans (2021) argues that the relationship between sustainability and the cost of capital depends from several factors that do not point unambiguously to one direction. First, it is not granted that sustainability affects systemic (i.e. not diversifiable) risk, which ultimately determines capital costs. Second, sustainability is an intangible asset which entails lower value during economic downturns, therefore the relationship between sustainability and the cost of capital may be time variant. Finally, capital costs are much difficult to estimate: Using realized (i.e. ex post) returns to approximate expected (i.e. ex ante) returns would provide a poor measure for equity capital costs, as realized returns could either result from high expected returns (so-called "cost of capital channel") or high unexpected returns (so-called "cash flow channel"). In conclusion, Edmans (2021) argues that it is difficult to establish a priori whether sustainable firms would benefit from cheaper financing costs.

through systemic risk, as sustainability makes firms less vulnerable to market-wide shocks, therefore lowering capital costs.[6]

While the topic of sustainability is at the center of the most recent debates among policy makers and academics, the empirical evidence for the financial sector is much narrow compared to the evidence for non-financial industries, primarily because financial firms are substantially different in their accounting systems and regulation from other businesses, therefore it seems appropriate to analyze them separately. A few studies examine ESG ratings of banks (see, among others, Miralles-Quirós et al. (2019) and Finger et al. (2018)), while the evidence for insurers is more narrow. Brogi et al. (2022) use data from US insures during the period 2010-2018 to test the main aspects that determine insurers' ESG "awareness", i.e. the implementation of specific policies to address all areas of ESG issues.

Based on the insights from the previous literature, we conclude that insurers may reduce their income volatility through reinsurance and sustainability. Reducing claims fluctuations is important for insurers, as they are subject to adverse claims fluctuation because of single large claims, or the claim accumulation in one catastrophic event, or a large number of claims in a year. Large claims fluctuation leads to volatile profit and an uncertain solvency position. Despite the relevance of this topic, the previous research has never questioned whether reinsurance and sustainability interact with each other. This article aims to fill this gap of knowledge by developing the following working hypothesis, which we will test in the next section analyzing data from worldwide insurers. We expect that, if insurers' income volatility is effectively controlled by sustainable practices, the additional benefits from ceding risk to reinsurers may be minimal, resulting in a decreased purchase of reinsurance. Empirically, this means observing that sustainability and reinsurance are negatively correlated. Therefore, we summarize our hypothesis as follows:

Working hypothesis: If an insurer can use sustainability as an alternative to reinsurance for stabilizing income volatility and mitigate claim risk, we should observe that the

[6] He et al. (2023) use data from Chinese firms during 2010-2020 to show that a good ESG performance significantly reduces the corporate risk-taking.

insurer's purchase of reinsurance decreases in the ESG score.

In general, risk management reduces systematic risk through mitigating countercyclical deadweight costs, and any improvement in the risk management approach should reduce the insurer's cost of capital (Hann et al., 2013; Berry-Stölzle and Xu, 2018). As reinsurance and sustainable policies belong to the risk management tools available to insurers, we expect that they will impact on financing costs. However, the literature has often highlighted the fact that reinsurance carries substantial costs to insurers. Therefore, in the following analysis we will take this issue into consideration, by testing the effect from reinsurance and sustainability on measures for insurers' profitability.

If the working hypothesis is valid, it means that sustainable insurers have low incentives to buy reinsurance, and may avoid that reinsurance costs could harm their profitability. However, this also implies that sustainable insurers would forego the potential benefits correlated with the use of reinsurance, as for example tax advantages and real services availability. Differently, if the working hypothesis is not plausible, we should observe the opposite pattern that reinsurance increases in sustainability, i.e. they are complement.

Addressing the interaction of sustainability with reinsurance, and testing the validity of our working hypothesis on real data is important for a deeper understanding of shareholders' consideration of ESG factors in investment decision-making. With no one theory able to explain this process, the academic literature on ESG has focused only on a few number of themes, therefore providing only a limited understanding of the motivations that drive firms to incorporate ESG policies in their business (Capelle-Blancard and Monjon, 2012; Daugaard, 2020; Huang, 2022). This lack of knowledge is more evident for financial firms, and for insurers in particular. Therefore, by dealing with reinsurance, the following analysis contributes to understand an activity specific to the insurance sector, which is likely to be affected by ESG policies.

3 Data and variables

We use Standard and Poor's Capital IQ and select all insurance companies for which the database provides annual information on their ESG scores for at least one year during the period 2013-2022. From the same database, for each company we download accounting data available at annual frequency, in order to measure the purchase of reinsurance and other company specific characteristics. The accounting data are taken from the Standard and Poor's Capital IQ library denominated "universal insurance financials", which provides accounting figures for companies from all regions in the world, classified into Africa, Asia-Pacific, Europe, Latin America and Caribbean, Middle East, and United States and Canada. We eliminate firms whose values on certain variables are at the top or bottom 1% of the values, following a winsorization of variables commonly used in the literature to remove the potential effects of outliers, as for example done by Cole and McCullough (2008) and Lei (2019) who analyze data from insurance companies. Overall, our sample counts a total number of 1,313 firm-year observations and spans all branches of insurance, classified into: Financial guaranty insurance, life and health insurance, managed care insurance, mortgage guaranty insurance, multiline insurance, property and casualty insurance, and title insurance. Appendix reports the complete list of companies that we analyze.

The ESG score computed by Standard and Poor's Capital IQ reflects the company performance on and management of key environmental, social, and governance (ESG) issues. All ESG scores are discrete numbers ranging 0-100, and reflect the performance of a company according to an industry specific assessment methodology and aggregation schemes. As we use the ESG score as an explanatory variable inside regression models, we denote with the variable ESG the natural logarithm of the ESG score. This transformation reduces the large variability in the original series of ESG scores, and allows us to interpret the estimated coefficients as the percentage change in the dependent variable following a one-percentage change in the ESG rating.

We approximate the insurer's purchase of reinsurance with the ratio of reinsurance ceded premiums to gross premiums, which include direct premiums written and reinsurance premiums assumed. We implement two versions of this ratio: The variable $REINS1$

is the ratio of ceded earned premiums to gross earned premiums, while $REINS2$ is the ratio of ceded premiums written to gross premiums written. $REINS1$ and $REINS2$ approximate the so-called "reinsurance ratio", which in the literature is a standard measure for the purchase of reinsurance (Mayers and Smith Jr, 1990; Garven and Lamm-Tennant, 2003; Cole and McCullough, 2006; Powell and Sommer, 2007; Shiu, 2011; Mankaï and Belgacem, 2016; Cummins et al., 2021; Upreti et al., 2022). When a company has a high reinsurance ratio it means the company has transferred a considerable part of its claim risk to a third-party reinsurer, i.e. the degree of risk retention is inversely proportional to the reinsurance ratio. Using the data available in Standard and Poor's Capital IQ the variable $REINS1$ can be calculated for insurance companies from all geographical locations, while $REINS2$ can be calculated only for European and United States insurance companies. For this reason in the other geographical locations $REINS2$ is reported in Table 1 as not available ("n.a.").

In the robustness section we estimate regression models for the loss ratio, the expense ratio, and the return on assets of our companies. The loss ratio LR is calculated as losses incurred in claims (paid to the insured for damages when the risk event happens) plus adjustment expenses incurred by the company for investigating and settling insurance claims, all divided by the premiums earned during the period. The expense ratio ER is the sum of all costs for acquiring, writing and servicing insurance divided by the premiums during the period. ROA is the the ratio of net income over total average assets.

Finally, in the regression models we include measures for the company's size and leverage, to control for two important factors explaining the purchase of reinsurance. We define the variable $SIZE$ as the natural logarithm of total assets and it works as an approximation of bankruptcy costs. Firm size would be inversely related to the cost of capital because information on larger firms is more readily available than information on smaller firms (Berry-Stölzle and Xu, 2018). There is indeed substantial empirical evidence on a negative relationship between firms' size and capital costs (among others see Gebhardt et al. (2001) and Hou et al. (2012)). If the increasing size reduces bankruptcy costs, then we expect that bigger insurance companies would have a lower incentive to buy reinsurance compared to smaller companies, in line with the evidence that insurance

demand is negatively related to size (Mayers and Smith Jr, 1990; Hoyt and Khang, 2000; Garven and Lamm-Tennant, 2003; Weiss and Chung, 2004). DE is the book value of debt divided by the book value of equity, and approximates the company's financial leverage.[7] Leverage is expected to affect the probability of bankruptcy. Carson and Hoyt (1995) illustrate that there is an optimal level of leverage, after which additional increases in leverage push upwards the default probability and decrease firm value. Leverage affects also the costs for the company's funding. Modigliani and Miller (1958) theorize that a firm's cost of equity, unlike its average cost of capital, is positively associated with its leverage. Fama and French (1992) empirically demonstrate that the ex post mean stock returns are an increasing function of firms' leverage, while more recently Dhaliwal et al. (2006), among others, document a positive relationship between measures of implied cost of equity and leverage. We expect that firms with a high DE have a stronger motive for using reinsurance in order to diminish expected bankruptcy costs and financing costs (Shiu, 2011). In addition, leverage works also as a proxy for the underinvestment problem of Myers (1977). Mayers and Smith Jr (1990) hypothesize that the use of reinsurance can potentially reduce underinvestment by transferring to the reinsurer some of the uncertainty resulting from potential large losses. Both Mayers and Smith Jr (1990) and Powell and Sommer (2007) test this hypothesis using leverage as a proxy for underinvestment problems.

We control for additional aspects that may influence the interplay between reinsurance and corporate sustainability. Prior research shows that taxation plays a role in explaining the purchase of reinsurance. Smith and Stulz (1985) contend that firms facing convex tax schedules have incentives to use reinsurance in order to reduce the volatility of their taxable income and thereby lower expected tax liabilities. Instead, Adiel (1996) illustrate that taxes and reinsurance are positively correlated. The argument is that reinsurance enhances the current reported earnings via the receipt of reinsurance commissions and so increases tax liabilities. Consequently, if tax matters, then insurance firms with high marginal tax rates should use less reinsurance than those with low marginal tax rates. To control for taxation, we compute the company's effective tax rate TAX, namely income

[7] We have tested also a measure for operating leverage computed as the ratio between premiums and equity surplus, obtaining results (available upon request) similar to the results reported in our tables.

tax provisions divided by net income before taxes and capital gains but after dividends to policyholders. We approximate growth opportunities with the variable PB, i.e. the ratio of stock price to book value per share. Firms with a high PB are considered relatively young firms, with good future prospects that result into lower systematic risk and financing cost. Given the lower risk, we expect that PB would be negatively correlated to reinsurance. We also include the dividend payout ratio DIV calculated as dividends declared during the year divided by earnings per share. Howatt et al. (2009) show that dividend increases signal a shift in the variance of earnings per share. Therefore, our conjecture is that dividend payers may be willing to purchase reinsurance in order to smooth income variability.

Table 1 reports variables' descriptive statistics separating the companies into different geographical regions. European insurers are the most sustainable, as the median ESG equals to 40. US insurers are much less sustainable, as the median ESG in the US equals to 24. As we disentangle the ESG pillars, the larger gap between Europe and US corresponds to the environmental rating (E), which is 42 in Europe while 12 in the US. US insurers instead purchase more reinsurance than European insurers, as $REINS1$ is respectively 0.10 and 0.06 in the two regions.[8]

[8]The International Association of Insurance Supervisors (IAIS) reports that the US reinsurance market was the largest in the world during the years 2019-2021 (IAIS, 2022).

Table 1: Descriptive statistics for insurers during 2013-2022 classified by geographical location. See Appendix Table 12 for the definitions of all variables.

Geographical location	Mean	Median	Min	Max	Sd
Africa					
ESG	36.16	36	11	64	14.7300
E	39.16	43	0	74	20.0911
S	28.60	28	1	59	16.6723
G	41.44	41	17	67	13.5645
*REINS*1	0.1201	0.1117	0.0433	0.3014	0.0698
*REINS*2	n.a.	n.a.	n.a.	n.a.	n.a.
LR	0.5901	0.6130	0.4980	0.6930	0.0671
ER	0.2905	0.2885	0.2750	0.3100	0.0129
ROA	0.0212	0.0158	-0.0005	0.0600	0.0183
Total assets	477.00($mil)	447.00($mil)	30.40($mil)	3050.00($mil)	530.00(mil)
DE	0.3278	0.3231	0.0436	0.8503	0.2005
TAX	0.3736	0.3129	0.1477	0.8850	0.1964
PB	1.9929	1.8173	0.7522	3.7125	0.7882
DIV	0.8170	0.5280	0.1421	8.7234	1.4965
Asia-Pacific					
ESG	40.31	28	0	88	27.5436
E	36.83	22	0	98	34.3578
S	38.83	27.5	0	95	28.6390
G	43.93	40	1	88	25.6232
*REINS*1	0.0880	0.0620	0.0061	0.6229	0.0943
*REINS*2	n.a.	n.a.	n.a.	n.a.	n.a.
LR	0.6624	0.6480	-0.0220	0.9729	0.1297
ER	0.2968	0.3100	0.1291	0.8210	0.0826
ROA	0.0169	0.0119	-0.0005	0.0732	0.0175
Total assets	1,019.38($mil)	87.30($mil)	29,549($)	1,160($mil)	2,190(mil)
DE	0.5033	0.3479	0.0400	1.9400	0.5053
TAX	0.2169	0.2461	-0.9084	0.6797	0.1458
PB	1.3908	0.9015	0.0076	7.2823	1.3003
DIV	0.5291	0.3727	0.0105	8.2893	0.6671
Europe					
ESG	48.45	40	6	91	25.2321
E	49.51	42	0	98	29.8600
S	42.38	31	2	95	27.5864
G	53.88	50	10	91	22.7997
*REINS*1	0.1157	0.0631	0.0001	0.6229	0.1389
*REINS*2	0.2099	0.1958	0.1803	0.2561	0.0282
LR	0.6597	0.6645	0.3327	0.8456	0.0632
ER	0.2617	0.2803	0.0991	0.3900	0.0691
ROA	0.0158	0.0094	-0.0005	0.0732	0.0151
Total assets	232.07($mil)	132.00($mil)	591,631($)	1,140($mil)	246.00(mil)
DE	0.6115	0.4998	0.0411	1.7000	0.4119
TAX	0.2110	0.2072	-0.3209	0.9634	0.1184
PB	1.6367	1.1790	0.2919	7.4568	1.2740
DIV	0.7644	0.5996	0.0531	5.4499	0.6881
Latin America and Caribbean					
ESG	18.64	9	0	61	19.4812

E	13.84	0	0	75	24.0100
S	17.92	9	0	61	20.9500
G	21.28	13	1	56	18.3263
$REINS1$	n.a.	n.a.	n.a.	n.a.	n.a.
$REINS2$	0.0024	0.0024	0.0001	0.0047	0.0033
LR	0.7185	0.7185	0.6950	0.7420	0.0332
ER	0.2880	0.2880	0.2621	0.3140	0.0368
ROA	0.0455	0.0552	-0.0005	0.0732	0.0267
$Total\ assets$	26.95($mil)	16.70($mil)	531,374($)	76,00($mil)	26.70($mil)
DE	0.2472	0.2113	0.0436	0.6382	0.1835
TAX	0.0804	0.0988	-0.0333	0.1757	0.1057
PB	0.5549	0.5578	0.5428	0.5641	0.0109
DIV	0.3748	0.2612	0.0000	1.0461	0.3391
Middle East					
ESG	7.714	7	1	21	5.4321
E	1.6	0	0	19	4.3232
S	6.886	5	0	27	7.2430
G	10.49	9	2	24	6.2840
$REINS1$	0.1463	0.1395	0.0061	0.4918	0.1092
$REINS2$	n.a.	n.a.	n.a.	n.a.	n.a.
LR	0.6620	0.6760	0.5411	0.7700	0.0794
ER	0.3395	0.3305	0.3200	0.3600	0.0187
ROA	0.0195	0.0136	-0.0005	0.0482	0.0154
$Total\ assets$	42.25($mil)	14.30($mil)	2.76($mil)	146.00($mil)	49.80(mil)
DE	0.5309	0.4273	0.0399	1.8800	0.5556
TAX	0.2310	0.2440	0.0373	0.3403	0.0789
PB	2.2443	1.7057	0.5389	4.9709	1.3430
DIV	0.4287	0.3653	0.1884	0.8607	0.1957
United States and Canada					
ESG	28.75	24	5	79	18.0211
E	21.36	12	0	94	23.9523
S	19.94	14	0	82	19.0000
G	39.17	38	10	87	17.7934
$REINS1$	0.1512	0.1015	0.0001	0.6229	0.1428
$REINS2$	0.1792	0.1534	-0.0286	0.7453	0.1483
LR	0.5622	0.6280	-0.4653	1.1390	0.2303
ER	0.3292	0.3140	0.1800	1.1960	0.1148
ROA	0.0256	0.0199	-0.0005	0.0732	0.0230
$Total\ assets$	113.25($mil)	33.30($mil)	257,200($)	941.00($mil)	193.00(mil)
DE	0.4461	0.3477	0.0490	1.9700	0.3430
TAX	0.1698	0.1976	-2.3510	1.4015	0.2484
PB	1.7228	1.3698	0.1248	7.2000	1.2270
DIV	0.3654	0.2398	0.0000	8.0483	0.6952

In Table 2 we compute descriptive statistics for companies separated into quartiles of ESG: Firms in the first (fourth) quartile have low (high) ESG ratings and are the least (most) sustainable firms. We observe a substantial difference in the purchase of reinsurance between the first quartile and the fourth quartile: For the least sustainable firms the median $REINS1$ and $REINS2$ are respectively 0.11 and 017, while for the

most sustainable firms these values are 0.06 and 0.00, i.e. reinsurance inside sustainable insurers is very little.

Table 2: Descriptive statistics for insurers during 2013-2022 classified by quartiles of ESG. See Appendix Table 12 for the definitions of all variables.

Quartiles of ESG	Mean	Median	Min	Max	Sd
Quartile 1					
ESG	10.5700	11	0	17	4.2170
E	2.5350	0	0	34	5.6490
S	5.6350	4	0	26	5.4780
G	16.6100	17	1	33	6.8760
$REINS1$	0.1591	0.1117	0.0001	0.6229	0.1492
$REINS2$	0.2217	0.1792	-0.0286	0.7453	0.1770
Quartile 2					
ESG	23.28	23	18	29	3.3230
E	15.06	13	0	55	10.5100
S	15.96	16	3	37	6.0261
G	34.67	35	12	54	8.6734
$REINS1$	0.1402	0.0793	0.0001	0.6229	0.1438
$REINS2$	0.1612	0.1632	-0.0286	0.3593	0.0992
Quartile 3					
ESG	39.86	38	30	55	7.6771
E	37.4	37	0	81	16.4234
S	31.63	30	11	59	9.7022
G	48.64	49	26	73	9.0724
$REINS1$	0.1082	0.0665	0.0006	0.6229	0.1171
$REINS2$	0.1170	0.0886	0.0006	0.3784	0.0965
Quartile 4					
ESG	73.02	75	56	91	9.5146
E	76.72	79	13	98	14.2111
S	70.3	72	43	95	12.7445
G	74.23	74	50	91	8.4568
$REINS1$	0.1064	0.0656	0.0001	0.6229	0.1094
$REINS2$	0.0006	0.0005	0.0005	0.0007	0.0001

4 Results

4.1 Regressions of reinsurance on sustainability

We conduct a regression analysis to test whether insurers' purchase of reinsurance is explained by their sustainability. In Table 3 we report the coefficients estimated from pooled OLS regressions of reinsurance on ESG scores. In Tables 4 we estimate the same models adding control variables for the company's size ($SIZE$), leverage (DE), taxes (TAX), growth options (PB), and dividends (DIV). In Tables 5-6 we implement panel regressions, which include firm and year fixed effects.[9]

[9]In our panel regressions we indicate with "firm FE" a set of dummy variables taking value of one for each company, while zero otherwise. Instead "time FE" means that the regression includes a set of dummy variables taking value of one in year t, while zero otherwise. In all our tables we report statistical significance based on standard errors clustered by company. We have tested that the quality

The sign on ESG is negative in all the Tables 3-6, and is highly significant except for one regression. This means that more sustainable insurers transfer less risk to reinsurers. As we separate the three ESG pillars and test the separate effect on reinsurance, we find that the governance and the social scores have stronger and more significant coefficients compared to the environmental score. A recent study of Morgan Stanley Capital International (MSCI) shows that the cost of equity as well the cost of debt decrease in the ESG rating (MSCI, 2020). The authors argue that debt costs are more tightly related to the governance rating rather than to the environmental and social rating. In fact, a strong governance score indicates a low risk of default which reduces the cost of debt (Switzer et al., 2018).

The sign on the variables controlling for size and leverage are in line with our expectations. In fact, $SIZE$ is negative and significant inside most of the regressions, i.e. large insurers purchase less reinsurance than small firms, in line with previous findings in the literature (Mayers and Smith Jr, 1990; Hoyt and Khang, 2000; Garven and Lamm-Tennant, 2003; Weiss and Chung, 2004). The positive sign on DE suggests that highly levered insurers buy huge amounts of insurance, consistent with the argument that a high leverage increases the probability of insolvency and underinvestment problems (Cole and McCullough, 2006). The negative tax effect (significant only in the OLS models) is consistent with the result documented by Adams et al. (2008) for United Kingdom insurers, and by Cole and McCullough (2006) for United States insurers.

of the results does not change as we cluster the standard errors by geographical region. These results are available upon request.

Table 3: OLS regressions of reinsurance on ESG scores. See Appendix Table 12 for the definitions of all variables included in the models. Standard errors are clustered at the company level and are reported in parenthesis.

Regressors	(1) $REINS1$	(2) $REINS1$	(3) $REINS1$	(4) $REINS1$	(5) $REINS2$	(6) $REINS2$	(7) $REINS2$	(8) $REINS2$
ESG	-0.0231**				-0.0957***			
	(0.0120)				(0.0316)			
E		-0.0123				-0.0196		
		(0.0100)				(0.0214)		
S			-0.0233***				-0.0468***	
			(0.0097)				(0.0155)	
G				-0.0220*				-0.1060***
				(0.0131)				(0.0381)
R-squared	0.0171	0.0081	0.0326	0.0151	0.1198	0.0269	0.1095	0.1012

Table 4: OLS regressions of reinsurance on ESG scores and control variables. See Appendix Table 12 for the definitions of all variables included in the models. Standard errors are clustered at the company level and are reported in parenthesis.

Regressors	(1) $REINS1$	(2) $REINS1$	(3) $REINS1$	(4) $REINS1$	(5) $REINS2$	(6) $REINS2$	(7) $REINS2$	(8) $REINS2$
ESG	-0.0141*				-0.1255***			
	(0.0139)				(0.0291)			
E		-0.0122				-0.0348**		
		(0.0111)				(0.0131)		
S			-0.0130*				-0.0547***	
			(0.0126)				(0.0141)	
G				-0.0072*				-0.1197***
				(0.0143)				(0.0396)
$SIZE$	-0.0189**	-0.0078	-0.0059	-0.0195**	-0.0296*	-0.0197*	0.0026	-0.0128*
	(0.0091)	(0.0073)	(0.0064)	(0.0084)	(0.0127)	(0.0202)	(0.0131)	(0.0102)
DE	0.0303**	0.0121	0.0232	0.0301	0.0843*	-0.1723	0.1911	0.1404**
	(0.0251)	(0.0264)	(0.0285)	(0.0254)	(0.0899)	(0.1164)	(0.1282)	(0.0603)
TAX	-0.1065***	-0.1000***	-0.0923***	-0.1083***	-0.2377*	-0.2145**	-0.2300*	-0.2191**
	(0.0321)	(0.0202)	(0.0333)	(0.1136)	(0.0321)	(0.0245)	(0.0389)	(0.0297)
PB	0.0016	0.0009	0.0016	0.0007	0.0128	0.0109	0.0111	0.0200
	(0.0152)	(0.0202)	(0.0152)	(0.0152)	(0.0245)	(0.0320)	(0.0298)	(0.0222)
DIV	0.0197**	0.0159*	0.0191**	0.0189*	0.0315**	0.0322**	0.0297*	0.0278**
	(0.0088)	(0.0092)	(0.0084)	(0.0082)	(0.0120)	(0.0143)	(0.0190)	(0.0188)
R-squared	0.0642	0.0598	0.0751	0.0683	0.2431	0.2231	0.2531	0.2500

Table 5: Panel regressions of reinsurance on ESG scores. See Appendix Table 12 for the definitions of all variables included in the models. Standard errors are clustered at the company level and are reported in parenthesis.

Regressors	(1) $REINS1$	(2) $REINS1$	(3) $REINS1$	(4) $REINS1$	(5) $REINS2$	(6) $REINS2$	(7) $REINS2$	(8) $REINS2$
ESG	-0.0202***				-0.0522**			
	(0.0051)				(0.0211)			
E		-0.0072*				-0.0097*		
		(0.0043)				(0.0063)		
S			-0.0137***				-0.0161***	
			(0.0033)				(0.0052)	
G				-0.0189***				-0.0601**
				(0.0061)				(0.0272)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of companies	146	115	143	146	46	25	43	46
R-squared	0.0891	0.0572	0.0903	0.0829	0.1604	0.1603	0.2511	0.1551

Table 6: Panel regressions of reinsurance on ESG scores and control variables. See Appendix Table 12 for the definitions of all variables included in the models. Standard errors are clustered at the company level and are reported in parenthesis.

Regressors	(1) $REINS1$	(2) $REINS1$	(3) $REINS1$	(4) $REINS1$	(5) $REINS2$	(6) $REINS2$	(7) $REINS2$	(8) $REINS2$
ESG	-0.0218***				-0.0492**			
	(0.0057)				(0.0221)			
E		-0.0078**				-0.0041**		
		(0.0043)				(0.0037)		
S			-0.0147***				-0.0156***	
			(0.0034)				(0.0055)	
G				-0.0240***				-0.0208***
				(0.0061)				(0.0273)
$SIZE$	-0.0124*	-0.0174**	-0.0143*	-0.0128	-0.0268*	-0.0358*	-0.0288	-0.0275
	(0.0095)	(0.0080)	(0.0080)	(0.0080)	(0.0271)	(0.0184)	(0.0190)	(0.0270)
DE	0.0281**	0.0208	0.0209*	0.0119	0.1040*	0.1034**	0.0905*	0.1030*
	(0.0114)	(0.0142)	(0.0122)	(0.0112)	(0.0583)	(0.0432)	(0.0481)	(0.0581)
TAX	0.0087	0.0091	0.0107	0.0126	0.0095	0.0111	0.0097	0.0127
	(0.0106)	(0.0113)	(0.0143)	(0.0103)	(0.0182)	(0.0165)	(0.0178)	(0.0196)
PB	-0.0007	-0.0001	-0.0004	-0.0009	-0.0011	-0.0010	-0.0009	-0.0005
	(0.0044)	(0.0043)	(0.0042)	(0.0039)	(0.0044)	(0.0045)	(0.0045)	(0.0045)
DIV	0.0024	0.0023	0.0024	0.0019	0.0023	0.0022	0.0021	0.0020
	(0.0027)	(0.0027)	(0.0026)	(0.0026)	(0.0025)	(0.0029)	(0.0023)	(0.0022)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of companies	145	113	142	145	46	25	43	46
R-squared	0.1011	0.0902	0.1020	0.0937	0.1776	0.2432	0.2691	0.1721

To explore more deeply how the relationship between reinsurance and sustainability behaves over time, we define $DELTAESG$ as the change of ESG between two consecutive years, i.e. $DELTAESG$ measures how large is the upgrade/downgrade of the company's

ESG rating. The quantities $DELTACEDPREA$ and $DELTACEDPRWR$ denote respectively the annual change (in log terms) of the ceded premiums earned and the ceded premiums written. In the columns(1)-(2) of Table 7 we regress $DELTACEDPR$ and $DELTACEDPRWR$ on $DELTAESG$ to verify if ESG upgrades/downgrades lead to changes in reinsurance. The negative sign on $DELTAESG$ inside both models corroborate our previous results, showing that an upgrade in the ESG rating leads firms to transfer less risk to reinsurers.

Table 7: OLS regressions of annual changes of reinsurance (columns(1)-(2)) and annual rates of reinsurance (columns(3)-(4)). See Appendix Table 12 for the definitions of all variables included in the models. Standard errors are clustered at the company level and are reported in parenthesis.

	(1)	(2)	(3)	(4)
Regression	$DELTACEDPR1$	$DELTACEDPR2$	$RATECEDPREA$	$RATECEDPRWR$
$DELTAESG$	-0.9983*	-0.4518**		
	(0.5041)	(0.1822)		
$DELTASIZE$	0.2730**	0.1938***		
	(0.1294)	(0.0683)		
$DELTAPRWR$	0.3693*	0.4091***		
	(0.2167)	(0.0789)		
$RATEPRWR$			2.3550***	6.1276***
			(0.2754)	(0.6899)
$RATEPRWR \times ESG$			-0.5932***	-1.5691***
			(0.0881)	(0.2193)
Controls	Yes	Yes	Yes	Yes
R-squared	0.3921	0.3726	0.3111	0.5495

In the columns(3)-(4) of Table 7 the dependent variable is the annual rate of reinsurance purchased by the company, computed as the premiums ceded to reinsurers in year $t+1$ minus the premiums ceded in year t divided by the premiums ceded in year t. We calculate the annual rate of purchased reinsurance using the premiums earned ($RATECEDPREA$) as well as the premiums written ($RATECEDPRWR$). The regressors include the annual rate of gross premiums written ($RATEPRWR$) and its interaction with ESG, beside all control variables of Table 4. An insurer with a high $RATEPRWR$ is a firm whose business is growing considerably, and our intuition is that the same firm may have a stronger incentive to buy reinsurance. The interaction term in the model tests if this effect varies with sustainability. That is, the interaction term would tell if sustainable insurers growing in business cede more/less risk to reinsurers.

We observe that the marginal effect from $RATEPRWR$ is positive, as according to our intuition. However, the coefficient on the interaction term is negative, meaning that sustainability decreases the total effect from $RATEPRWR$ (i.e. the marginal effect plus the conditional effect). Our interpretation is that insurers expanding in business and (at the same time) becoming more sustainable are less inclined to shift risk to reinsurers.

4.2 Regressions for the loss ratio, the expense ratio, and the return on assets

We conduct additional regressions in order to corroborate the interpretation of our results. Inside Table 8 we test the effect from sustainability and from reinsurance on the loss ratio LR (columns (1)-(4)-(7)), the expense ratio ER (columns (2)-(5)-(8)), and the return on assets ROA (columns (3)-(6)-(9)). The set of controls is the same as in Table 4. We find that LR decreases significantly in ESG and $REINS1$, suggesting that both sustainability and reinsurance reduce losses and making insurers more stable. The coefficient of ESG is negative on ER while is positive on ROA, meaning that sustainability reduces expenses while improving profitability. The pattern for $REINS1$ is opposite, i.e. reinsurance increases expenses while reducing profitability. As insurers' losses and profitability would be determined at the same time, in Table 9 we estimate simultaneous systems of equations for LR, ER, and ROA following the three-stage least squares method suggested by Zellner and Theil (1962). The coefficients on ESG, $REINS1$, and $REINS2$ have the same sign as in the models estimated separately, and are statistically significant in almost all equations. Therefore, problems of simultaneity do not seem to affect the results much seriously.

We argue that this evidence is consistent with the discussion in section (2). Insurers can use reinsurance and sustainability to reduce income volatility, therefore the two could enhance financial strength reducing the impact of potential losses. However, purchases of reinsurance would involve high costs that could harm the company's profitability. Conversely, a sound ESG profile would improve profitability, in line with the argument that sustainability has a strong positive effect on cash-flows (Giese et al., 2019).

Table 8: OLS regressions for the expense ratio (columns (1)-(4)-(7)), loss ratio (columns (2)-(5)-(8)), and return on assets (columns (3)-(6)-(9)) on ESG scores, reinsurance, and control variables. See Appendix Table 12 for the definitions of all variables included in the models. Standard errors are clustered at the company level and are reported in parenthesis.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Regressors	*ER*	*LR*	*ROA*	*ER*	*LR*	*ROA*	*ER*	*LR*	*ROA*
ESG	-0.0227***	-0.0187*	0.0023***						
	(0.0060)	(0.0100)	(0.0010)						
*REINS*1				0.1622***	-0.1480***	-0.0175***			
				(0.0351)	(0.0512)	(0.0045)			
*REINS*2							0.2761***	-0.2715***	-0.0299***
							(0.0597)	(0.0952)	(0.0111)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.0566	0.1911	0.4794	0.0521	0.2232	0.4747	0.1541	0.3611	0.4383

Table 9: Symultaneous systems of equation for the expense ratio, loss ratio, and return on assets explained by ESG scores, reinsurance, and control variables. See Appendix Table 12 for the definitions of all variables included in the models. Standard errors are reported in parenthesis.

	(1)	(2)	(3)	(4)	(5)	(6)
	System of equations			System of equations		
Regressors	*ER*	*LR*	*ROA*	*ER*	*LR*	*ROA*
ESG	-0.0494**	-0.1128***	0.0078*	-0.0429*	-0.1228***	0.0091*
	(0.0238)	(0.0391)	(0.0046)	(0.0226)	(0.0369)	(0.0045)
*REINS*1	0.2239**	-0.4131***	-0.0299*			
	(0.0912)	(0.1466)	(0.0173)			
*REINS*2				0.28573***	-0.5182***	-0.0246
				(0.0767)	(0.1253)	(0.0153)
Controls	Yes	Yes	Yes	Yes	Yes	Yes

5 Robustness

5.1 Alternative measure of reinsurance for United States insurers

For the previous regression outcomes we have analyzed data which Standard and Poor's Capital IQ provides for global insurers, i.e. for insurance companies from all geographies.

We now use data available only for US and Canadian companies about their balance sheet reinsurance assets and reinsurance liabilities. Reinsurance assets are receivables, recoverables, and prepaid expenses related to reinsurance agreements, while reinsurance liabilities are all liabilities related to reinsurance agreements. Using these figures we calculate for each company the ratio of reinsurance assets to total assets (RA_AS), the ratio of reinsurance assets to total liabilities (RA_L), and the ratio of reinsurance liabilities to total liabilities (RL_L). These variables are proportional to reinsurance transactions, therefore we can use them to test their relationship with sustainability inside US and Canada insurers. Table 10 shows that the three quantities decrease in ESG, corroborating the argument that a sound ESG performance decreases the relative weight of reinsurance transactions on the insurer's balance sheet.

Table 10: OLS regressions (columns (1)-(3)) and panel regressions (columns (4)-(6)) of US insurers' reinsurance on ESG scores and control variables. See Appendix Table 12 for the definitions of all variables included in the models. Standard errors are clustered at the company level and are reported in parenthesis.

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS			Panel regressions		
Regressors	*RA_AS*	*RA_L*	*RL_L*	*RA_AS*	*RA_L*	*RL_L*
ESG	-0.0311***	-0.0101***	-0.0129***	-0.0186***	-0.0031	-0.0041
	(0.0081)	(0.0022)	(0.0043)	(0.0052)	(0.0020)	(0.0030)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	No	Yes	Yes	Yes
Time FE	No	No	No	Yes	Yes	Yes
R-squared	0.1071	0.0982	0.1022	0.1555	0.1062	0.0743

5.2 Effects from catastrophic events and the COVID-19 pandemic

We test whether the effect from ESG scores on reinsurance varies with losses due to catastrophes. In fact, Finken and Laux (2009) demonstrate that losses from catastrophic events affect the (re)insurance market. Based on a theory of asymmetric information, the authors show that, when losses from catastrophic events are low, the reinsurance

market is stable and reinsurers' ability to extract rents from their information advantage is limited. However, as expected losses from catastrophic events increase, the likelihood that insurers will switch their reinsurer increases. This context justifies the existence of the catastrophe (so-called "cat") bonds market, as cat bonds can reduce the problem of asymmetric information in a reinsurance relationship and discipline the issues of high reinsurance premiums and cross-subsidization of high-risk insurers by low-risk insurers, in line with Froot (2001).[10] To test whether catastrophes may affect the relationship between reinsurance and sustainability, we use the information available in the insurers' accounting fillings about catastrophe losses, defining the variable *Catastrophe Loss* the losses attributable to catastrophes divided by gross earned premiums. In Table 11-column(1) we observe that the purchase of reinsurance increases in the magnitude of catastrophe losses. Nonetheless, the total effect from the ESG score is negative and significant like in our baseline models presented in the previous section, as the marginal effect of ESG and its interaction with catastrophe losses are both negative and significant in the equation explaining $REINS1$.[11]

[10]Catastrophe bonds are a prominent type of insurance-linked securities (ILS), which are financial instruments that allow investors to speculate on a variety of events, including catastrophes such as hurricanes, earthquakes and pandemics. See for example https://content.naic.org/cipr-topics/insurance-linked-securities.

[11]All the results inside Table 11 remain qualitatively similar also when the dependent variable is $REINS2$, and the same results do not vary substantially also when we use the one period lagged *Catastrophe Loss* instead than the contemporaneous value.

Table 11: OLS regressions for reinsurance on ESG scores interacted with losses due to catastrophe events (column (1)), ESG scores before/after the COVID-19 pandemic (column (2)), ESG scores interacted with losses due to the COVID-19 pandemic (column(3)). See Appendix Table 12 for the definitions of all variables included in the models. Standard errors are clustered at the company level and are reported in parenthesis.

	(1)	(2)	(3)
Regressors	$REINS1$	$REINS1$	$REINS1$
ESG	-0.0668*		-0.1243**
	(0.0353)		(0.0455)
$Catastrophe\ Loss$	2.1479**		
	(0.9379)		
$ESG \times Catastrophe\ Loss$	-0.5520*		
	(0.3955)		
$ESG \times (COVID = Yes)$		-0.0120	
		(0.0134)	
$ESG \times (COVID = No)$		-0.0150	
		(0.0134)	
$COVID\ Loss$			-1.2817
			(1.3976)
$ESG \times COVID\ Loss$			0.5037
			(1.0386)
Controls	Yes	Yes	Yes
R-squared	0.1509	0.0658	0.1661

Finally, as the sample spans the horizon 2013-2022, we verify if the recent COVID-19 pandemic influences our baseline estimates. Kirti and Shin (2020) point out that the COVID-19 pandemic caused large increases in morbidity and mortality that challenged (re)insurers. In particular, the authors highlight that reinsurers may bear concentrated pandemic risk, and that after the huge COVID-19 shock the price for mortality reinsurance may rise, as it happens with other catastrophe reinsurance (Froot, 2001).

In Table 11-column(2) we interact ESG with a dummy variable that separates the years before the COVID-19 pandemic ($COVID = Yes$) from the years after the pandemic ($COVID = No$). The two interaction terms are negative although not statistically significant, suggesting that there is not a considerable difference in the estimated effect before/after the COVID-19 pandemic. In Table 11-column(3) we test a variable measuring the severity of losses related to the COVID-19 pandemic, computed as the losses and

loss adjustment expenses reported by the company that are primarily attributed to the COVID-19 pandemic divided by gross earned premiums ($COVID\ Loss$). Controlling for COVID-19 losses does alter the main results, as the sign of ESG is negative and significant, and its interaction with $COVID\ Loss$ is positive but not significant.[12]

In conclusion, the tests that we conducted in this subsection provide robustness to the finding that reinsurance and sustainability are negatively correlated. Although the outcomes may still be affected by a certain degree of endogeneity, we have verified that they are robust to alternative models, and also are not affected by catastrophes. Therefore, problems of endogeneity seem not to affect much worryingly our results.

6 Conclusions

The analysis of world-wide insurers during 2013-2022 shows that our firms tend to purchase less reinsurance when they have strong ESG performance. This finding is robust as we control for insurer specific characteristics like size, leverage, and taxes, and also as we control for catastrophe losses (e.g. the COVID-19 pandemic). In particular, insurers with high social and governance scores shift less risk to reinsurers. In contrast, the relationship between reinsurance and the environmental score is not significant. Furthermore, we illustrate that insurers' profitability increases in the ESG score while decreases in reinsurance. Our interpretation is that sustainability provides insurers a competitive advantage which results into a cheaper access to capital markets, and lowers their incentive of ceding risk to reinsurers.

Our outcomes deliver an important message to insurance managers, as they suggest that sustainability is an alternative to reinsurance for a more efficient risk management. A sound ESG performance would limit high reinsurance costs (Lei, 2019; Cummins et al., 2021), and would prevent firms to be largely exposed to shocks happening in the reinsurance market. In fact, reinsurance is a global business with a few large reinsurers dominating the market, therefore reinsurance counterparty credit risk is highly concentrated, and a reinsurance crisis could be triggered by the failure of one or more leading

[12]The coefficients in column (3) of Table 11 have similar magnitude and statistical significance also when we use the one period lagged $COVID\ Loss$.

reinsurers, creating insolvency problems and contagion (Cummins and Weiss, 2014).[13] The European Central Bank (ECB) points out that the activation in 2004 of so-called "rating triggers" in the framework of the Solvency II regime had the effect of destabilizing the financial position of several reinsurers. A reinsurance contract including a rating trigger foresees that if the reinsurer's rating falls below a specified security threshold the same company has to return large amounts of premium to customers (i.e. the cedent insurer). This mechanism may increase the vulnerability of reinsurers to liquidity risk in the same way as runs can take place on banks (ECB, 2006).

Our results are important for drawing actions of policy making. In fact, we show that unsustainable firms make large use of reinsurance. This would be a serious concern for regulators, given the recent discussions on whether unsustainable firms are highly risky for the system. For example, the International Monetary Fund (IMF) argues that ESG issues can have a material impact on firms' performance and on the stability of the whole financial system. This statement is based on the evidence that governance failures at banks and corporations contributed to the Asian and the global financial crisis. For this reasons the IMF declares that it will continue to incorporate ESG related considerations, with more decisive policies that would include, among others, disclosure by firms in order to incentivize investors to use ESG data (IMF, 2019). The same International Monetary Fund (IMF) argues that the contribution of insurers to systemic risk has increased during the most recent time, although it remains not entirely clear if this pattern is determined from reinsurance transactions. In fact, broad potential spill overs depend on the scale and complexity of reinsurers' nontraditional non-insurance activities and, potentially, the change in systemic risk of primary insurers (IMF, 2016).

To conclude, it is relevant for regulators to learn that there is a significant interplay between sustainability and reinsurance. Our results suggest that increasing levels of sustainability could result into a reinsurance market made primarily by a network of

[13] Berger et al. (1992) examine the liability insurance crisis of the mid-1980s in the US, analyzing the role of the reinsurance market in contributing to the crisis. The authors document that significant shocks to reinsurers in the early 1980s led to subsequent disruptions to the price and availability of reinsurance, spreading the problems to primary insurers. Using data from the US property-casualty insurance industry, Park and Xie (2014) find that the likelihood of a primary insurer's downgrade increases with its reinsurance default risk exposure from downgraded reinsurers, and this negative effect also spills over to insurers that are not directly exposed to the credit risk of downgraded reinsurers.

reinsurers linked to unsustainable firms. This insight is important for regulators wishing to promote the efficient functioning of the insurance sector. In fact, supervisors are faced in each country with the need to balance, on the one hand, protection of the policyholder, public confidence and the prevention of insurance and reinsurance failures against, on the other hand, the risks of ineffective, counterproductive or excessive regulation (Rossi and Lowe, 2002). There are various ways in which appropriate regulatory treatment of reinsurers' business models can be achieved, and one for example could relate to the calculation of reinsurers' capital requirements.

References

Adams, M., Hardwick, P., and Zou, H. (2008). Reinsurance and corporate taxation in the United Kingdom life insurance industry. Journal of Banking & Finance, 32(1):101–115.

Adiel, R. (1996). Reinsurance and the management of regulatory ratios and taxes in the property-casualty insurance industry. Journal of Accounting and Economics, 22(1-3):207–240.

Berger, L. A., Cummins, J. D., and Tennyson, S. (1992). Reinsurance and the liability insurance crisis. Journal of Risk and Uncertainty, 5:253–272.

Berry-Stölzle, T. R. and Xu, J. (2018). Enterprise risk management and the cost of capital. Journal of Risk and Insurance, 85(1):159–201.

Brogi, M., Cappiello, A., Lagasio, V., and Santoboni, F. (2022). Determinants of insurance companies' environmental, social, and governance awareness. Corporate Social Responsibility and Environmental Management, 29(5):1357–1369.

Capelle-Blancard, G. and Monjon, S. (2012). Trends in the literature on socially responsible investment: Looking for the keys under the lamppost. Business Ethics: A European Review, 21(3):239–250.

Carson, J. M. and Hoyt, R. E. (1995). Life insurer financial distress: Classification models and empirical evidence. Journal of Risk and Insurance, pages 764–775.

Cole, C. R. and McCullough, K. A. (2006). A reexamination of the corporate demand for reinsurance. Journal of Risk and Insurance, 73(1):169–192.

Cole, C. R. and McCullough, K. A. (2008). A comparative analysis of US property and casualty reinsurers and insurers. Risk Management and Insurance Review, 11(1):179–207.

Cummins, J. D., Dionne, G., Gagné, R., and Nouira, A. (2021). The costs and benefits of reinsurance. The Geneva Papers on Risk and Insurance-Issues and Practice, 46:177–199.

Cummins, J. D. and Weiss, M. A. (2014). Systemic risk and the US insurance sector. Journal of Risk and Insurance, 81(3):489–528.

D'Arcy, S. P. and Garven, J. R. (1990). Property-liability insurance pricing models: An empirical evaluation. Journal of Risk and Insurance, pages 391–430.

Daugaard, D. (2020). Emerging new themes in environmental, social and governance investing: A systematic literature review. Accounting & Finance, 60(2):1501–1530.

Dhaliwal, D., Heitzman, S., and Zhen Li, O. (2006). Taxes, leverage, and the cost of equity capital. Journal of Accounting Research, 44(4):691–723.

ECB (2006). Financial stability review.

Edmans, A. (2021). Does sustainability reduce the cost of capital? https://cepr.org/voxeu/columns/does-sustainability-reduce-cost-capital.

EIOPA (2019). Consultation paper on an opinion on sustainability within Solvency II. https://register.eiopa.europa.eu/Publications/Consultations/EIOPA-BoS-19-241_Consultation_Paper_on_an_opinion_%20on_sustainability_in_Solvency_II.pdf.

Fama, E. F. and French, K. R. (1992). The cross-section of expected stock returns. the Journal of Finance, 47(2):427–465.

Finger, M., Gavious, I., and Manos, R. (2018). Environmental risk management and financial performance in the banking industry: A cross-country comparison. Journal of International Financial Markets, Institutions and Money, 52:240–261.

Finken, S. and Laux, C. (2009). Catastrophe bonds and reinsurance: The competitive effect of information-insensitive triggers. Journal of Risk and Insurance, 76(3):579–605.

Friede, G., Busch, T., and Bassen, A. (2015). ESG and financial performance: Aggregated evidence from more than 2000 empirical studies. Journal of Sustainable Finance & Investment, 5(4):210–233.

Froot, K. A. (2001). The market for catastrophe risk: A clinical examination. Journal of Financial Economics, 60(2-3):529–571.

Garven, J. R. and Lamm-Tennant, J. (2003). The demand for reinsurance: Theory and empirical tests. Insurance and Risk Management, 7(3):217–237.

Gebhardt, W. R., Lee, C. M., and Swaminathan, B. (2001). Toward an implied cost of capital. Journal of Accounting Research, 39(1):135–176.

Gianfrate, G., Schoenmaker, D., and Wasama, S. (2015). Cost of capital and sustainability: A literature review. Rotterdam School of Management, Erasmus University, Working Paper.

Giese, G., Lee, L.-E., Melas, D., Nagy, Z., and Nishikawa, L. (2019). Foundations of ESG investing: How ESG affects equity valuation, risk, and performance. The Journal of Portfolio Management, 45(5):69–83.

Gurenko, E. and Itigin, A. (2013). Reinsurance as capital optimization tool under Solvency II. World Bank Policy Research Working Paper, (6306).

Hann, R. N., Ogneva, M., and Ozbas, O. (2013). Corporate diversification and the cost of capital. The Journal of Finance, 68(5):1961–1999.

He, F., Ding, C., Yue, W., and Liu, G. (2023). Esg performance and corporate risk-taking: Evidence from china. International Review of Financial Analysis, 87:102550.

Hoerger, T. J., Sloan, F. A., and Hassan, M. (1990). Loss volatility, bankruptcy, and the demand for reinsurance. Journal of Risk and Uncertainty, 3:221–245.

Hou, K., Van Dijk, M. A., and Zhang, Y. (2012). The implied cost of capital: A new approach. Journal of Accounting and Economics, 53(3):504–526.

Howatt, B., Zuber, R. A., Gandar, J. M., and Lamb, R. P. (2009). Dividends, earnings volatility and information. Applied Financial Economics, 19(7):551–562.

Hoyt, R. E. and Khang, H. (2000). On the demand for corporate property insurance. Journal of Risk and Insurance, pages 91–107.

Huang, D. Z.-X. (2022). Environmental, social and governance factors and assessing firm value: Valuation, signalling and stakeholder perspectives. Accounting & Finance, 62:1983–2010.

IAIS (2022). Global insurance market report (gimar). https://www.iaisweb.org/uploads/2022/12/GIMAR-2022.pdf.

IMF (2016). Global financial stability report. https://www.imf.org/en/Publications/GFSR/Issues/2016/12/31/Potent-Policies-for-a-Successful-Normalization.

IMF (2019). Global financial stability report. https://www.imf.org/en/Publications/GFSR/Issues/2019/10/01/global-financial-stability-report-october-2019.

Jean-Baptiste, E. L. and Santomero, A. M. (2000). The design of private reinsurance contracts. Journal of Financial Intermediation, 9(3):274–297.

Kirti, D. and Shin, M. Y. (2020). Impact of COVID-19 on insurers. International Monetary Fund Research, pages 1–11.

Lei, Y. (2019). Reinsurance and insurers' risk-return profile. Journal of Insurance Issues, 42(1):37–65.

Mankaï, S. and Belgacem, A. (2016). Interactions between risk taking, capital, and reinsurance for property–liability insurance firms. Journal of Risk and Insurance, 83(4):1007–1043.

Mayers, D. and Smith Jr, C. W. (1990). On the corporate demand for insurance: Evidence from the reinsurance market. Journal of Business, pages 19–40.

Miralles-Quirós, M. M., Miralles-Quirós, J. L., and Redondo-Hernández, J. (2019). The impact of environmental, social, and governance performance on stock prices: Evidence from the banking industry. Corporate Social Responsibility and Environmental Management, 26(6):1446–1456.

Modigliani, F. and Miller, M. H. (1958). The cost of capital, corporation finance and the theory of investment. The American Economic Review, 48(3):261–297.

MSCI (2020). ESG and the cost of capital. https://www.msci.com/www/blog-posts/esg-and-the-cost-of-capital/01726513589.

Myers, S. C. (1977). Determinants of corporate borrowing. Journal of Financial Economics, 5(2):147–175.

NAIC (2022a). Redesigned state climate risk disclosure survey. https://content.naic.org/sites/default/files/inline-files/2022RevisedStateClimateRiskSurvey.pdf.

NAIC (2022b). Reinsurance. https://content.naic.org/cipr-topics/reinsurance.

Park, S. C. and Xie, X. (2014). Reinsurance and systemic risk: The impact of reinsurer downgrading on property–casualty insurers. Journal of Risk and Insurance, 81(3):587–622.

Powell, L. S. and Sommer, D. W. (2007). Internal versus external capital markets in the insurance industry: The role of reinsurance. Journal of Financial Services Research, 31(2):173–188.

PRA (2019). Enhancing banks' and insurers' approaches to managing the financial risks from climate change. https://www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/policy-statement/2019/ps1119.

Rossi, M.-L. and Lowe, N. (2002). Regulating reinsurance in the global market. The Geneva Papers on Risk and Insurance. Issues and Practice, 27(1):122–133.

Scordis, N. A., Suzawa, Y., Zwick, A., and Ruckner, L. (2014). Principles for sustainable insurance: Risk management and value. Risk Management and Insurance Review, 17(2):265–276.

SEC (2022). SEC proposes rules to enhance and standardize climate-related disclosures for investors. https://www.sec.gov/news/press-release/2022-46.

Shiu, Y.-M. (2011). Reinsurance and capital structure: Evidence from the United Kingdom non-life insurance industry. Journal of Risk and Insurance, 78(2):475–494.

Smith, C. W. and Stulz, R. M. (1985). The determinants of firms' hedging policies. Journal of Financial and Quantitative Analysis, 20(4):391–405.

Switzer, L. N., Tu, Q., and Wang, J. (2018). Corporate governance and default risk in financial firms over the post-financial crisis period: International evidence. Journal of International Financial Markets, Institutions and Money, 52:196–210.

UNEP FI (2012). Principles for sustainable insurance. https://www.unepfi.org/insurance/insurance/the-principles/.

Upreti, V., Adams, M., and Jia, Y. (2022). Risk management and the cost of equity: Evidence from the United Kingdom's non-life insurance market. The European Journal of Finance, 28(6):551–570.

Weiss, M. A. and Chung, J.-H. (2004). US reinsurance prices, financial quality, and global capacity. Journal of Risk and Insurance, 71(3):437–467.

Zellner, A. and Theil, H. (1962). Three-stage least squares: Simultaneous estimation of simultaneous equations. Econometrica, 30(1):54–78.

7 Appendix

These are the insurance companies that we analyze:

Africa: Discovery Limited, Momentum Metropolitan Holdings Limited, OUTsurance Group Limited, Old Mutual Limited, Sanlam Limited.

Asia-Pacific: AIA Group Limited, AUB Group Limited, Anicom Holdings Inc., Bajaj Finserv Ltd., Bangkok Life Assurance Public Company Li, Cathay Financial Holding Co. Ltd., China Development Financial Holding Corp, China Pacific Insurance Co. Ltd., China Reinsurance Corporation, DB Insurance Co. Ltd., Dai-ichi Life Holdings Inc., Dhipaya Group Holdings Public Company Li, Dream Incubator Inc., Fanhua Inc., Fubon Financial Holding Co. Ltd., General Insurance Corporation of India, HDFC Life Insurance Company Limited, Hanwha Life Insurance Co., Ltd., Helia Group Limited, Hubei Biocause Pharmaceutical Co. Ltd., Hyundai Marine & Fire Insurance Co. Ltd., ICICI Lombard General Insurance Company, Insurance Australia Group Limited, Japan Post Holdings Co. Ltd., Japan Post Insurance Co. Ltd., Korean Reinsurance Company, Lifenet Insurance Company, Mirae Asset Life Insurance Co. Ltd., MS&AD Insurance Group Holdings Inc., Max Financial Services Limited, Medibank Private Limited, Mercuries & Associates Holding Ltd., Mercuries Life Insurance Company Ltd., Meritz Financial Group Inc., New China Life Insurance Company Ltd., Ping An Insurance Company of China, QBE Insurance Group Limited, Religare Enterprises Limited, Samsung Fire & Marine Insurance Co. Ltd., Samsung Life Insurance Co. Ltd., Shin Kong Financial Holding Co. Ltd., Shinkong Insurance Co. Ltd., Sompo Holdings Inc., Steadfast Group Limited, Suncorp Group Limited, Syarikat Takaful Malaysia Keluarga Berhad, T&D Holdings Inc., The People's Insurance Company of China, Tokio Marine Holdings Inc., Tong Yang Life Insurance Co. Ltd., nib holdings limited.

Europe: ASR Nederland N.V., AXA SA, Admiral Group plc, Aegon N.V., Allianz SE, Alm. Brand A/S, Aon plc, Assicurazioni Generali S.p.A., Aviva plc, Beazley plc, Coface SA, Chesnara plc, Chubb Limited, Direct Line Insurance Group plc, Gjensidige Forsikring ASA, Grupo Catalana Occidente S.A., Helvetia Holding AG, Just Group plc, Legal & General Group Plc, Línea Directa Aseguradora, Münchener Rückversicherungs-Gesellschaft, NN Group N.V., Phoenix Group Holdings plc, Poste Italiane S.p.A., Powszechny

Zaklad Ubezpieczen SA, Protector Forsikring ASA, Prudential plc, Scor SE, Sabre Insurance Group plc, Saga plc, Sampo Oyj, Solid Försäkringsaktiebolag, Storebrand ASA, Swiss Life Holding AG, Swiss Re AG, Topdanmark A/S, Tryg A/S, UNIQA Insurance Group AG, Unipol Gruppo S.p.A., Willis Towers Watson Public Limited Comp, Wüstenrot & Württembergische AG, Zurich Insurance Group AG, ageas SA/NV.

Latin America and Caribbean: Alper Consultoria e Corretora de Seguros, Greenlight Capital Re Ltd., Hapvida Participaçoes e Investimentos SA, IRB-Brasil Resseguros S.A., Quálitas Controladora, S.A.B. de C.V., Wiz Soluções e Corretagem de Seguros S.A.

Middle East: Bupa Arabia for Cooperative Insurance Co, Clal Insurance Enterprises Holdings Ltd., Gulf Insurance Group, Harel Insurance Investments & Financial, I.D.I. Insurance Company Ltd., Menora Mivtachim Holdings Ltd, Qatar Insurance Company Q.S.P.C., Saudi Reinsurance Company, The Company for Cooperative Insurance, Walaa Cooperative Insurance Company, Zur Shamir Holdings Ltd.

United States and Canada: Amerisafe Inc., AXIS Capital Holdings Limited, Aflac Incorporated, Ambac Financial Group Inc., American Equity Investment Life Holding, American Financial Group Inc., American International Group Inc., Arch Capital Group Ltd., Argo Group International Holdings Ltd., Arthur J. Gallagher & Co., Assurant Inc., Assured Guaranty Ltd., Brighthouse Financial Inc., Brookfield Reinsurance Ltd., black & black Inc., CNO Financial Group Inc., Centene Corporation, Cigna Corporation, Cincinnati Financial Corporation, Citizens Inc., Donegal Group Inc., Elevance Health Inc., Employers Holdings, Inc., Enstar Group Limited, Equitable Holdings Inc., Erie Indemnity Company, Essent Group Ltd., Everest Re Group Ltd., Fairfax Financial Holdings Limited, Fidelity National Financial Inc., First American Financial Corporation, Genworth Financial Inc., Globe Life Inc., HCI Group, Inc., Hallmark Financial Services Inc., HealthEquity Inc., Heritage Insurance Holdings Inc., Hiscox Ltd, Horace Mann Educators Corporation, Humana Inc., Intact Financial Corporation, Investors Title Company, Jackson Financial Inc., James River Group Holdings Ltd., Kemper Corporation, Kinsale Capital Group Inc., Lancashire Holdings Limited, Lincoln National Corporation, Loews Corporation, MBIA Inc., MGIC Investment Corporation, Manulife Financial Corporation, Markel Corporation, Marsh & McLennan Companies Inc., Mercury General

Corporation, MetLife Inc., Molina Healthcare Inc., NMI Holdings Inc., Old Republic International Corporation, Oscar Health Inc., Palomar Holdings Inc., Primerica Inc., Principal Financial Group Inc., ProAssurance Corporation, Prudential Financial Inc., RLI Corp., Radian Group Inc., Reinsurance Group of America Inc., RenaissanceRe Holdings Ltd., Safety Insurance Group Inc., SelectQuote Inc., Selective Insurance Group Inc., SiriusPoint Ltd., Stewart Information Services Corporation, Sun Life Financial Inc., The Allstate Corporation, The Hanover Insurance Group Inc., The Hartford Financial Services Group Inc., The Progressive Corporation, The Travelers Companies Inc., Trisura Group Ltd., Trupanion Inc., United Fire Group Inc., United Insurance Holdings Corp., UnitedHealth Group Incorporated, Universal Insurance Holdings Inc., Unum Group, Voya Financial Inc., W. R. Berkley Corporation, White Mountains Insurance Group Ltd., iA Financial Corporation Inc.

Table 12: Definition of variables.

Variable	Definition
Catastrophe Loss	Losses and loss adjustment expenses attributable to catastrophes as reported by the company divided by gross earned premiums.
$COVID-19$ *Loss*	Catastrophic losses as reported by the company that are primarily attributed to the COVID-19 pandemic loss and loss adjustment expenses divided by gross earned premiums.
DE	Company's book value of total debt divided by book value of total equity.
$DELTAESG$	Natural logarithm of the difference between the company's ESG score in year t and the ESG score in year $t-1$.
$DELTACEDPREA$	Natural logarithm of the difference between the company's ceded premiums earned in year t and the ceded premiums earned in year $t-1$.
$DELTACEDPRWR$	Natural logarithm of the difference between the company's ceded premiums written in year t and the ceded premiums written in year $t-1$.
$DELTASIZE$	Natural logarithm of the difference between the company's total assets in year t and the total assets in year $t-1$.

$DELTAPWR$	Natural logarithm of the difference between the company's total premiums written in year t and the total premiums written $t-1$.
DIV	Dividend per share declared during the year divided by earnings per share.
E	Natural logarithm of the company's environmental score. The environmental score is a discrete number and ranges 0-100.
ER	Company's "expense ratio" computed as the sum of all the costs for acquiring, writing and servicing insurance divided by the net premiums earned during the period.
ESG	Natural logarithm of the company's environmental, social, and governance (ESG) score. The ESG score is a discrete number and ranges 0-100.
G	Natural logarithm of the company's governance score. The governance score is a discrete number and ranges 0-100.
LR	Company's "loss ratio" calculated as losses incurred in claims plus adjustment expenses incurred for investigating and settling insurance claims divided by the net premiums earned during the period.
PB	Stock price divided by book value per share.
$RATECEDPREA$	Difference between the company's ceded premiums earned in year t and the ceded premiums earned in year $t-1$ divided by the ceded premiums earned in year $t-1$.
$RATECEDPRWR$	Difference between the company's ceded premiums written in year t and the ceded premiums written in year $t-1$ divided by the ceded premiums earned in year $t-1$.
RA_AS	Sum of company's reinsurance assets (i.e. receivables, recoverables, and prepaid expenses related to reinsurance agreements) divided by total assets.

RA_L	Sum of company's reinsurance assets (i.e. receivables, recoverables, and prepaid expenses related to reinsurance agreements) divided by total liabilities.
RL_L	Sum of company's reinsurance liabilities (i.e. all liabilities related to reinsurance agreements) divided by total liabilities.
$REINS1$	Company's ceded earned premiums divided by gross earned premiums.
$REINS2$	Company's ceded premiums written divided by gross premiums written.
ROA	Company's "return on assets" calculated as net income divided by total average assets.
S	Natural logarithm of the company's social score. The social score is a discrete number and ranges 0-100.
$SIZE$	Natural logarithm of the company's total assets.
TAX	Income tax provisions divided by net income before taxes and capital gains at the net of dividends to policyholders.

Note: Data for the analysis are taken from Standard and Poor's Capital IQ. More information about the companies in our sample and the variables' construction can be found at www.capitaliq.spglobal.com.