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The network structure and systemic risk in the global non-life insurance market

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ABSTRACT

This paper contributes to the literature on systemic risk by assessing the systemic importance of insurers in the global non-life insurance market. First, we estimate the bilateral reinsurance claims matrix using the aggregate outstanding reinsurance data from ISIS and theoretically analyze the interconnectedness in the global reinsurance network using network indicators. The robustness of the estimated matrix is fully assured by sensitivity analysis. Second, we theoretically analyze the contagious defaults introducing the Eisenberg–Noe framework. Reinsurers play a dominant role in the reinsurance network and most of them are included in our data sample. The network analysis finds that some reinsurers with large centrality measures are central in the hierarchical structure of the network. The default analysis shows the occurrences of many stand-alone defaults and only one contagious default via the global reinsurance network after the global financial crisis. In addition, one stress test based on a hypothetical severe stress scenario predicts a few occurrences of contagious defaults in the future. It follows from these analyses that systemic risk via the global reinsurance network is relatively restricted in the global non-life insurance market. In conclusion, our methodology would help supervisory authorities develop an assessment approach for interconnectedness in the global reinsurance network and aid the implementation of insurer stress tests for default contagion.

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1. Introduction

There has been growing interest in the systemic importance of insurers among regulators, and hence the lack of both theoretical and empirical studies on the role of reinsurers[1] and their interconnectedness has become a major issue. The purpose of this study is to analyze the systemic importance of the global reinsurance network to the global non-life insurance market. The network analysis plays a significant role in the analysis of systemic importance.

In May 2012, as the global systemic risk regulation in the insurance sector, the International Association of Insurance Supervisors (IAIS) issued a consultation paper proposing an assessment methodology for Global Systemically Important Insurers (G-SIIs),[2] in which they adopted an indicator-based assessment approach consistent with the policy of the Basel Committee on Banking Supervision (IAIS, 2012a, 2013). The weight of each indicator for G-SIIs is as follows: size (5%),[3] global activity (5%), interconnectedness (40%), non-traditional insurance and non-insurance activities (45%), and substitutability (5%). Higher evaluation weighting was given to interconnectedness as well as non-traditional insurance and non-insurance activities.

In July 2012, the IAIS released a policy paper entitled "Reinsurance and Financial Stability" (IAIS, 2012b), a sequel to its 2011 policy paper "Insurance and Financial Stability" (IAIS, 2011). The paper addresses reinsurance-specific concerns and evaluates the reinsurance marketplace. It examines the relationship between reinsurance and financial stability and, more specifically, whether traditional reinsurance-related activities pose systemic risk.

"Reinsurance and Financial Stability" addresses reinsurance-specific concerns relating to market concentration rates, risks arising from accumulations and high-value risks, the similarities of reinsurance risk portfolios, and issues associated with alternative

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[1] In our study, they include both reinsurance companies and primary insurance companies who underwrite reinsurance.

[2] The FSB has consulted with the IAIS and national authorities and has decided to identify for 2014 the nine G-SIIs identified in 2013—Allianz, American International Group (AIG), Generali Assicurazioni, Aviva, Axa, MetLife, Ping An Insurance (Group) Company of China, Prudential Financial (the United States), and Prudential (the United Kingdom) (IAIS, 2014).

[3] The number shown in parentheses indicates the weight.

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risk transfer (ART), which include non-reinsurance activities such as the underwriting of credit default swaps (CDS). One of the findings of this paper is that traditional reinsurance is unlikely to cause or amplify systemic risk. Nonetheless, the interconnectedness of a reinsurance network is yet to be analyzed.

As for the relationship between the reinsurance network and default risk, Lin et al. (2015) advocate that in the reinsurance market, linkages among reinsurers (i.e., network cohesion) are a concern to an insurer given the possibility that a shock to one reinsurer may spread to others. This means that the insurer will need to consider network default risk in addition to individual insolvency risk.

Accordingly, in our study, the interconnectedness and systemic risk are analyzed as follows. First, we analyze the interconnectedness in the global reinsurance network using network indicators such as degrees and centrality measures ("network analysis"). It is to be noted that reinsurers (including primary insurers engaged in reinsurance undertaking business) are dominant in the network.

Second, we conduct the model analysis of contagious defaults. For the analysis, we apply the Eisenberg–Noe framework (Eisenberg and Noe, 2001) to the global reinsurance network and set up the default mechanism ("default analysis"). In this framework, defaults are classified into stand-alone defaults and contagious defaults, which are defaults that trigger a domino effect.[4] Because contagious defaults can be caused in a specific setting, it is important to determine whether this framework is suitable for the theoretical analysis using real-world data. Strictly speaking, this framework only describes simultaneous defaults for one period, not a dynamic setting for a multi-period context. We apply the framework to the multi-period setting using market values estimated based on a stochastic credit risk model and theoretically analyze the global reinsurance network.

In addition, it is important to validate whether many defaulted and non-defaulted insurers suffered losses because of the reinsurance payments by the defaulted counterparties. Hence, we use a stress test to analyze contagious defaults and the occurrences of indirect loss caused by the stand-alone defaults of counterparties.

An important preparation to conduct these analyses is the estimation of bilateral reinsurance claims in the global reinsurance network. It is to be noted that the robustness of the estimated bilateral matrix is fully assured by sensitivity analysis in Section 7.

The top 118 listed insurance groups in total[5] were selected for this study. It is to be noted that all listed non-life reinsurance groups are included. Hence, this sample covers a major share of the global non-life reinsurance network. Refer to Appendix A for the details.

This paper contributes to the literature on systemic risk by theoretically analyzing the interconnectedness implied in the global reinsurance network using network indicators, theoretically analyzing the contagious defaults introducing the Eisenberg–Noe framework, and conducting a stress test in the global reinsurance network.

The network analysis finds that some reinsurers with large centrality measures are central in the hierarchical structure of the network. The default analysis shows the occurrences of many stand-alone defaults and only one contagious default via the global reinsurance network after the global financial crisis. One stress test based on a hypothetical severe stress scenario predicts a few occurrences of contagious defaults in the future.

Our methodology would assist in the development of monitoring and early warning indicators related to systemic risk in the global non-life insurance market by the respective supervisory authorities. Further, it could be used in the implementation of insurers' internal systemic stress tests of default contagion.

The rest of this paper is organized as follows. Section 2 reviews the extant literature on systemic risk in the insurance sector and the measurement of interconnectedness in financial networks. Section 3 describes the mechanism of defaults in the global non-life insurance market, and Section 4 discusses the network structure and estimations of the bilateral reinsurance claims matrix and market value of assets. Section 5 describes the data used in this study. Section 6 presents the results of the risk analysis. Section 7 assesses the stability of the estimated bilateral reinsurance claims matrix, and Section 8 concludes the paper.

2. Literature review

Most recently, some papers have been published related to the measurement of systemic risk in the insurance sector. Chen et al. (2014) examine the interconnectedness between banks and insurers in the United States with Granger causality tests using the distress insurance premium as a systemic risk measure. The probabilities of default are calculated from market value data on credit default swap spreads and asset return correlations from intraday stock prices.

Kanno (2014) conducts two types of model approaches and scrutinizes each insurer's marginal systemic risk contribution to the entire Asia-Pacific insurance sector during the global financial crisis and thereafter. Kanno's paper also applies the distress insurance premium as a systemic risk measure by considering the "policyholder protection scheme" of each country and then incorporating the dynamic conditional correlation.

Bierth et al. (2015) study the exposure and contribution of 253 life and non-life insurers to systemic risk. Their analysis focuses on the exposure and contribution of individual insurers to the systemic risk of the global financial sector. They employ an insurer's Marginal Expected Shortfall (MES), Systemic Risk Index/Capital Shortfall (SRISK) and ΔCoVaR as the main dependent variables in the regression analyses. They estimate the three measures of systemic risk for each quarter using daily stock market data for sample insurers.

In general, the insurance market does not contain the feedback mechanisms that would make it fully interconnected and hence prone to potentially systemic events akin to those observed in the interbank market. However, the interconnectedness in the insurance sector has not yet been analytically explored using the contagious default approach or network theory. Hence, the literature review mainly aims to investigate the interconnectedness of the reinsurance network.

Park and Xie (2014) analyze the interconnectedness between reinsurers and US property–casualty (P/C) insurers. They present the first detailed examination on the impact of major global reinsurer insolvency on the US P/C insurance industry to illustrate the potential systemic risk caused by the interconnectedness of the insurance sector through reinsurance. They find that the likelihood of a primary insurer's downgrade increases with its reinsurance default risk exposure from downgraded reinsurers.

To the best of our knowledge, there is no paper that directly deals with the relationship between the reinsurance network and default events. However, Lin et al. (2015) investigate the role of reinsurance networks in an insurer's reinsurance purchase decision. Using network theory, they develop a framework that delineates how the pattern of linkages among reinsurers determines three reinsurance costs (loadings, contagion costs, and search and monitoring costs) and characterizes an insurer's

[4] In the Eisenberg–Noe framework, multi-step defaulting events are not expressed.

[5] They are 26 listed reinsurance groups and 92 listed primary insurance groups with the non-life gross premiums written over US$50 million for at least one year out of the period 2006–2013.

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