Is the New Regulation Successful in Reducing Systemic Risk of

Global Systemically Important Insurers?

Empirical Evidence from Insurers around the Globe

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**Abstract**

In response to the public awareness of the “too-big-to-fail” problem arisen from the financial crisis in 2008, the G-20 has explicitly expressed the need to tighten up supervision on global systemically important insurers (G-SIIs) since November 2011 and the International Association of Insurance Supervisors (IAIS) has published a series of policy measures to supervise G-SIIs since July 2013 with the objective of addressing the systemic risks of G-SIIs. With a panel dataset from 2007 to 2015, we analyze the effect of the new regulation on 174 international insurers from 33 countries. We find that the systemic risk of G-SIIs decreases by approximately 13% to 27% after the G-20 declaration and the IAIS’s publication of the new policy measures. Further analysis reveals that the new regulation is not only effective in the U.S., but also reduces the systemic risk of G-SIIs on a worldwide basis. We also find that the new policy measures reduce the systemic risk of large insurers regardless of their G-SII status, suggesting that the threat of being designated as G-SIIs motivates large insurers to change their risk-taking behaviors. Our results are robust to different kinds of systemic risk measures, different proxies for market index, alternative time period of the treatment effect, and the multiple imputation method for addressing the problem of missing data. The findings are also valid if we exclude data from the financial crisis. Finally, we calculate the systemic importance score and find that G-SIIs change their characteristics to decrease systemic importance after the new regulation.

**Keywords**: Systemic Risk; Global Systemically Important Insurers; G-SII; Too-Big-to-Fail; Insurance Regulation

1. **Introduction**

*“It is unacceptable that large firms that the government is now compelled to support to preserve financial stability were among the greatest risk-takers during the boom period. The existence of too-big-to-fail firms also violates the presumption of a level playing field among financial institutions. In the future, financial firms of any type whose failure would pose a systemic risk must accept especially close regulatory scrutiny of their risk-taking.”*

Bernanke, Ben, former Chairman of Federal Reserve. “The Crisis and the Policy Response.” 13 January 2009, London School of Economics, London, England. Speech.

The financial crisis in 2008 raised the public awareness of the “too-big-to-fail” problem. Subsequent to the G20 Leaders’ declaration made in November 2011 expressing the need to address the moral hazard and systemic risk of global systemically important insurers (G-SIIs), the International Association of Insurance Supervisors (IAIS) published the methodologies of assessing G-SIIs (IAIS, 2013a) and the policy measures applicable to them (IAIS, 2013b) in July 2013. Shortly afterwards, the IAIS also published the basic capital requirements (BCR) for G-SIIs (IAIS, 2014) in October 2014 and the higher loss absorbency (HLA) requirements for G-SIIs (IAIS, 2015) in October 2015. The intention of the new regulation is to reduce the systemic risk of G-SIIs so that the moral hazard associated with government interventions during the financial distress of G-SIIs can be minimized. However, the question of whether the new regulation is successful in achieving the intended objective is contentious.

On the one hand, the grounds of enhancing supervision on G-SIIs have been well documented in literature. One of the most discussed problems about G-SIIs is moral hazard (e.g. Kim, 2011; Ötker *et al*., 2011). When the failure of a G-SII can threaten the stability of the economy, the market would expect the government to provide assistance to prevent the G-SII from liquidating or to provide guarantees to protect the creditors. With such expectation, creditors and credit rating agencies do not fully price the credit risk of lending to the G-SII, resulting in a lower cost of finance. In fact, Ueda and Di Mauro (2013) estimate that systemically important financial institutions (SIFIs) have a funding cost advantage of between 60bps and 80bps, which is also consistent with Araten and Turner (2013)’s findings. The funding cost advantage reduces market discipline on G-SIIs and encourages G-SIIs to take greater risks and further expansion. This moral hazard leads to inefficient capital allocation and taxpayers have to pay for the cost of bailing out G-SIIs when they are in trouble. This is consistent with Dombret and Ebner (2013) in the sense that SIFIs make decisions mainly based on their private benefits and costs, but lack the incentive to factor the macroeconomic costs arisen from systemic risk into their decision-making process. Apart from the moral hazard problem, large financial institutions also have negative impact on social welfare. Boyd and Heitz (2016)’s calculations indicate that the costs of large financial institutions’ systemic risk brought to the economy are always much larger than the potential benefits due to economies of scale, suggesting that the social costs of large financial institutions exceed the social benefits. All of the above findings support the need to enhance supervision on G-SIIs and provide incentive for G-SIIs to change their risk taking behaviors.

On the other hand, many studies raise concerns about the details of the IAIS’s proposed G-SII supervisory framework. First, the G-SII designation reinforces the market perception that G-SIIs will be supported by governments when they are in trouble (Kessler, 2014). In other words, an insurer is viewed by the market as safer after it has been designated as G-SII because of the implicit government guarantees. If the benefits of increased safety exceed the costs of being designated as G-SII (e.g. greater compliance costs and more stringent capital requirements, etc.), insurers have incentive to generate more risks so that they can be designated as G-SIIs (Guiné, 2014), which is contrary to the policy intention of the G-20 and the IAIS. Whether the costs of G-SII designation exceed its benefits remains an unanswered empirical question. Second, as insurers, banks and non-bank financial institutions are subject to three different kinds of designation assessment methodologies, regulatory arbitrage among financial institutions is possible if the risk indicators in these three methodologies are not reconcilable. Jobst (2014) suggests the need to conduct cross-sectoral analysis of assessment approaches for G-SIIs, global systemically important banks (G-SIBs), and non-bank non-insurer global systemically important financial institutions (NBNI G-SIFIs) in areas with common risk drivers (e.g. funding sources, derivative trading, intra-financial assets and liabilities, etc.) so as to prevent regulatory arbitrage. Third, how the five factors (i.e. size, global activity, interconnectedness, non-traditional and non-insurance activities, and substitutability) in the indicator-based G-SII assessment approach proposed by the IAIS relate to systemic risk lacks empirical support. Using data of publicly traded insurers with U.S. headquarters, Weiβ and Mühlnickel (2014) find that global activity and substitutability do not contribute to systemic risks. Instead, insurers’ contribution to systemic risks is mainly driven by their size. Hence, it is clear that the IAIS needs to re-consider the exceptionally low weighting (5%) assigned to size in its proposed indicator-based assessment approach. Based on data from 253 international insurers, Bierth *et al.* (2015) also find that leverage is the primary driver for insurers’ contribution to systemic risks. Ironically, the IAIS does not consider leverage as one of the factors in the indicator-based assessment approach. Using factors not related to systemic risk or missing factors that drive systemic risk in the indicator-based assessment approach not only biases the G-SII assessment results, but also biases the HLA required capital by placing G-SIIs in the wrong bucket. Fourth, the short implementation timeframe of G-SII policy measures together with the uncertainties underlying them generate risks for the effectiveness and accuracy of those measures (Guiné, 2014). For example, if an insurer is newly designated as G-SII in November of the current year, it has to implement liquidity management and planning as well as systemic risk management plan (SRMP) by the end of next year. It also has to calculate the BCR required capital and HLA required capital on a consolidated basis with appropriate reporting to regulators in the next year. It is a challenge to comply with the above enhanced measures within the very short timeframe, even if the G-SII concerned has deployed huge resources on the compliance project. In addition, the insurance capital standard (ICS), which is intended to replace the BCR and has a significant impact on the HLA required capital, has not been finalized at the time of writing. The uncertainties underlying the capital requirements may lead to undesirable behaviors of G-SIIs (e.g. unable to optimize its business operation given the uncertain capital requirements).

Although numerous studies have been conducted to support the need to enhance supervision on G-SIIs and criticize the details of supervisory framework proposed by the IAIS, very few studies have investigated whether the new regulation successfully achieves its intended objective of reducing the systemic risk of G-SIIs. The purpose of this paper is to fill the gap in literature and empirically examine whether the new regulation reduces the systemic risk of G-SIIs. We follow existing literature to measure insurers’ systemic risk with Marginal Expected Shortfall (MES) proposed by Acharya *et al.* (2010), Systemic Risk Index (SRISK) proposed by Acharya *et al.* (2012), and ΔCoVAR proposed by Adrian and Brunnermeier (2014). Using a panel dataset of 174 international insurers from 2007 to 2015 and the World Datastream Financial Index as the proxy for market index, we find that the systemic risk of G-SIIs decreases by approximately 13% to 27% after the G-20 declared to tighten up supervision on G-SIIs and the IAIS published the new policy measures. The findings suggest that the new regulation motivates G-SIIs to change their risk-taking behaviors, which are consistent with Moenninghoff *et. al.* (2015)’s event study that argues the costs of complying with the new international regulation on G-SIBs are greater than the benefits of being perceived as safer by the market after G-SIB designation.

We further conduct additional analysis to the above findings. First, we examine whether the empirical results are sensitive to the choice of proxy for market index. Using World Datastream Market Index, World Datastream Bank Index, and World Datastream Insurance Index as alternative proxies for market index, we recalculate MES, SRISK and ΔCoVAR for each insurer and re-perform the regression analysis. The results are similar no matter which index is used as market proxy. Second, we investigate whether the results are driven by the extreme values of data from financial crisis. We follow the National Bureau of Economic Research (NBER)’s definition of business cycle contraction and repeat the regression analysis after dropping the data from 2007 Q4 to 2009 Q2. The regression results still suggest that the new regulation significantly decreases the systemic risks of G-SIIs. Third, we check the robustness of the time period of our treatment effect. We revise the treatment time period to ensure that all G-SIIs were certain of their G-SII status in the revised period. The empirical findings do not materially change with the revised treatment effect. Fourth, we study whether the new regulation’s impact on G-SIIs remains strong outside the U.S., as the public awareness of the “too-big-to-fail” problem in the insurance sector arose from the financial distress of the American International Group and the subsequent bailout from the U.S. government in 2008. Some industry practitioners even consider that the regulators around the world follow the U.S. lead in regulation of G-SIIs (PricewaterhouseCoopers, 2013). After splitting our sample into U.S. insurers and non-U.S. insurers, we repeat the regression analysis and find that the new regulation reduces systemic risk of G-SIIs on a worldwide basis. Fifth, we examine whether the new policy measures reduce systemic risk of large insurers, regardless of whether they have been designated as G-SIIs. By defining large insurers as the upper quartile of insurers in terms of total assets and total insurance reserves, we find that the new regulation reduces the systemic risk of large insurers regardless of their G-SII status, which is supportive of the argument that the threat of being designated as G-SIIs motivates large insurers to change their risk-taking behaviors. Sixth, we address the missing data problem of the quarterly accounting data using the Little’s (1988) MCAR test and the multiple imputation method to impute the missing values. The regression results are similar before and after the multiple imputation, implying that although the data are not missing completely at random, the missing data problem does not bias our empirical findings. Finally, we construct the systemic importance score based on insurers’ accounting data and find that G-SIIs change their characteristics after the new regulation to decrease their systemic importance.

We compliment the literature on systemic risk and insurance regulation by performing empirical analysis on a panel of international insurers. To the best of our knowledge, we are the first to provide empirical evidence supporting the effectiveness of the G-20’s and the IAIS’s new supervisory measures on G-SIIs. To be specific, we show that the systemic risk of G-SIIs decreases significantly after the regulators focus on the supervision of G-SIIs. This finding is important to both the regulators and industry practitioners around the globe in the sense that the new regulation is heading to the right direction and has achieved the intended objective.

We organize the remainder of this paper as follows. Section 2 presents the data and discusses the measures of systemic risk. We present the empirical model and discuss the empirical results in Section 3. Section 4 conducts additional analysis to the baseline regression model. Section 5 states the concluding remarks.

1. **Data**

In this section, we discuss the construction of our sample and the methodologies for measuring systemic risk. We also explain our choice of independent variables and present the descriptive statistics as well as the results of univariate analysis.

* 1. ***Sample construction***

We construct the panel dataset from the *Thomson Reuters Financial Datastream* for the period 2007 to 2015. We first select all the insurers that are constituents of the World Datastream Insurance Index. Next, all insurers with quarterly accounting data or daily stock prices unavailable in *Datastream* are omitted. We are then left with 174 insurers from 33 countries. Nine of these insurers[[1]](#footnote-1) were designated as G-SIIs by the Financial Stability Board (FSB) in July 2013 (FSB, 2013). The full list of insurers in our sample can be found in Table I.

**[Table I inserted here]**

Quarterly accounting data and daily stock prices of these 174 insurers are downloaded from *Datastream* and are expressed in U.S. dollars. Country-specific macroeconomic variables, such as the annual GDP growth rate and inflation, are retrieved from the *World Development Indicators* of World DataBank. In addition, index prices of World Datastream Financial Index, World Datastream Market Index, World Datastream Bank Index, and World Datastream Insurance Index are retrieved from *Datastream* and are expressed in U.S. dollars.

* 1. ***Measuring systemic risk***

We use three different kinds of measures for systemic risk in this study. They are MES proposed by Acharya *et al.* (2010), SRISK proposed by Acharya *et al.* (2012), and ΔCoVAR proposed by Adrian and Brunnermeier (2014). Each of these measures represents different dimension of systemic risk, and they have been widely discussed in literature and applied in various studies of systemic risk (e.g. Anginer *et al.*, 2014a; Anginer *et al.*, 2014b; Weiβ and Mühlnickel, 2014; Mühlnickel and Weiβ, 2015; Bierth *et al.*, 2015). These three measures are briefly discussed below:

MES

Acharya *et al.* (2010) defines MES as the losses of a firm in the tail of the aggregate sector’s loss distribution. Mathematically, MES can be expressed as:

*MESi = - E [ Ri | Rm < VaRα]*  (1)

where *MESi* is the MES of firm *i*, *Ri* is the return of firm *i*, *Rm* is the return of the market index, and *VaRα* is the value-at-risk of the market index with confidence level 1-*α*%. In our study, we calculate the MES on a quarterly basis for each insurer using its daily stock prices. We choose the World Datastream Financial Index as our proxy for market index. In section 4.1, we will replace the World Datastream Financial Index with the World Datastream Market Index, World Datastream Bank Index, and World Datastream Insurance Index for robustness check. Following Weiβ and Mühlnickel (2014) and Bierth *et al.* (2015), we choose *α* to be 5. A higher value of MES represents more systemic risks. Although the MES measure is relatively easy to construct and interpret, it only measures how much an insurer is exposed to a financial crisis, but does not measure how much an insurer contributes to a crisis (Adrian and Brunnermeier, 2014). Hence, we also use SRISK and ΔCoVAR as alternative measures for systemic risks.

SRISK

Acharya *et al.* (2012) defines SRISK as the expected capital shortfall of a firm during financial crisis. Mathematically, SRISK can be expressed as:

*SRISKi = E [Capital Shortfalli | Crisis]*  (2)

where *SRISKi* is the SRISK of firm *i*, and *Capital Shortfalli* is the extra capital firm i needs. For empirical calculation of SRISK, Acharya *et al.* (2012) further simplifies equation (2) as follows:

*SRISKi = k x Debti – (1 – k) x exp(-18 x MESi) x Equityi* (3)

where *k* is a prudential capital ratio, *Debti* and *Equityi* are debt and equity of firm *i* respectively. We follow Weiβ and Mühlnickel (2014) and Bierth *et al.* (2015) to set *k* as 8%. After reviewing the basic capital requirements published by the IAIS (IAIS, 2014), we do not consider 8% to be inappropriate for a prudential capital ratio. Based on the quarterly accounting data and the quarterly MES calculated previously, we compute the SRISK for each insurer on a quarterly basis. A higher value of SRISK represents more systemic risks.

ΔCoVAR

ΔCoVAR captures the tail dependency between insurers and market index. Adrian and Brunnermeier (2014) defines *CoVARαi* as the value-at-risk of the market index with confidence level 1 – *α* given the insurer *i*’s stock return equals to its *VaRαi*. *ΔCoVARα* is then defined as the difference between *CoVARα* and *CoVAR50%*. Mathematically, the calculation of *ΔCoVARα* is expressed below:

*Pr (Rm ≤ CoVARα |Ri =VaRiα | Ri = VaRαi) = α%* (4)

*ΔCoVARαi = CoVARα|Ri =VaRiα – CoVARα|Ri =VaRi50* (5)

For the empirical estimation of ΔCoVAR, Adrian and Brunnermeier (2014) show that equation (5) can be simplified to:

*ΔCoVARαi = iα (VaRαi – VaR50i)* (6)

where *iα* is the estimated coefficient of performing quantile regression with market return as dependent variable and stock return of insurer i as independent variable, and *VaRαi* is the VaR of insurer *i* with confidence level 1 – *α*%. We use the rolling window method to run quantile regressions on daily stock returns for each insurer to obtain *iα* for each quarter, and subsequently compute the *ΔCoVARαi* on a quarterly basis. To be consistent with previous systemic risk measures, we choose *α* to be 5. A lower value of ΔCoVAR represents more systemic risk.

* 1. ***Independent variables***

As we attempt to capture the effect of the new regulation on G-SII’s systemic risk, the variable of our interest is the interaction term *Policy x GSII*, where *Policy* is a dummy variable that takes the value of 1 for the time period on or after the first quarter of 2012, and *GSII* is a dummy variable that takes the value of 1 if the insurer has been designated by the FSB as global systemically important. As the G20 publicly declared the need to tighten supervision on G-SIIs during the meetings in November 2011 and June 2012, the IAIS responded by publishing three different policy measures governing the supervision of G-SIIs in July 2013, October 2014 and October 2015. The regulatory attention paid to the supervision of G-SIIs is expected to generate incentives for G-SIIs to change their risk-taking behaviors from 2012 Q1 to the end of our sample period and hence, the *Policy* dummy remains at 1 during this period. If the new regulation successfully reduces the systemic risk of G-SIIs, we should expect the estimated coefficient for the interaction term to be negative when systemic risk is measured by MES and SRISK, and positive when systemic risk is measured by ΔCoVAR.

Apart from the interaction term, we add a bunch of insurer-specific characteristics as control variables. We use the natural logarithm of total assets to proxy for an insurer’s size because Weiβ and Mühlnickel (2014) find that insurers’ contribution to systemic risk is mainly driven by their size. We also proxy leverage of an insurer by the ratio of market value of assets to market value of equities, as Bierth *et al.* (2015) find that leverage is the primary driver for insurer’s systemic risk. Other important control variables include non-insurance activities and other incomes besides operating income, as the IAIS (2011) suggests that non-insurance activities are more likely to amplify and contribute to systemic risks than insurance activities. We proxy non-insurance activities with non-policyholder liabilities scaled by total liabilities. We also scale other incomes besides operating income by net sales. If an insurer operates not only in its domestic country, it is intuitive to argue that the financial distress of the insurer is more likely to be contagious to the financial systems in other countries. Hence, we proxy global activities with the amount of foreign sales scaled by total sales. Fahlenbrach *et al.* (2012) argues that banks with short-term funding are more likely to be in financial distress during crisis. Hence, we use the ratio of long term debts to total debts as proxy for liquidity. Trigeorgis and Lambertides (2014) suggest that market-to-book ratio seems to proxy for distress variables, and therefore we include market-to-book ratio as a control variable. To control for the different characteristics between life and non-life insurers, we use a *Life* dummy that takes the value of 1 for life insurers and 0 for non-life insurers. To assess the quality of an insurer’s insurance portfolio, we include the loss ratio as a control variable. We also include investment income because an exceptionally high investment income may imply excessive risk taking in the insurer’s investment portfolio. In addition, we control the performance of insurer by its return on assets (ROA) and the quality of management by the ratio of operating expenses to net sales. To control for country-specific macroeconomic characteristics, we use the annual GDP growth and inflation as control variables, as Baselga-Pascual *et al.* (2015) show that falling GDP and high inflation rates increase bank risk. Table II documents the definition of the above variables.

**[Table II inserted here]**

* 1. ***Descriptive statistics***

The descriptive statistics are summarized in table III. Panel A, B and C report the statistics of systemic risk measures, firm characteristics, and country-specific macroeconomic variables respectively. The mean of MES, SRISK and ΔCoVAR are 2.15%, US$3.36 billion, and -0.98% respectively. The time evolution of these three systemic risk measures is reported in Figure 1. Before the financial crisis in 2008, systemic risk of insurers remains at a low level. However, both three measures indicate that systemic risk increases sharply during the financial crisis in 2008. The peak of MES (6.80%) and SRISK ($5.12 billion) occur in the fourth quarter of 2008, while the trough of ΔCoVAR (-2.82%) occurs in the first quarter of 2009. Although the systemic risk decreases temporarily after the financial crisis, another peak occurs near the end of 2011. Subsequently, the G20 made a declaration after the meeting on 4 November 2011 explicitly expressing the need to develop supervisory framework for internationally active insurance groups. On 19 June 2012, the G20 reiterated the need to supervise G-SIIs. In response, the IAIS published various policy measures to govern G-SIIs in 2013, 2014 and 2015. Coincidentally, we observe a downward trend on insurers’ systemic risk in the same period. Whether the new regulation contributes to the downward trend observed between 2012 and 2015 is the main research question we would address in later sections.

**[Table III inserted here]**

**[Figure I inserted here]**

* 1. ***Univariate analysis***

Before applying multivariate regression in section 3, we conduct the univariate analysis in this subsection. In particular, we attempt to investigate whether G-SIIs and non G-SIIs are different in nature. We also investigate whether systemic risk and insurer-specific characteristics change for G-SIIs before and after the new regulation. We repeat the same analysis on non-G-SIIs as well. The results are reported in Table IV.

**[Table IV inserted here]**

Column 1 to 3 report the difference of systemic risk and insurer characteristics between G-SIIs and non G-SIIs; column 4 to 6 report the difference of systemic risk and insurer characteristics before and after the regulation for G-SIIs; column 7 to 9 report the difference of systemic risk and insurer characteristics before and after the regulation for non G-SIIs. As indicated by all the risk measures, G-SIIs have more systemic risk than non-G-SIIs, both before and after the new regulation. The systemic risk of insurers decrease dramatically after the publication of new policy measures. MES, SRISK, and ΔCoVAR of G-SIIs are respectively reduced from 4.47%, US$30.04 billion, and -1.63% to 2.18%, US$20.07 billion, and -0.76% after the new regulation, which represent approximately 51%, 33% and 53% reduction of systemic risks. We also observe a downward trend of systemic risk among non-G-SIIs, but the magnitude of risk reduction is not as much as that for G-SIIs. The significant reduction of systemic risk among G-SIIs is accompanied by a 11.31 reduction of leverage and 6.6% reduction of global activities. The univariate analysis results strongly suggest that the introduction of new regulation changes the characteristics as well as systemic risk of G-SIIs. We also observe that G-SIIs are very different from non-G-SIIs. G-SIIs are generally bigger in size, operate on higher leverage, engage in more non-insurance activities, have stronger global presence, greater need for liquidity, lower book-to-market ratio, lower loss ratio, lower ROA, and higher operating expenses than non-G-SIIs. These insurer-specific characteristics probably play some roles in affecting the systemic risk of insurers, and the univariate analysis results motivate us to control for these characteristics in the multivariate regressions in section 3.

1. **Empirical Model and Results**

We investigate the effect of the new regulation on G-SIIs with the following baseline empirical model:

*Systemic riskit = β0 + β1 Policyt x GSIIi + β2 Insurer characteristicsit-1*

*+ β3 Country-specific macroeconomic characteristicsit-1*

*+ fi + st* *+ eit* (7)

where *i* represents an insurer, *t* represents a quarter, *systemic risk* is measured either by MES, SRISK or ΔCoVAR, *Policy* is a dummy that equals to 1 on or after 2012 Q1, *GSII* is a dummy that equals to 1 for insurers designated as G-SIIs, *Insurer characteristics* and *Country-specific macroeconomic characteristics* are variables described in section 2.3, *f* is the firm-specific effect, *s* is the time-specific effect, and *e* is the error term. We allow for a time-lag of one quarter for characteristics because *Systemic riskit* measures the systemic risk from the beginning of period t to the end of period t while the *Insurer characteristicst-1* and *Country-specific macroeconomic characteristicst-1* are based on figures at the end of period t-1. Firm fixed effect and time fixed effect are included to control for unobserved time-invariant insurer characteristics and insurer-invariant time effect respectively. We also cluster standard errors at the country level to control for heteroscedasticity. If the new regulation is effective in reducing the systemic risk of G-SIIs, we would expect *β1* to be negative when systemic risk is measured by MES and SRISK, and positive when systemic risk is measured by ΔCoVAR. The results of the baseline regression are reported in Table V.

**[Table V inserted here]**

Column 1, 2 and 3 report the coefficient estimates when systemic risks are measured by MES, SRISK and ΔCoVAR respectively. The estimated coefficients for the interaction term *Policy x GSII* in all the regressions indicate that the new regulation reduces the systemic risks of G-SIIs and are statistically significant. Due to the new regulation, MES and SRISK of G-SIIs decrease by 0.68% and US$7.99 billion respectively, which represent 15% of average MES and 27% of average SRISK for G-SIIs before the new regulation. ΔCoVAR of G-SIIs is also reduced by 0.21%, which represents 13% of average ΔCoVAR before the new regulation. The magnitude of systemic risks reduction due to new regulation in regression analysis is much smaller than that suggested by univariate analysis because some of the reduction in systemic risks are explained by changes in insurer characteristics and country-specific macroeconomic characteristics. It is also interesting to note that changes in insurer characteristics are endogenous and the new regulation may generate incentive for G-SIIs to change their characteristics. For example, Table IV suggests that the average leverage of G-SIIs decreases by 11.31 after the new regulation while the average leverage of non G-SIIs does not change much. Table V also suggests that a decrease in leverage reduces the MES and SRISK of insurers. Hence, some of the effect of the new regulation is captured by changes in insurer characteristics, and the coefficient for the interaction term *Policy x GSII* underestimates the effect of the new regulation on G-SIIs’ systemic risks. The actual reduction of G-SIIs’ systemic risk due to the new policy measures should be greater than 0.68% of MES, US$7.99 billion of SRISK and 0.21% of ΔCoVAR. We will further discuss the change in insurer characteristics in Section 4.7.

The regression results are consistent with the argument that the costs of complying with the new regulation are higher than the benefits of being perceived by the market as safer after the G-SII designation. Otherwise, G-SIIs would have intentionally taken more risks to enjoy the lower external funding costs associated with the G-SII designation. The results suggest that the new policy measures have achieved the regulator’s intended objective of reducing systemic risks of G-SIIs.

1. **Additional analysis**

In this section, we investigate whether the empirical results in section 3 are caused by spurious correlation and perform additional analysis on the baseline regression. In particular, we examine whether the observations in section 3 are sensitive to the choice of market proxy or mainly driven by the data of the financial crisis. We also check the robustness of the time period of the *Policy* dummy. We further investigate whether the systemic risks of G-SIIs are reduced by the new regulation on a worldwide basis and whether large insurers are affected by the new regulation regardless of their G-SII status. Finally, we examine whether the missing data problem biases our empirical findings and whether G-SIIs change their characteristics after the new regulation to decrease their systemic importance.

* 1. ***Are empirical results sensitive to the choice of proxy for market index?***

According to the International Monetary Fund (IMF), Bank for International Settlements (BIS), and FSB (IMF *et al.*, 2009), systemic risk is defined as “the disruption of the flow of financial services that is (i) caused by an impairment of all or parts of the financial system; and (ii) has the potential to have serious negative consequences for the real economy”. As the first half of the definition stresses on the disruption of the flow of financial services, we proxy the market index with the World Datastream Financial Index in our baseline regression. In this subsection, we proxy the market index with the World Datastream Market Index, which covers over 6,000 constituent entities over the world, to address the second half of the definition concerning the negative consequences for the real economy. As a robustness check, we also use the World Datastream Bank Index and the World Datastream Insurance Index as alternative proxies for market index to examine whether the empirical results in the baseline regression are sensitive to the choice of market proxy. The MES, SRISK and ΔCoVAR are recalculated for each insurer with the above market indices and we repeat the regression analysis with the updated systemic risk measures. The results are reported in Table VI.

**[Table VI inserted here]**

Column 1 to 3 report the results when the market index is proxied by the World Datastream Market Index; column 4 to 6 report the results when the market index is proxied by the World Datastream Bank Index; column 7 to 9 report the results when the market index is proxied by the World Datastream Insurance Index. The estimated coefficients of the interaction term *Policy x GSII* in column 1 to 9 indicate that the new regulation reduces systemic risks of G-SIIs regardless of the choice of proxy for the market index. The estimated coefficients of the interaction term are statistically significant for all the regressions, and the magnitude of the estimated coefficients is similar to that reported in Table V. The regression results in Table VI suggest that our baseline regression results are robust to different choices of proxy for the market index, and the new regulation reduces systemic risks of G-SIIs no matter we focus the definition of systemic risks on the negative consequences associated with the financial system or the whole economy.

* 1. ***Are the empirical results mainly driven by the data from financial crisis?***

As noted in Figure 1, MES and SRISK reached their peaks while ΔCoVAR reached its trough during the financial crisis in 2008 and 2009. Insurer’s stock returns and accounting figures also experienced exceptionally high volatilities during such period. Hence, one may be skeptical of whether our regression results are biased by the extreme systemic risk values and uncommon fluctuations in accounting figures caused by the financial crisis. To address this concern, we exclude the data from financial crisis and re-perform the regression analysis in this subsection. As the National Bureau of Economic Research (NBER) determined the recent business cycle contraction began in December 2007 and ended in June 2009 (NBER, 2010), we dropped the data during this period. The regression results with the updated dataset are reported in Table VII.

**[Table VII inserted here]**

Column 1, 2, and 3 report the estimated coefficients of regressions with the dataset excluding data from financial crisis. The estimated coefficients for the interaction term *Policy x GSII* are significant for all the regressions, except that the estimated magnitude of systemic risk reduction due to the new regulation is slightly smaller than that of the baseline regression reported in Table V. This is not unexpected as the average systemic risks of G-SIIs before regulation become smaller if we drop the data from financial crisis. Taken together, we conclude that the new regulation is still effective in reducing systemic risks of G-SIIs even if we exclude the data from financial crisis.

* 1. ***Were G-SIIs aware of their designation before July 2013?***

As the first G-SII designation was made by the FSB in July 2013, one may be skeptical that insurers were not aware of their G-SII status and therefore, they were not motivated to change their risk-taking behaviors from 2012 Q1 to 2013 Q2 and our *Policy* dummy is not defined accurately. We argue that the media revealed the identities of some G-SIIs from a leak of FSB’s potential G-SII list as early as November 2009 (Jenkins and Davies, 2009) and hence, some insurers were aware of their potential designation way before July 2013. In addition, the IAIS conducted field tests and requested information from several selected insurers for the purpose of G-SII identification way before the formal designation in July 2013. The selected insurers should have an educated guess of their likelihood of being designated as G-SIIs. Nevertheless, to cast doubt on whether our *Policy* dummy is defined accurately, we change the time period of the dummy from 2012 Q1 – 2015 Q4 to 2013 Q4 – 2015 Q4 to ensure that all G-SIIs were certain of their designation in the revised time period. We then repeat the regression analysis with the revised *Policy* dummy in this subsection. The results are reported in Table VIII.

**[Table VIII inserted here]**

Column 1, 2 and 3 report the regression results with the revised *Policy* dummy. The estimated coefficients for the interaction term *Policy x GSII* in Table VIII are very similar to those reported in Table V, both in terms of magnitude and statistical significance. The results suggest that our conclusion about the effectiveness of the new regulation remains unchanged even if we revise the time period of *Policy* dummy to ensure that all G-SIIs were certain of their designation in the revised time period.

* 1. ***Does the new regulation affect G-SIIs on a worldwide basis?***

Since the financial crisis in 2008, much of the public attention about G-SIIs has been placed on the financial distress of American International Group and the subsequent bailout from the U.S. government. The regulation of G-SIIs in the U.S. also keeps ahead of international standards. For example, the U.S. passed the Dodd-Frank Wall Street Reform and Consumer Protection Act to tighten regulation on systemically important financial institutions on 21 July 2010, and the Financial Stability Oversight Council (FSOC) of the U.S. named the American International Group as systemically important on 8 July 2013. Both the G-SII regulation and designation in the U.S. are one step ahead of the FSB and the IAIS. Some industry practitioners even consider that the global follows the U.S. lead in regulation of G-SIIs (PricewaterhouseCoopers, 2013). Hence, one may be skeptical of whether the new regulation can effectively reduce systemic risks of G-SIIs outside the U.S. This sub-section attempts to address this concern by performing regression separately on U.S. insurers and non U.S. insurers. The results are reported in Table IX.

**[Table IX inserted here]**

Column 1, 2 and 3 report the regression results on U.S. insurers only. As all insurers in the U.S. sample belong to the same country, we cluster the standard errors at the insurer level instead of the country level in column 1, 2, and 3. Most of the estimated coefficients for the interaction term *Policy x GSII* suggest that the new regulation is effective in reducing the systemic risks of U.S. G-SIIs. The estimated coefficients in column 1 and 3 are statistically significant, but the estimated coefficient in column 2 is not. However, we should be cautious about the inference of the estimated coefficients in column 1 to 3 because we only have three G-SIIs (i.e. American International Group, Metlife, and Prudential Financial) in the U.S. sample. The limited sample size may cause difficulties in interpreting the inference of estimated coefficients.

Column 4, 5, and 6 report the regression results on non U.S. insurers. All the estimated coefficients for the interaction term *Policy x GSII* are statistically significant and strongly indicate that the new regulation effectively reduces the systemic risks of non U.S. G-SIIs. Taken together, the regression results from column 1 to 6 suggest that the new policy measures not only affect G-SIIs in the U.S., but also affect G-SIIs on a worldwide basis.

* 1. ***Does the new regulation affect large insurers regardless of their G-SIIs status?***

In this sub-section, we investigate whether the reduction in systemic risks due to the new regulation is confined to insurers designated as G-SIIs only. If the compliance costs with the new regulation are higher than the benefits of being perceived as safer by the market, we would expect that the threat of being designated as G-SIIs motivates large insurers to change their risk-taking behaviors so that they could avoid the G-SII designation in the next round of review by the IAIS. To examine this issue, we define an insurer as large if its total assets belong to the upper quartile of the whole sample. The baseline regression is then performed on the whole sample, with the *GSII* dummy replaced by the *Large* dummy. For robustness, we also use insurance reserves as an alternative yardstick to define large insurers and repeat the same analysis. The empirical results are reported in Table X.

**[Table X inserted here]**

Column 1 to 3 report the regression results when size of insurers is defined by total assets, while column 4 to 6 report the regression results when size of insurers is defined by insurance reserves. The estimated coefficients for the interaction term *Policy x GSII* in all the regressions are statistically significant and suggest that the new regulation reduces the systemic risks of large insurers regardless of their G-SII status. Even if a large insurer is not designated as G-SII and is not subject to the new policy measures, the threat of being designated as G-SII in future review by the IAIS motivates it to change its risk-taking behaviors.

* 1. ***Do the missing data bias our empirical findings?***

As noted in Table III, some of the quarterly accounting data are missing from our sample of insurers in *Datastream* for unknown reasons. The extent of the missing data problem varies across different variables. The variable *Global activities* have the most missing data as around 24% of our sample does not have quarterly data regarding the amount of foreign sales. As a result, the number of firm-quarter observations available for regression decreases by 24% because of the missing data problem arisen from a single explanatory variable. If the accounting data are not missing completely at random (“MCAR”), the regression results could potentially be biased for ignoring the missing data (see Little and Rubin, 2002; Yeh, 2009). Data are considered as MCAR if the missing pattern of the quarterly accounting data does not depend on the values of other variables in our sample. To examine whether the accounting data in our sample are MCAR, we apply the Little’s MCAR test (Little, 1988) to all the variables in Table III. We obtain a chi-square statistic of 6283, which is highly significant (at a 99% critical value of χ3692 = 435.12) to reject the null of MCAR. Therefore, we conclude that the missing accounting data in our sample are not MCAR.

To cast doubt on whether the missing data problem would bias our baseline regression results in section 3, we apply the multiple imputation method proposed by Rubin (1987) and use the information revealed from the non-missing data in our sample to impute the missing values. As we have more than 20% of missing information for the quarterly accounting data, we follow Graham *et al.* (2007)’s suggestion to implement 20 imputations for each missing data, with the willingness to tolerate 1% power falloff. With the imputed values for missing accounting data, we repeat the regression analysis with the larger sample. The results are reported in Table XI.

**[Table XI inserted here]**

Column 1, 2 and 3 report the estimated coefficients of regression with imputed values for all the missing quarterly accounting data. As noted from the estimated coefficients for the interaction term *Policy x GSII*, the regression results are similar to that of the baseline regression reported in Table V. The variable of interest in the first row of Table XI are statistically significant and their magnitude are similar to that reported in Table V, suggesting that the new regulation is effective in reducing systemic risks of G-SIIs after we address the missing data problem. Taken together, we conclude that although the quarterly accounting data in our sample are not MCAR, our regression results are not biased by the missing data.

* 1. ***Does the new regulation affect the characteristics of G-SIIs?***

As both the construction of MES, SRISK and ΔCoVAR are based on stock returns, one potential criticism is that all the risk measures only reflect the insurers’ systemic risks perceived by the investors, but do not reflect their systemic importance generated by the insurer-specific characteristics. It remains unclear whether the new regulation changes the characteristics of G-SIIs.

To address this question, we follow Bramer and Gischer (2013) to construct the systemic importance score based on accounting data. As their proposed score is intended to measure the systemic importance of banks, we modify the proposed score according to the indicators suggested by the IAIS (2016) to measure the systemic importance of insurers. While we are unable to include all the IAIS’s suggested indicators due to the limited availability of data from the *Thomson Reuters Financial Datastream*, we consider that the modified systemic importance score captures many of the IAIS’s suggested indicators and reflects the insurers’ relative systemic importance due to their firm characteristics. The systemic importance score for insurer i is constructed from nine indicators and is calculated as follows:

*Scoreit = Asset indicatorit + Revenue indicatorit + Foreign sale indicatorit + Reinsurance indicatorit + Non-policyholder liabilities indicatorit + Non-insurance revenue indicatorit + Short term funding indicatorit + Investment cash flow indicatorit + Financing cash flow indicatorit*  (8)

*Variable Indicatorit = Variableit / it*  (9)

where n is the total number of insurers at time t. An insurer having higher score value is more systemically important.

To investigate the effect of the new regulation on insurers’ characteristics, we perform a univariate analysis on G-SIIs and compare their systemic importance score as well as the constituent indicators before and after the new regulation. The results are documented in Table XII.

**[Table XII inserted here]**

As noted in Table XII, the average systemic importance score for G-SIIs decreases significantly after the new regulation. A closer investigation at the constituent indicators reveals that most of the constituent indicators decrease after the new regulation, suggesting that G-SIIs change their risk-taking behaviors and firm characteristics to decrease their systemic importance.

1. **Conclusion**

The issue of whether the recent regulators’ focus on tightening up supervision of G-SIIs and the subsequent policy measures are effective in reducing the systemic risks of G-SIIs is controversial. On the one hand, some insurers fought hard to get rid of the G-SII designations, reflecting insurers’ incentive to avoid the heavy compliance cost with the new regulation. For example, MetLife appealed to the U.S. court attempting to overturn the decision made by the FSOC earlier designating MetLife as a systemically important financial institution. (Tracy, 2016). The final court ruling is not available at the time of writing. Assicurazioni Generali S.p.A. was also successfully removed from the list of G-SIIs in November 2015 by shrinking its business and selling its reinsurance and banking operations (Jenkins, 2016). On the other hand, there is wide consensus among researchers that systemic important institutions enjoy the benefits of lower funding costs (Araten, M., & Turner, C. M., 2013; Ueda and Di Mauro, 2013; Moenninghoff *et al.*, 2015). If the benefits of G-SII designation exceed the compliance costs, the new regulation may unintentionally encourage insurers to take on more risks.

We shed light on the literature on systemic risks and insurance regulation by addressing the question of whether the new regulation is effective in reducing G-SIIs’ systemic risks. By analyzing a panel dataset covering 174 international insurers from 33 countries, we provide empirical evidence supporting the effectiveness of the new regulation. In particular, after controlling for insurer characteristics and country-specific macroeconomic characteristics, we find that the new regulation decreases the average systemic risks of G-SIIs by around 13% to 27%. The finding is robust to various systemic risk measures, alternative proxies for market index, different time period of the treatment effect, and the multiple imputation method addressing the missing data problem. The regression results are also similar no matter we include the data from the financial crisis or not. Further investigation reveals that G-SIIs change their characteristics to decrease their systemic importance after the new regulation. Interestingly, we find that the effect of the new regulation is on a worldwide basis, although the U.S. regulation on G-SIIs is one step ahead of other countries. We also find that the new regulation reduces the systemic risks of large insurers regardless of their G-SII status, suggesting that the threat of being designated as G-SII motivates large insurers to change their risk-taking behaviors.

From a public policy standpoint, our findings have important implications for the regulation of G-SIIs and reduction of systemic risks in the insurance sector. Our results show that the recent policy measures proposed by the IAIS are heading to the right direction and have achieved the intended objective of reducing the systemic risks of G-SIIs. The new policy measures have also resulted in unintended consequences of reducing systemic risks of large insurers. Despite the numerous criticisms on the IAIS’s proposed supervisory framework on G-SIIs (e.g. Jobst, 2014; Weiβ *et al.*, 2014; Bierth *et al.*, 2015), the empirical evidence in this study suggests that the new regulation at least deserves some credit in reducing the systemic risks of the insurance industry.

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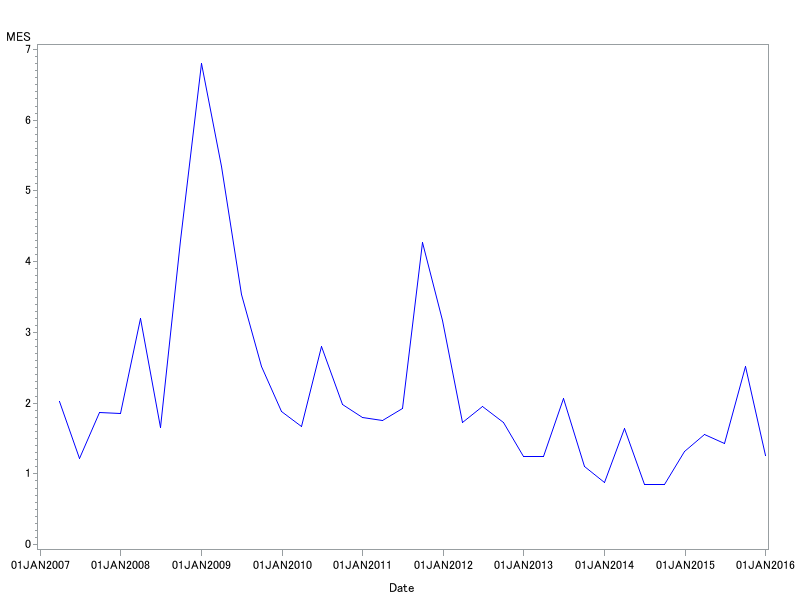
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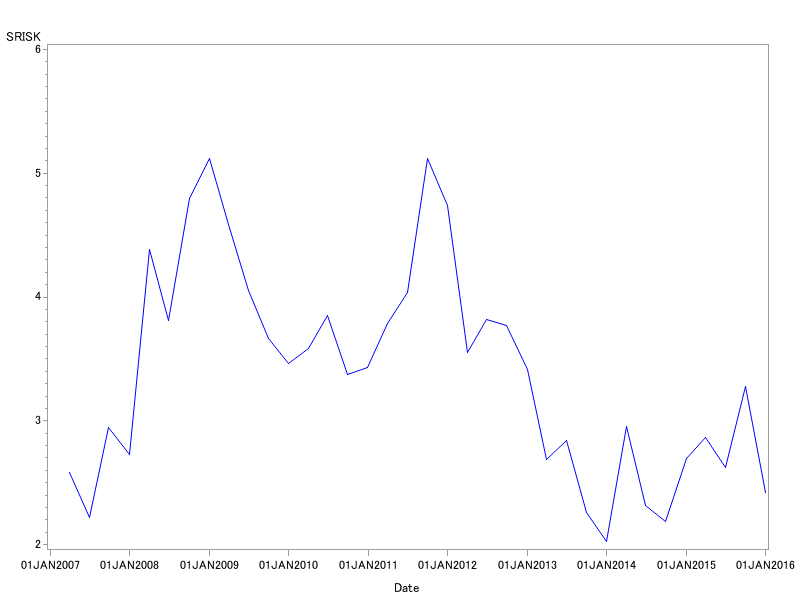
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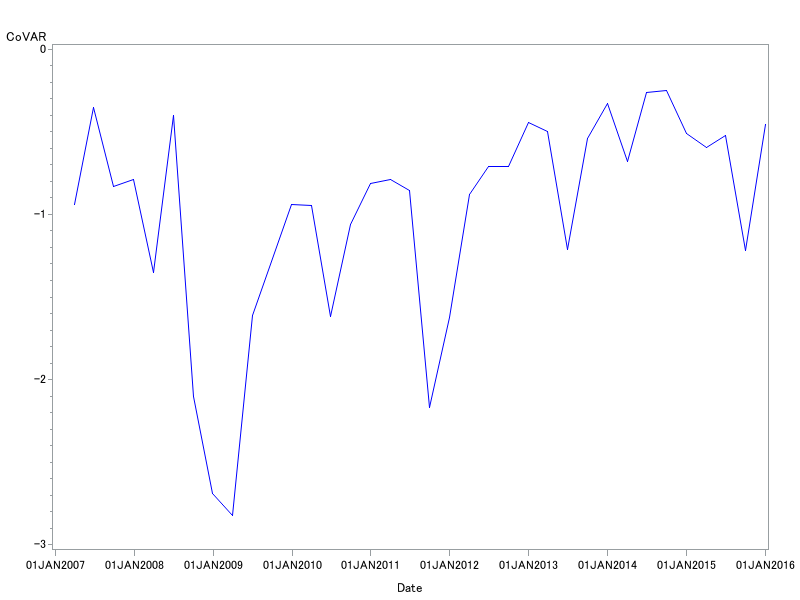
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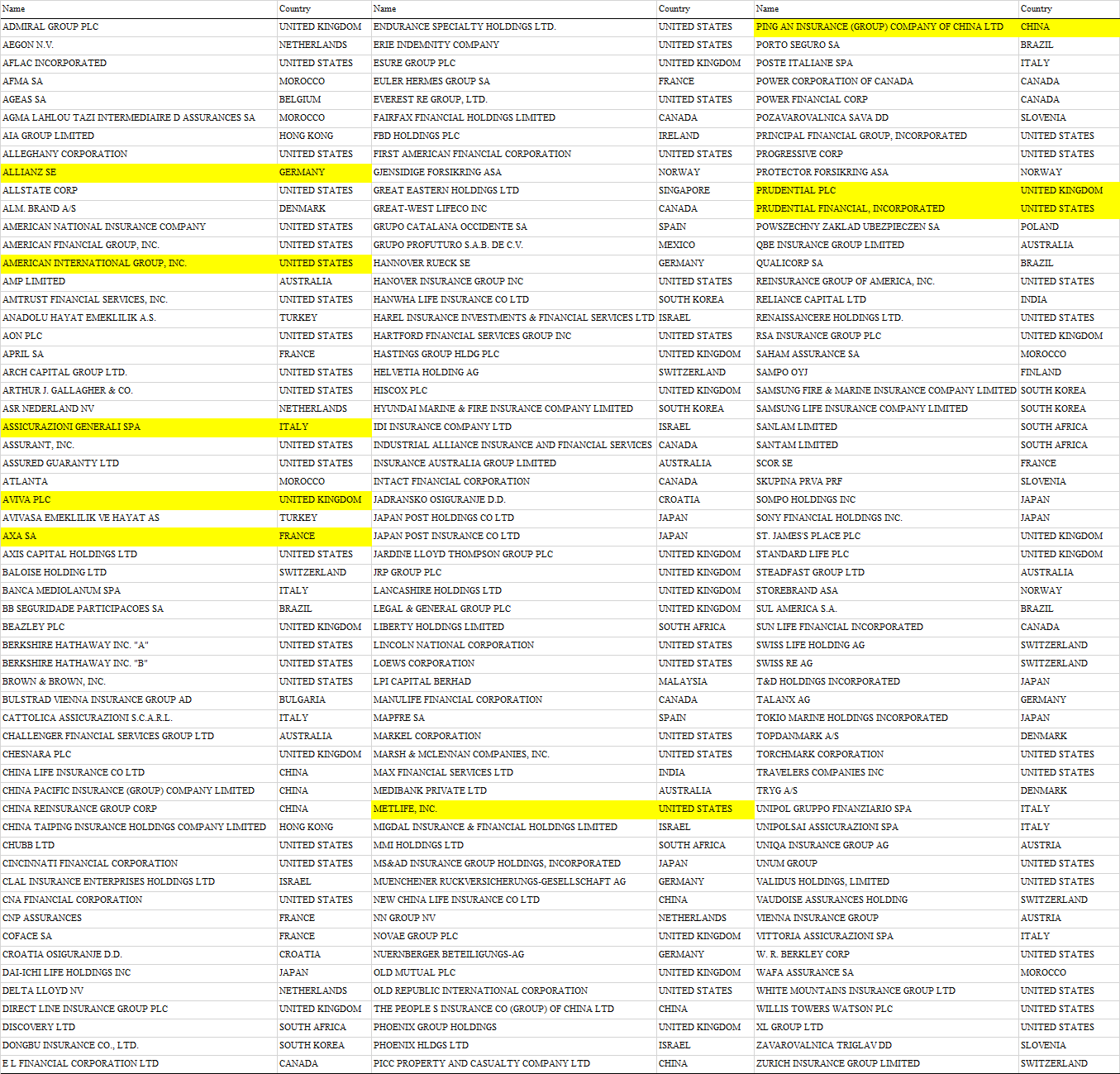
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**Figure 1.** **Time evolution of MES, SRISK and ΔCoVAR**







**Table I. List of insurers in the panel dataset**

|  |
| --- |
| The list above is constructed by first selecting all the insurers that are constituents of the World Datastream Insurance Index. Next, all insurers with quarterly accounting data or daily stock prices unavailable in *Datastream* are omitted. The final dataset consists of 174 insurers from 33 countries. G-SIIs designated by the FSB in July 2013 are highlighted in the table. The names (item WC06001) and countries (item GEOGN) of the insurers are extracted from the *Worldscope* database. |

**Table II. Definition of variables**

|  |  |  |
| --- | --- | --- |
| **Variables** | **Definitions** | |
| (*Datastream* data items in brackets) | | |
| ΔCoVAR  Asset indicator  G-SII (1/0) | | ΔCoVAR captures the tail dependency between insurers and market index. Refer to section 2.2 for detailed methodology and calculation.  Total assets (WC02999) scaled by the aggregation of assets for the whole sample  The G-SII dummy, which equals to 1 if the insurer has been designated by the FSB as global systemically important, and 0 otherwise |
| Financing cash flow indicator | | Cash flow from financing activities (WC04890) scaled by the aggregation of cash flow from financing activities for the whole sample |
| Foreign sale indicator | | Foreign sale (WC07101) scaled by the aggregation of foreign sale for the whole sample |
| GDP growth  Global activities  Inflation | | Annual percentage growth of gross domestic product  Foreign sales scaled by total sales (WC08731)  Inflation measured by change in consumer price index |
| Investment cash flow indicator | | Sum of cash paid for investment purchases (WC04760) and cash received from investment sales (WC04440), scaled by the aggregation of investment purchases and sales for the whole sample |
| Investment income | | [investment income (WC01006)] / [total assets (WC02999)] |
| Large (1/0) | | The large dummy, which equals to 1 if the insurer’s total assets (WC02999) or insurance reserves (WC03030) belong to the upper quartile of the whole sample, and 0 otherwise |
| Leverage | | [book value of asset (WC02999) – book value of equity (WC03501) + market value of equity (WC08001)] / [market value of equity (WC08001)] |
| Life (1/0) | | The life dummy, which equals to 1 for life insurers (SIC code 6311 or 6321), and 0 for non-life insurers |
| Liquidity | | [long term debts (WC03251)] / [total debts (WC03255)] |
| Log(Assets in billions) | | Natural logarithm of total assets (WC02999) in billions |
| Loss ratio | | The aggregate of claims and change in reserve divided by earned premium (WC15549) |
| Market-to-book ratio | | [market value of equity (WC08001)] / [book value of equity (WC03501)] |
| MES | | Marginal Expected Shortfall is the losses of an insurer in the tail of the aggregate sector’s loss distribution. Refer to section 2.2 for detailed methodology and calculation. |
| Non-insurance activities | | [total liabilities (WC03351) – insurance reserves (WC03030)] / [total liabilities (WC03351)] |
| Non-insurance revenue indicator | | Other incomes besides operating incomes (WC01262) scaled by the aggregation of other incomes besides operating incomes for the whole sample |
| Non-policyholder liability indicator | | The difference between total liabilities (WC03351) and insurance reserves (WC03030), scaled by the aggregation of the difference between total liabilities and insurance reserves for the whole sample |
| Operating expenses | | [operating expenses (WC01249)] / [net sales or revenues (WC01001)] |
| Other incomes | | [other incomes besides operating incomes (WC01262)] / [net sales or revenues (WC01001)] |
| Policy (1/0) | | The policy dummy, which equals to 1 from 2012 Q1 to 2015 Q4, and 0 on or before 2011 Q4 |
| Reinsurance indicator  Revenue indicator | | Reinsurance reserve (WC01005) scaled by the aggregation of reinsurance reserve for the whole sample  Net sales or revenues (WC01001) scaled by the aggregation of sales for the whole sample |
|  | |  |
| ROA | | Return on assets (WC08326) |
| Short term funding indicator | | The difference between total debt (WC03255) and long term debt (WC03251), scaled by the aggregation of the difference between total debt and long term debt for the whole sample |
| SRISK | | Systemic Risk Index is the expected capital shortfall of an insurer during financial crisis. Refer to section 2.2 for detailed methodology and calculation. |
|  | |  |

**Table III.** **Summary statistics**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Moments** | | | | **Percentiles** | | | | |  |
| **Variable** | **Mean** | **Std. dev** | **Skewness** | **Kurtosis** | **10th** | **25th** | **50th** | **75th** | **90th** | **N** |
| ***Panel A: Systemic risk measures*** | | | | | | |  |  |  |  |
| MES (%) | 2.15 | 2.09 | 3.47 | 33.48 | 0.17 | 0.85 | 1.67 | 2.86 | 4.43 | 5422 |
| SRISK (in billions) | 3.36 | 9.07 | 3.89 | 18.55 | 0.00 | 0.00 | 0.00 | 1.11 | 10.68 | 5422 |
| ΔCoVAR (%) | -0.98 | 0.85 | -1.76 | 4.31 | -2.03 | -1.32 | -0.77 | -0.39 | -0.15 | 5422 |
|  |  |  |  |  |  |  |  |  |  |  |
| ***Panel B: Firm characteristics*** | | | | | | |  |  |  |  |
| Log (Assets in billions) | 3.30 | 1.90 | -0.38 | 0.16 | 0.78 | 2.08 | 3.30 | 4.72 | 5.87 | 5390 |
| Leverage | 10.08 | 13.41 | 6.41 | 73.26 | 1.99 | 3.06 | 5.83 | 11.9 | 22.34 | 5369 |
| Non-insurance activities | 0.30 | 0.27 | 7.50 | 115.97 | 0.09 | 0.15 | 0.24 | 0.39 | 0.58 | 4896 |
| Other incomes (%) | 0.05 | 4.42 | -9.29 | 161.71 | -1.03 | -0.04 | 0.00 | 0.18 | 1.52 | 5390 |
| Global activities | 0.27 | 0.30 | 0.81 | -0.28 | 0.00 | 0.00 | 0.15 | 0.50 | 0.73 | 4125 |
| Liquidity | 0.82 | 0.28 | -1.88 | 2.57 | 0.42 | 0.76 | 0.95 | 1.00 | 1.00 | 5057 |
| Market-to-book ratio | 1.74 | 1.36 | 3.15 | 14.66 | 0.75 | 0.96 | 1.34 | 2.06 | 3.09 | 5369 |
| Life (1/0) | 0.41 | 0.49 | 0.35 | -1.88 | 0.00 | 0.00 | 0.00 | 1.00 | 1.00 | 5422 |
| Loss ratio | 1.85 | 23.43 | 32.52 | 1094.53 | 0.52 | 0.66 | 0.80 | 1.02 | 1.43 | 4835 |
| Investment income | 0.03 | 0.02 | 0.85 | 22.99 | 0.01 | 0.02 | 0.03 | 0.04 | 0.04 | 4956 |
| ROA (%) | 2.58 | 3.40 | 3.15 | 20.43 | 0.28 | 0.70 | 1.58 | 3.54 | 5.99 | 5328 |
| Operating expenses | 0.88 | 0.12 | -0.97 | 20.70 | 0.76 | 0.83 | 0.89 | 0.94 | 0.97 | 5231 |
|  |  |  |  |  |  |  |  |  |  |  |
| ***Panel C: Country-specific macroeconomic variables*** | | | | | | |  |  |  |  |
| GDP growth (%) | 1.78 | 2.68 | 0.21 | 2.94 | -1.67 | 0.82 | 1.97 | 2.61 | 4.67 | 5422 |
| Inflation (%) | 2.25 | 1.97 | 1.51 | 4.49 | 0.05 | 1.10 | 2.07 | 3.16 | 4.48 | 5422 |
|  |  |  |  |  |  |  |  |  |  |  |
| This table presents the summary statistics for the variables used in our regression analysis. The sample is constructed by first selecting all the insurers that are constituents of the World Datastream Insurance Index. Next, all insurers with quarterly accounting data or daily stock prices unavailable in *Datastream* are omitted. The final dataset consists of 174 insurers from 33 countries. The variables are defined in Table II. | | | | | | | | | | |

**Table IV. Univariate analysis of insurers before and after the new regulation**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Total | | | G-SIIs | | | Non G-SIIs | | |
|  | G-SIIs  (1) | Non G-SIIs  (2) | Difference  (3) | Before regulation  (4) | After regulation  (5) | Difference  (6) | Before regulation  (7) | After regulation  (8) | Difference  (9) |
| MES (%) | 3.45 | 2.07 | -1.38\*\*\*  (-7.39) | 4.47 | 2.18 | -2.29\*\*\*  (-7.20) | 2.66 | 1.42 | -1.25\*\*\*  (-24.68) |
| SRISK (in billions) | 25.61 | 1.95 | -23.66\*\*\*  (-22.39) | 30.04 | 20.07 | -9.98\*\*\*  (-5.01) | 2.06 | 1.83 | -0.23  (-1.49) |
| ΔCoVAR (%) | -1.25% | -0.96 | 0.29\*\*\*  (5.53) | -1.63 | -0.76 | 0.87\*\*\*  (10.43) | -1.28 | -0.60 | 0.68\*\*\*  (32.44) |
| Log (Assets in billions) | 6.39 | 3.10 | -3.29\*\*\*  (-87.58) | 6.30 | 6.50 | 0.20\*\*\*  (3.82) | 2.97 | 3.24 | 0.27\*\*\*  (5.44) |
| Leverage | 22.26 | 9.32 | -12.94\*\*\*  (-7.33) | 27.13 | 15.81 | -11.31\*\*\*  (-3.70) | 9.38 | 9.25 | -0.13  (-0.41) |
| Non-insurance activities | 0.38 | 0.29 | -0.09\*\*\*  (-9.34) | 0.38 | 0.38 | 0.002  (0.11) | 0.31 | 0.27 | -0.04\*\*\*  (-4.52) |
| Other incomes (%) | 0.41 | 0.03 | -0.38\*\*  (-2.37) | 0.44 | 0.36 | -0.08  (-0.30) | 0.11 | -0.07 | -0.18  (-1.40) |
| Global activities | 0.44 | 0.26 | -0.18\*\*\*  (-14.23) | 0.47 | 0.40 | -0.066\*\*\*  (-2.96) | 0.30 | 0.23 | -0.07\*\*\*  (-7.53) |
| Liquidity | 0.72 | 0.83 | 0.11\*\*\*  (8.28) | 0.71 | 0.74 | 0.04  (1.64) | 0.83 | 0.83 | 0.002  (0.29) |
| Market-to-book ratio | 1.58 | 1.75 | 0.17\*\*  (2.43) | 1.66 | 1.48 | -0.18  (-1.42) | 1.76 | 1.74 | -0.01  (0.38) |
| Loss ratio | 1.06 | 1.90 | 0.84\*\*  (2.33) | 1.06 | 1.06 | 0.00  (0.01) | 0.96 | 2.92 | 1.96\*\*\*  (2.60) |
| Investment incomes | 0.03 | 0.03 | -0.002  (-1.09) | 0.03 | 0.03 | 0.002  (0.77) | 0.03 | 0.03 | -0.001  (-1.60) |
| ROA (%) | 0.63 | 2.71 | 2.08\*\*\*  (23.93) | 0.54 | 0.73 | 0.19  (1.42) | 2.69 | 2.72 | 0.03  (0.31) |
| Operating expenses | 0.92 | 0.87 | -0.04\*\*\*  (-8.10) | 0.91 | 0.91 | -0.005  (-0.57) | 0.88 | 0.87 | -0.01\*\*\*  (-3.02) |
|  |  |  |  |  |  |  |  |  |  |
| The table above reports the univariate analysis of the three systemic risk measures and insurer characteristics before and after the new regulation. It also compares the systemic risk and characteristics of G-SIIs and non-G-SIIs. The variables are defined in Table II. t-statistics are reported in parentheses; \*, \*\*, and \*\*\* indicate significance at the 10%, 5% and 1% levels respectively. | | | | | | | | | |

**Table V. Baseline regression of systemic risks on the whole sample**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Dependent variable | | |
|  | MES (%) | SRISK (in billions) | ΔCoVAR (%) |
|  | (1) | (2) | (3) |
| Policy x GSII | -0.680\*\*\*  (-4.36) | -7.990\*  (-1.88) | 0.214\*\*\*  (3.87) |
| Log (Assets in billions) | 0.177  (1.04) | 3.972\*\*  (2.72) | -0.163\*\*  (-2.44) |
| Leverage | 0.029\*\*\*  (11.34) | 0.195\*\*\*  (4.36) | 0.002\*\*  (2.32) |
| Non-insurance activities | -0.056  (-0.48) | 2.243\*  (1.83) | -0.009  (-0.2) |
| Other incomes | -1.560  (-0.91) | 4.206  (0.89) | 0.778\*\*  (2.67) |
| Global activities | 0.464  (1.33) | 1.098  (0.64) | 0.062  (0.55) |
| Liquidity | -0.124  (-0.52) | -0.465  (-0.44) | 0.011  (0.14) |
| Market-to-book ratio | -0.003  (-0.03) | 0.148  (0.69) | 0.02  (0.85) |
| Life | 0.059  (0.06) | 16.116\*\*  (2.36) | -0.053  (-0.18) |
| Loss ratio | -0.001\*\*\*  (-4.8) | 0.001  (0.97) | -0.000  (-0.23) |
| Investment incomes | 7.223\*\*  (2.58) | -7.809  (-0.78) | -0.852  (-0.71) |
| ROA (%) | -0.028  (-0.75) | 0.049  (0.78) | -0.025\*\*  (-2.7) |
| Operating expenses | 0.53  (0.79) | 0.012  (0.01) | -0.183  (-0.69) |
| GDP growth (%) | -0.036  (-0.65) | 0.216\*  (1.73) | -0.022  (-1.48) |
| Inflation (%) | -0.04  (-0.55) | -0.161  (-1.28) | 0.022  (1.36) |
| Firm fixed effects | Yes | Yes | Yes |
| Time fixed effects | Yes | Yes | Yes |
| Observations | 3439 | 3439 | 3439 |
| R2 | 0.570 | 0.884 | 0.690 |
| The table above reports the result of running the baseline regression on the whole sample. MES, SRISK and ΔCoVAR are computed with the World Datastream Financial Index as proxy for market index. Firm fixed effects and time fixed effects are included. Standard errors are clustered at the country level and t-statistics are reported in parentheses; \*, \*\*, and \*\*\* indicate significance at the 10%, 5% and 1% levels respectively. The variables are defined in Table II. | | | |

**Table VI: Regression with market index proxied by different datastream indices**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | World Datastream Market Index | | | World Datastream Bank Index | | | World Datastream Insurance Index | | |
|  | Dependent variable | | | | | | | | |
|  | MES (%) | SRISK(in billions) | ΔCoVAR (%) | MES (%) | SRISK(in billions) | ΔCoVAR (%) | MES (%) | SRISK(in billions) | ΔCoVAR (%) |
|  | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Policy x GSII | -0.581\*\*\* (-5.63) | -7.796\* (-1.92) | 0.134\*\* (2.58) | -0.615\*\*\* (-4.12) | -7.759\* (-1.89) | 0.222\*\*\* (4.51) | -0.735\*\*\* (-4.75) | -7.913\* (-1.99) | 0.241\*\*\* (3.98) |
| Log (Assets in billions) | 0.139 (0.98) | 3.894\*\* (2.71) | -0.110\*\* (-2.52) | 0.287\*\* (2.05) | 4.101\*\*\* (2.88) | -0.147\* (-2.04) | 0.054 (0.30) | 3.946\*\* (2.69) | -0.137\* (-1.88) |
| Leverage | 0.027\*\*\* (8.39) | 0.196\*\*\* (4.38) | 0.002\*\* (2.15) | 0.029\*\*\* (11.82) | 0.192\*\*\* (4.43) | 0.002\* (2.01) | 0.024\*\*\* (10.38) | 0.193\*\*\* (4.49) | 0.003\*\* (2.64) |
| Non-insurance activities | -0.119 (-1.48) | 2.242\* (1.82) | -0.010 (-0.44) | -0.036 (-0.32) | 2.283\* (1.92) | 0.014 (0.26) | -0.142 (-0.91) | 2.277\* (1.82) | -0.022 (-0.50) |
| Other incomes | -2.181 (-1.6) | 3.664 (0.74) | 0.807\*\*\* (2.95) | -1.482 (-0.77) | 3.673 (0.80) | 1.074\*\* (2.69) | -0.952 (-0.52) | 3.987 (0.86) | 0.861\* (1.79) |
| Global activities | 0.052 (0.19) | 0.819 (0.45) | 0.040 (0.55) | 0.382 (1.17) | 1.062 (0.58) | 0.060 (0.47) | 0.118 (0.38) | 0.724 (0.41) | 0.024 (0.32) |
| Liquidity | -0.010 (-0.06) | -0.276 (-0.28) | 0.002 (0.03) | -0.132 (-0.56) | -0.510 (-0.47) | -0.002 (-0.02) | -0.108 (-0.64) | -0.446 (-0.40) | -0.034 (-0.36) |
| Market-to-book ratio | -0.025 (-0.33) | 0.156 (0.75) | 0.008 (0.44) | -0.028 (-0.42) | 0.155 (0.71) | 0.031 (1.34) | -0.141 (-1.66) | 0.128 (0.58) | 0.025 (1.12) |
| Life | -0.261 (-0.35) | 15.964\*\* (2.38) | 0.194 (0.98) | 0.510 (0.66) | 16.716\*\* (2.50) | 0.000  (0.00) | -0.978 (-1.09) | 15.776\*\* (2.31) | 0.271 (0.77) |
| Loss ratio | -0.002\*\*\* (-8.14) | 0.001 (0.87) | -0.000 (-1.42) | -0.002\*\*\* (-4.69) | 0.001 (1.06) | 0.000 (0.53) | -0.002\*\*\* (-9.86) | 0.001 (0.60) | 0.000 (0.50) |
| Investment incomes | 6.591\*\*\* (2.95) | -8.077 (-0.82) | 0.106 (0.10) | 6.97\*\*\* (2.90) | -9.019 (-0.93) | -0.237 (-0.17) | 5.768\*\* (2.38) | -6.968 (-0.72) | -0.310 (-0.26) |
| ROA (%) | 0.015 (0.41) | 0.056 (0.99) | -0.022\*\* (-2.75) | -0.036 (-0.86) | 0.037 (0.61) | -0.027\*\* (-2.49) | -0.023 (-0.53) | 0.033 (0.53) | -0.028\*\* (-2.16) |
| Operating expenses | 1.029 (1.54) | -0.036 (-0.02) | -0.28 (-1.43) | 0.403 (0.54) | 0.009 (0.01) | -0.23 (-0.75) | 0.160 (0.21) | -0.204 (-0.13) | -0.120 (-0.43) |
| GDP growth (%) | 0.039 (1.15) | 0.226\* (1.86) | -0.022\* (-1.88) | -0.033 (-0.67) | 0.201 (1.66) | -0.039\*\* (-2.13) | -0.068 (-1.11) | 0.220\* (1.77) | -0.008 (-0.66) |
| Inflation (%) | -0.026 (-0.38) | -0.143 (-1.12) | 0.010 (0.89) | -0.011 (-0.15) | -0.128 (-0.99) | 0.022 (1.35) | -0.043 (-0.58) | -0.135 (-1.13) | 0.024 (1.21) |
| Firm fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Time fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 3439 | 3439 | 3439 | 3439 | 3439 | 3439 | 3439 | 3439 | 3439 |
| R2 | 0.569 | 0.882 | 0.690 | 0.552 | 0.885 | 0.679 | 0.627 | 0.890 | 0.701 |
| The table above reports the result of running the baseline regression on the whole sample, with MES, SRISK and ΔCoVAR computed by using the World Datastream Market Index, the World Datastream Bank Index, and the World Datastream Insurance Index as proxies for market index. Firm fixed effects and time fixed effects are included. Standard errors are clustered at the country level and t-statistics are reported in parentheses; \*, \*\*, and \*\*\* indicate significance at the 10%, 5% and 1% levels respectively. The variables are defined in Table II. | | | | | | | | | |

**Table VII. Regression of systemic risks excluding data from the financial crisis**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Dependent variable | | |
|  | MES (%) | SRISK (in billions) | ΔCoVAR (%) |
|  | (1) | (2) | (3) |
| Policy x GSII | -0.448\*\*\*  (-3.61) | -6.325\*  (-1.78) | 0.186\*\*\*  (5.10) |
| Log (Assets in billions) | 0.336\*\*\*  (2.99) | 2.516\*\*  (2.61) | -0.102\*  (-2.01) |
| Leverage | 0.01\*\*\*  (3.07) | 0.174\*\*\*  (2.90) | 0.004\*\*\*  (6.97) |
| Non-insurance activities | 0.031  (0.27) | 1.794\*  (2.00) | 0.025  (0.47) |
| Other incomes | -1.844  (-1.61) | 9.736  (1.37) | 0.718\*  (1.95) |
| Global activities | 0.113  (0.43) | 0.966  (0.52) | 0.029  (0.27) |
| Liquidity | -0.07  (-0.41) | 0.381  (0.48) | -0.032  (-0.58) |
| Market-to-book ratio | -0.096\*  (-1.86) | -0.064  (-0.30) | 0.042\*\*  (2.22) |
| Life | 0.572  (1.01) | 9.742\*\*  (2.29) | 0.218  (0.97) |
| Loss ratio | -0.001\*\*\*  (-2.88) | 0.001  (0.52) | -0.000  (-0.93) |
| Investment incomes | 3.207  (1.50) | -9.328  (-0.74) | 0.238  (0.20) |
| ROA (%) | 0.053\*\*  (2.33) | 0.04  (0.53) | -0.018\*  (-2.02) |
| Operating expenses | 0.795  (1.63) | -3.587  (-1.30) | 0.017  (0.07) |
| GDP growth (%) | -0.003  (-0.08) | 0.213\*  (1.82) | -0.02  (-1.33) |
| Inflation (%) | 0.008  (0.16) | -0.023  (-0.23) | 0.016  (1.14) |
| Firm fixed effects | Yes | Yes | Yes |
| Time fixed effects | Yes | Yes | Yes |
| Observations | 2924 | 2924 | 2924 |
| R2 | 0.556 | 0.900 | 0.673 |
| The table above reports the result of running the regression on sample without data from the financial crisis. MES, SRISK and ΔCoVAR are computed with the World Datastream Financial Index as proxy for market index. Firm fixed effects and time fixed effects are included. Standard errors are clustered at the country level and t-statistics are reported in parentheses; \*, \*\*, and \*\*\* indicate significance at the 10%, 5% and 1% levels respectively. The variables are defined in Table II. | | | |

**Table VIII. Regression of systemic risks with revised time period for the *Policy* dummy**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Dependent variable | | |
|  | MES (%) | SRISK (in billions) | ΔCoVAR (%) |
|  | (1) | (2) | (3) |
| Policy x GSII | -0.643\*\*\*  (-4.65) | -8.874\*\*  (-2.45) | 0.188\*\*\*  (3.62) |
| Log (Assets in billions) | 0.203  (1.17) | 4.221\*\*  (2.49) | -0.172\*\*  (-2.53) |
| Leverage | 0.029\*\*\*  (10.76) | 0.202\*\*\*  (4.55) | 0.002\*  (1.96) |
| Non-insurance activities | -0.046  (-0.40) | 2.364\*  (1.84) | -0.012  (-0.26) |
| Other incomes | -1.479  (-0.86) | 5.056  (1.01) | 0.751\*\*  (2.68) |
| Global activities | 0.482  (1.35) | 1.288  (0.96) | 0.056  (0.49) |
| Liquidity | -0.136  (-0.56) | -0.658  (-0.57) | 0.014  (0.19) |
| Market-to-book ratio | 0.001  (0.01) | 0.204  (0.91) | 0.019  (0.82) |
| Life | 0.203  (0.22) | 17.565\*\*  (2.21) | -0.101  (-0.34) |
| Loss ratio | -0.001\*\*\*  (-4.85) | 0.002  (1.17) | -0.000  (-0.32) |
| Investment incomes | 7.346\*\*\*  (2.81) | -6.272  (-0.59) | -0.89  (-0.77) |
| ROA (%) | -0.030  (-0.79) | 0.032  (0.51) | -0.025\*\*  (-2.69) |
| Operating expenses | 0.497  (0.74) | -0.389  (-0.25) | -0.172  (-0.65) |
| GDP growth (%) | -0.037  (-0.66) | 0.208  (1.70) | -0.022  (-1.47) |
| Inflation (%) | -0.044  (-0.61) | -0.223  (-1.62) | 0.024  (1.43) |
| Firm fixed effects | Yes | Yes | Yes |
| Time fixed effects | Yes | Yes | Yes |
| Observations | 3439 | 3439 | 3439 |
| R2 | 0.570 | 0.884 | 0.689 |
| The table above reports the result of running the baseline regression with revised time period for the *Policy* dummy. To ensure all G-SIIs were certain of their designation during the time period for the *Policy* dummy, we revise the dummy so that it equals to 1 from 2013 Q4 to 2015 Q4. MES, SRISK and ΔCoVAR are computed with the World Datastream Financial Index as proxy for market index. Firm fixed effects and time fixed effects are included. Standard errors are clustered at the country level and t-statistics are reported in parentheses; \*, \*\*, and \*\*\* indicate significance at the 10%, 5% and 1% levels respectively. The variables are defined in Table II except the *Policy* dummy. | | | |

**Table IX. Regression of systemic risks on U.S. insurers and non U.S. insurers**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | US Insurers | | | Non-US Insurers | | |
|  | Dependent variable | | | | | |
|  | MES (%) | SRISK(in billions) | ΔCoVAR (%) | MES (%) | SRISK(in billions) | ΔCoVAR (%) |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
| Policy x GSII | -1.257\*\*\* (-3.15) | 0.568  (0.15) | 0.314\*\*\* (2.93) | -0.630\*\*  (-2.39) | -12.498\*\*\* (-3.1) | 0.255\*\*\* (4.54) |
| Log (Assets in billions) | 0.279  (1.38) | 2.117  (1.42) | -0.196\*\*  (-2.5) | 0.417\*  (1.91) | 4.445\*\* (2.43) | -0.156\*  (-1.85) |
| Leverage | 0.019\*\*  (2.51) | 0.254\*\*\* (10.36) | 0.004\*\*  (2.53) | 0.026\*\*\*  (3.20) | 0.104\*\* (2.06) | 0.001  (0.51) |
| Non-insurance activities | -1.823  (-1.46) | -0.271 (-0.09) | 0.470  (1.40) | -0.113  (-0.93) | 2.445\*  (1.97) | 0.002  (0.05) |
| Other incomes | -0.812  (-0.27) | 15.754\* (1.75) | 0.669  (1.56) | -1.604  (-0.75) | 0.095  (0.02) | 0.479  (1.28) |
| Global activities | -0.401  (-0.79) | 4.474\*  (1.80) | 0.246  (1.19) | 0.752\*  (1.78) | -1.656 (-1.26) | -0.063  (-0.54) |
| Liquidity | -0.657  (-0.90) | 1.091  (0.49) | 0.21  (1.09) | 0.095  (0.49) | -0.06  (-0.05) | -0.054  (-0.88) |
| Market-to-book ratio | -0.398  (-1.27) | 0.334  (0.33) | 0.104\*\*  (2.07) | -0.074  (-0.81) | 0.068  (0.28) | 0.023  (1.08) |
| Life | -1.108\*\*\* (-2.97) | 3.355\*  (1.87) | 0.149  (1.07) | 1.219  (1.12) | 16.344\*  (1.90) | -0.041  (-0.11) |
| Loss ratio | -2.612  (-1.47) | -6.902 (-1.55) | 0.666\*\*  (2.23) | -0.002\*\*\*  (-6.92) | 0.002  (1.37) | 0.000  (0.3) |
| Investment incomes | 41.528\*\* (2.05) | -30.081 (-0.94) | -11.576\*\* (-2.20) | 5.667\*\*\*  (4.21) | -12.741 (-1.59) | -1.021  (-0.87) |
| ROA (%) | -0.013  (-0.08) | 0.157  (1.38) | -0.013  (-0.50) | 0.020  (0.38) | 0.058  (0.58) | -0.017\*  (-1.76) |
| Operating expenses | 3.637  (1.04) | 0.979  (0.16) | -0.705  (-1.26) | 0.872  (0.82) | 0.862  (0.35) | -0.156  (-0.53) |
| GDP growth (%) | 67.917  (0.64) | 8.639  (0.02) | 81.875\*\* (2.06) | 0.016  (0.40) | 0.178  (1.47) | -0.006  (-0.41) |
| Inflation (%) | -406.472 (-0.65) | -41.356 (-0.02) | -488.012\*\* (-2.06) | 0.011  (0.19) | -0.067 (-0.62) | 0.01  (0.59) |
| Firm fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Time fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1009 | 1009 | 1009 | 2430 | 2430 | 2430 |
| R2 | 0.684 | 0.882 | 0.657 | 0.616 | 0.901 | 0.727 |
| The table above reports the result of running the baseline regression on U.S. insurers and non U.S. insurers separately. MES, SRISK and ΔCoVAR are computed with the World Datastream Financial Index as proxy for market index. Firm fixed effects and time fixed effects are included. Standard errors are clustered at the country level for regressions on non U.S. insurers and at the insurer level for regressions on U.S. insurers. t-statistics are reported in parentheses; \*, \*\*, and \*\*\* indicate significance at the 10%, 5% and 1% levels respectively. The variables are defined in Table II. | | | | | | |

**Table X. Regression of systemic risks with focus on large insurers instead of G-SIIs**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Define large insurers based on total assets | | | Define large insurers based on insurance reserves | | |
|  | Dependent variable | | | | | |
|  | MES (%) | SRISK(in billions) | ΔCoVAR (%) | MES (%) | SRISK(in billions) | ΔCoVAR (%) |
|  | (1) | (2) | (3) | (4) | (5) | (6) |
| Policy x Large | -0.532\*\*\*  (-3.00) | -2.133\* (-1.75) | 0.172\*\*  (2.57) | -0.425\*\*  (-2.56) | -1.883\* (-1.73) | 0.179\*\*  (2.58) |
| Log (Assets in billions) | 0.217  (1.30) | 4.554\*\* (2.34) | -0.176\*\*\* (-2.96) | 0.226  (1.35) | 4.59\*\*  (2.33) | -0.179\*\*\* (-3.08) |
| Leverage | 0.029\*\*\* (10.48) | 0.207\*\*\* (4.49) | 0.002\*\*  (2.08) | 0.029\*\*\* (10.18) | 0.206\*\*\* (4.42) | 0.002\*\*  (2.24) |
| Non-insurance activities | -0.024  (-0.20) | 2.432\*  (1.75) | -0.019  (-0.52) | -0.044  (-0.35) | 2.353\*  (1.75) | -0.013  (-0.36) |
| Other incomes | -1.473  (-0.82) | 5.568  (1.04) | 0.751\*\*  (2.73) | -1.516  (-0.85) | 5.357  (1.00) | 0.773\*\*\*  (2.80) |
| Global activities | 0.418  (1.36) | 1.126  (0.74) | 0.077  (0.79) | 0.442  (1.42) | 1.202  (0.81) | 0.074  (0.77) |
| Liquidity | -0.054  (-0.25) | -0.085 (-0.09) | -0.012  (-0.19) | -0.066  (-0.30) | -0.115 (-0.11) | -0.012  (-0.19) |
| Market-to-book ratio | -0.028  (-0.30) | 0.049  (0.23) | 0.028  (1.20) | -0.024  (-0.24) | 0.058  (0.26) | 0.029  (1.21) |
| Life | -0.067  (-0.07) | 17.66\*\* (2.05) | -0.01  (-0.03) | 0.041  (0.05) | 17.973\*\* (2.05) | -0.018  (-0.06) |
| Loss ratio | -0.002\*\*\* (-5.85) | 0.001  (0.69) | -0.000  (-0.06) | -0.002\*\*\* (-6.18) | 0.001  (0.63) | 0.000  (0.03) |
| Investment incomes | 7.571\*\*\* (2.97) | -5.81  (-0.52) | -0.964  (-0.95) | 7.707\*\*\*  (3.12) | -5.095 (-0.44) | -1.047  (-1.08) |
| ROA (%) | -0.029  (-0.76) | 0.036  (0.61) | -0.025\*\*\* (-3.04) | -0.027  (-0.71) | 0.046  (0.78) | -0.026\*\*\* (-3.05) |
| Operating expenses | 0.454  (0.76) | -0.516  (-0.30) | -0.158  (-0.69) | 0.540  (0.90) | -0.156 (-0.09) | -0.19  (-0.83) |
| GDP growth (%) | -0.039  (-0.68) | 0.187  (1.58) | -0.021  (-1.51) | -0.040  (-0.70) | 0.180  (1.52) | -0.02  (-1.49) |
| Inflation (%) | -0.028  (-0.37) | -0.098 (-0.74) | 0.018  (1.05) | -0.031  (-0.42) | -0.109 (-0.82) | 0.019  (1.07) |
| Firm fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Time fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 3439 | 3439 | 3439 | 3439 | 3439 | 3439 |
| R2 | 0.572 | 0.877 | 0.691 | 0.571 | 0.876 | 0.691 |
| The table above reports the result of running the regression on the whole sample, with the GSII dummy replaced by the Large dummy. An insurer is considered as large if its total assets or insurance reserves belong to the upper quartile of the whole sample. MES, SRISK and ΔCoVAR are computed with the World Datastream Financial Index as proxy for market index. Firm fixed effects and time fixed effects are included. Standard errors are clustered at the country level and t-statistics are reported in parentheses; \*, \*\*, and \*\*\* indicate significance at the 10%, 5% and 1% levels respectively. The variables are defined in Table II. | | | | | | |

**Table XI. Regression of systemic risks with the multiple imputation method**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Dependent variable | | |
|  | MES (%) | SRISK (in billions) | ΔCoVAR (%) |
|  | (1) | (2) | (3) |
| Policy x GSII | -0.716\*\*\*  (-4.56) | -7.369\*\*  (-2.23) | 0.234\*\*\*  (4.40) |
| Log (Assets in billions) | 0.014  (0.17) | 2.422\*  (1.70) | -0.086\*\*\*  (-2.74) |
| Leverage | 0.032\*\*\*  (12.33) | 0.194\*\*\*  (4.35) | 0.002\*\*  (2.38) |
| Non-insurance activities | -0.257\*\*  (-2.30) | 1.326\*  (1.77) | -0.006  (-0.18) |
| Other incomes | -0.159  (-0.26) | 1.997  (1.16) | -0.182  (-0.81) |
| Global activities | 0.209  (1.54) | 0.071  (0.17) | -0.028  (-0.59) |
| Liquidity | -0.036  (-0.31) | -0.775  (-1.27) | -0.02  (-0.38) |
| Market-to-book ratio | -0.008  (-0.12) | 0.001  (0.00) | 0.021  (1.58) |
| Life | -0.899\*\*  (-2.43) | 8.231  (1.26) | 0.292\*  (1.93) |
| Loss ratio | -0.001\*\*  (-2.37) | 0.002  (1.14) | 0.000  (1.34) |
| Investment incomes | 6.051\*  (1.87) | -4.502  (-0.73) | -0.534  (-0.74) |
| ROA (%) | -0.013  (-0.55) | 0.082  (1.28) | -0.004  (-0.73) |
| Operating expenses | -0.077  (-0.22) | 1.036  (0.96) | 0.167  (1.46) |
| GDP growth (%) | -0.043  (-1.35) | 0.095  (1.30) | -0.016  (-1.25) |
| Inflation (%) | -0.038  (-0.74) | -0.132\*  (-1.92) | 0.006  (0.33) |
| Firm fixed effects | Yes | Yes | Yes |
| Time fixed effects | Yes | Yes | Yes |
| Observations | 5422 | 5422 | 5422 |
| R2 | 0.543 | 0.863 | 0.6442 |
| The table above reports the result of regression analysis with the multiple imputation method to address the missing data problem. MES, SRISK and ΔCoVAR are computed with the World Datastream Financial Index as proxy for market index. Firm fixed effects and time fixed effects are included. Standard errors are clustered at the country level and t-statistics are reported in parentheses; \*, \*\*, and \*\*\* indicate significance at the 10%, 5% and 1% levels respectively. The variables are defined in Table II. | | | |

**Table XII. Univariate analysis of the systemic importance score before and after the new regulation**

|  |  |  |  |
| --- | --- | --- | --- |
|  | G-SIIs | | |
|  | Before regulation  (1) | After regulation  (2) | Difference  (3) |
| Asset indicator (%) | 3.49 | 3.00 | -0.49\*\*\*  (-3.31) |
| Revenue indicator (%) | 3.01 | 2.56 | -0.45\*\*\*  (-2.99) |
| Foreign sale indicator (%) | 5.64 | 4.40 | -1.24\*\*\*  (-3.39) |
| Reinsurance indicator (%) | 3.60 | 2.15 | -1.45\*\*\*  (-5.33) |
| Non-policyholder liability indicator (%) | 2.89 | 2.92 | 0.03  (0.13) |
| Non-insurance revenue indicator (%) | 1.58 | 1.23 | -0.35  (-0.88) |
| Short term funding indicator (%) | 4.64 | 3.70 | -0.94\*\*  (-1.99) |
| Investment cash flow indicator (%) | 3.15 | 2.76 | -0.39  (-1.36) |
| Financing cash flow indicator (%) | 3.69 | 3.28 | -0.41  (-0.75) |
| Systemic importance score (%) | 30.80 | 25.68 | -5.12\*\*\*  (-3.07) |
|  |  |  |  |
| The table above reports the univariate analysis of the systemic importance score and its constituent indicators for G-SIIs before and after the new regulation. The variables are defined in Table II. t-statistics are reported in parentheses; \*, \*\*, and \*\*\* indicate significance at the 10%, 5% and 1% levels respectively. | | | |

1. These nine insurers are Allianz SE, American International Group, Inc., Assicurazioni Generali S.p.A., Aviva plc, Axa S.A., MetLife, Inc., Ping An Insurance (Group) Company of China, Ltd., Prudential Financial, Inc., and Prudential plc. [↑](#footnote-ref-1)