

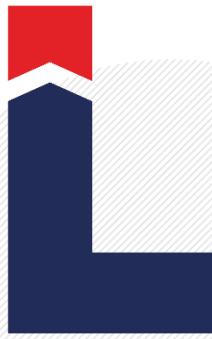


Research
Education
Outreach

CCA



**University
of Torino**



LTI@UniTO
LONG-TERM INVESTORS

Structure and complexity of global insurance groups

Anastasia Kartasheva

No. 10

November 2021

LTI WORKING PAPERS

www.carloalberto.org/lti/working-papers

© 2021 by Anastasia Kartasheva.

Any opinions expressed here are those of the authors and not those of LTI.

Structure and Complexity of Global Insurance Groups¹

Anastasia Kartasheva

19 November 2021

Abstract

The top 100 international (re)insurance groups account for 85% of the global insurance assets and thus are the driving force of the global insurance supply. Yet little is known about their internal structure, business focus and the international footprint. We fill the gap by providing the first comprehensive analysis of the structure and complexity of the global insurance groups. We construct and analyze a novel dataset on the corporate structure of the top 100 global insurance groups with headquarters located in 21 countries and their 8,000 subsidiaries located in 117 countries and offshore territories. We document how the level of internationalization and the business focus of foreign subsidiaries vary across headquarters regions as well as advanced and emerging economies. Then we examine the measures of business and geographic complexity of insurance groups and relate them to insurers' performance and their contribution to the global risk sharing.

Keywords: global insurance market, insurers' corporate structure and complexity, financial regulation.

¹ Kartasheva is affiliated with the University of St Gallen, the Long-Term Investment Initiative at the University of Torino (LTI@UniTO), the Wharton School, email: anastasia.kartasheva@unisg.ch. I thank Nicola Cetorelli, Stijn Claessens, Elisa Luciano, Giovanna Nicodano and Luca Regis for helpful comments. I am grateful to Kristina Micic for her contribution at the early stage of the project. Judy Yueh Ling Song provided excellent research assistance. I gratefully acknowledge LTI@UniTO hospitality and generous support during my research fellowship.

1. Introduction

The top 100 world largest (re)insurance groups are the driving force of the global insurance market. In aggregate, top insurance groups account for 85% of the global insurance assets and operate internationally. Yet, little is known about their structure, complexity and the global footprint. The objective of the paper is to fill the gap. We construct a novel dataset that contains detailed information about each group's corporate structure (i.e., its corporate tree), the geographical location and the business profile of group's subsidiaries in 2018. We collect information on the top 100 largest insurance groups (by asset size in 2018) that are headquartered in 21 countries, of which 17 are the advanced economies and 4 are the emerging markets. These groups are composed of about 8,000 subsidiaries that operate in 117 countries and offshore territories.

We employ the dataset to unveil a substantial diversity in the business models of insurance groups in terms of structure, business and international focus of subsidiaries. Our analysis reveals the particularities of insurance business models across the major insurance markets in Asia, Europe and North America. Then we construct measures of business and geographic group complexity and explore how complexity is related to group size, performance and ability to contribute to the global risk sharing. We also explore the systemic risk implications of the insurance group structure. That is, we relate the geographic and business structure of the group to its operation in multiple insurance prudential regulatory regimes and connect the regulatory complexity to the potential costly resolution in case of failure during the market stress. We also identify a potential for the cross-regional transmission of shocks through the network of domestic and foreign subsidiaries.

Our findings can be summarized as follows. Most of the foreign business of the major international insurance groups remains in advanced economies. That is, even though insurance groups in some regions like Europe and Japan have many foreign subsidiaries, these subsidiaries operate mainly in the UK or the US insurance markets. At the same time, the extent of internationalization of insurance groups varies significantly across regions. European and Japanese insurance groups have the highest share of foreign subsidiaries. By contrast, the US and Chinese groups are domestically focused with very limited exposure to other insurance markets. Furthermore, we find that international insurance groups actively use offshore centers in their operations. The highest share of offshore subsidiaries is in Japanese insurance groups where they account on average for 7% of all subsidiaries. Offshore subsidiaries are also common for European insurance groups, with the share of 5% and the largest absolute aggregate number of legal entities.

The major insurance groups are highly diverse in terms of their business focus. We classify the business focus of subsidiaries in four categories, (i) the core insurance business of life and non-life insurance and insurance intermediation (brokerage); (ii) reinsurance; (iii) other financial services and (iv) non-financial businesses. We find that the business focus of the insurance groups in Continental Europe is mainly in the core insurance business and reinsurance, both domestically and internationally. By contrast, the US and the Japanese insurance groups have a significant number of non-core and often non-financial subsidiaries,

creating a conglomerate structure where remotely related businesses reside under the insurance HQ. The insurance groups in the UK have distinct business models for their domestic and international subsidiaries. While domestic subsidiaries concentrate in life insurance, reinsurance and financials, the international subsidiaries have strong presence in insurance brokerage and non-financial sectors. The insurance groups in China emerge as providers of broader financial services that often extend beyond insurance. Chinese insurance groups also have a distinctively low share of reinsurance subsidiaries compared to groups in advanced economies.

Next, we quantify insurance group complexity across several dimensions and relate complexity to group size and performance. Our indicators of complexity include the total count of levels of subsidiaries in the group corporate structure, the ratio of insurance and non-insurance business as well as insurance and other financial businesses, and the Herfindahl indices of geographic and business complexity. Following the analysis of Cetorelli and Goldberg (2014) who analyze the complexity of bank holding companies operating in the US, we explore the linkages between the insurance group size and its complexity. The main finding of Cetorelli and Goldberg (2014) analysis is that the bank complexity is unequal to its size. That is, asset size is a poor predictor of bank group complexity. We perform similar analysis for the sample of the major insurance groups and find that the link between complexity and size is even weaker for the insurance companies than banks.

We also explore how group complexity is related to group performance using common market characteristics of performance, Tobin Q and return on assets. We find that insurance groups with higher *business complexity*, i.e. higher diversity of businesses between insurance and non-financial subsidiaries, obtain higher market valuations. Furthermore, it is the non-financial subsidiaries that contribute to higher valuations, while the share of non-insurance financial businesses has no significant effect. By contrast, market valuations are not affected by the insurance group size and geographic complexity. Besides providing the first assessment of the impact of group structure on performance, our results are complementary to the seminal paper by Laeven and Levine (2007) who document the diversification discount when banks combine lending and non-lending financial activities. We document the opposite effect where business complexity yields a diversification premium to global insurance groups.²

Insurance group structure can enhance the insurance group's ability to provide global risk sharing by diversifying risks internationally. Or, it can be shaped to overcome the hurdles of multiple fragmented domestic insurance supervisory regimes and capital controls. We analyze the relevance of these factors for the group structure. As a starting point, we identify the domestic insurance market attributes that explain the decision of an international insurance group to operate there the subsidiaries. Our results for insurance market corroborate with the findings of the previous research in corporate finance (La Porta et al, 2000). We find that financial development, the quality of the regulatory regime and insurance

² An important methodological difference between Laeven and Levine (2007) and our analysis is that their analysis is performed on the legal entity basis while we measure performance on the level of the HQ of an insurance group.

density in the market are positively related to the number of foreign insurance subsidiaries established by the major insurance groups.

Finally, we provide some initial analysis on whether the group structure is set up to overcome the hurdles of the regulatory regimes. Relatedly, we analyze the drivers of the decision to set up offshore subsidiaries by major insurance group. Furthermore, we explore whether complexity enables insurance groups to enter countries with high insurance protection gaps.

Our study is the first comprehensive analysis of the global insurance groups and the structure of the global insurance market. Only a few previous studies analyze the international insurance market, e.g., Berry-Stolzle et al (2013), Cole et al (2012), Outreville (2008), relying on earlier smaller cross-country datasets of insurers on the legal entity basis without regard to the group structure.³ The lack of analysis of the modern global insurance market contrasts with the growing literature on global banks. For example, in a recent review of the research on global banks, Claessens (2016) cites about 150 research papers on the topic. The international banking literature has demonstrated that while global banking brings the benefits of global risk sharing during the period of stress in hosts market, it also introduces risks related to international shock transmission. Our main contribution in the current paper is to start filling the gap in the analysis of the global insurance market.

Understanding the functioning of the global insurance market is important for several reasons. Like global banks, global insurers have become complex and highly interconnected with the capital markets. As discussed in Herring and Carmassi (2012), while increasing complexity is a response of financial conglomerates to deal with agency problems arising from asymmetric information, costly financial distress, taxes and regulation, complexity may make institutions too complex to fail. In insurance, the issue of complexity of corporate structure is magnified by the fragmented insurance regulatory regimes and the weaknesses of group supervision. As we discuss in more detail below, even in the advanced economies insurance groups operate under diverse domestic regulatory regimes. Unlike Basel III international minimum requirements in banking, no such standard is yet developed for insurance companies.

As investors, insurers and reinsurance hold over \$30 trillion of global assets under management. Insurers' business models have real effects on their asset allocation and can contribute to systemic risk (Chodorow-Reich et al (2020), Ellul et al (2021)). Because financial conglomerates' corporate structure affects their business models, it may have real effects on insurers asset allocation and insurance groups' contribution to systemic risk. Therefore, analysis of the group structure can improve the understanding of the transmission channels of systemic shocks. For example, our analysis indicates a potential transmission channel of market shocks affecting insurers asset valuations and investment returns from the US market to Japan and Europe.

³ Berry-Stolzle et al (2013) analyze a sample of about 1700 companies in 2005-2007 without regard to the group structure; Outreville (2008) considers a sample of 45 groups in 2003 but has no information about the group structure; Cole et al (2012) analyse a sample of US reinsurers in 1998-2008.

As risk managers and risk carriers, (re-) insurers provide \$5 trillion of world premium volume of insurance coverage. In particular, it permits businesses and households to insure the financial consequences of intensified natural disasters due to climate change. However, in 2018 the global protection gap, that is, the ratio between insured and total losses, for natural catastrophes was 76% - meaning that only 24% of losses are insured (Ito and McCauly, 2019; Swiss Re, 2019). The puzzle is that even in the most developed insurance markets in advanced economies the gap is 65%. Understanding the global insurance market structure can help to identify the supply imperfections contributing to the gap.

The rest of the paper is organized follows. The next section reviews the mechanisms of intragroup capital market and risk sharing. Section 3 describes the dataset and provides some basic summary statistics. Sections 4 reports the geographical and line of business characteristics of the global insurance groups. Section 5 analyzes simple measures of group complexity and reports how these measures are related to the insurance group size. Section 6 provides the analysis of the relationship between group structure and complexity characteristics and the market-based measures of group performance. Section 7 we provide a few initial analyses on the group complexity and global risk sharing. The conclusion follows.

2. Why does insurance group structure matter?

Risk pooling and diversification are at the core of the insurance business. In the seminal paper, Borch (1962) developed the framework for the analysis of the optimal risk sharing. It explains that the maximum capacity for risk bearing in the economy is attained when individual insurers trade risks with each other through an active reinsurance market. Then the insurance industry can sustain the maximum loss equal to its aggregate capacity, i.e. the total amount of the insurance industry equity capital.

In practice, most of the risk sharing in the global insurance industry is achieved within the largest insurance groups using a network of their subsidiaries rather than third-party reinsurers. Among the top 100 insurance groups in our sample, 97 are the primary insurance groups and only 3 are the reinsurance groups. Also, the size of the balance sheet of the largest insurance groups is multiples of the size of reinsurers. In fact, the size of the each of the three major reinsurers in our sample ranges about 20-45% of the size of the largest primary insurance groups. Of course, insurance groups do not operate in isolation and transfer risk between each other. Furthermore, insurance groups participate in a large variety of different businesses besides insurance, that may either diversify the risks or introduce additional co-movements with the financial markets. For these reasons, analysis of the group structure provides a significant step towards understanding the mechanisms of global risk sharing.

The insurance group structure creates an internal capital market where the individual subsidiaries can reinsurer losses or borrow capital. The extensive theoretical literature on the internal financial markets has identified several mechanisms that facilitate risk sharing and capital management or impose additional agency costs. One of the advantages of the internal capital market is that it reduces the information asymmetries among subsidiaries in the group

(see, e.g., Diamond (1991), Rajan (1992), Saunders and Walter (1994), and Stein (2002)) and improves the monitoring incentives among its members (Diamond, (1994)). As a result, it reduces the cost of internal financing relative to external financing. But the dark side of the internal capital market is that it makes it more difficult to design appropriate managerial incentive schemes and align incentives between the corporate group insiders and outsiders (Scharfstein and Stein (2000)).

Internal capital markets of large insurance groups can also fill the void in host countries where the domestic financial capital markets are poorly developed, similarly to the role of internal capital markets of the multinational corporations expanding to emerging markets (Desai, Foley and Hines (2004)). In countries with lower level of financial development, which are typically also the ones with the highest protection gaps (Swiss Re, 2019), large insurance groups may be better positioned to supply insurance capacity compared to smaller domestic players. However, in these markets the international groups may also adopt more risky strategies due to lower reputation costs and be subject to less risk-sensitive supervisory regimes.

The group structure affects the group risk bearing capacity due to the limited liability protection of the subsidiaries and the holding company which affects the costs of financial distress and, therefore, the cost of external financing (Bianco and Nicodano, 2002). Luciano and Nicodano (2014) and Nicodano and Regis (2019) analyse the corporate structure in which the holding company provides conditional guarantees to the subsidiaries and therefore increases the joint value under a tax-bankruptcy trade-off. The corporate structure with separate subsidiaries also provides a mechanism to isolate the group from fat-tail risks of some exposures. Separating some risks in a subsidiary that can become insolvent improves the solvency of the other subsidiaries in the insurance group (Ibragimov, Jaffee and Walden 2009, 2011; Jaffee and Russell, 1997; Zanjani, 2002).

3. Data

We build a comprehensive sample of the major insurance groups that enables to explore the internal organization of groups and their international presence. The unique feature of our dataset which sets us aside from a few earlier studies of the international insurance market (e.g., Altuntas et al. 2015, Berry-Stolze et al. 2013, Outreville 2008, Cole et al 2012.) is that we collect information on the corporate structure of insurance groups. These data permit to analyse the global insurance market through the lenses of the internal organization and interaction among various entities which form part of an insurance group.⁴

3.1 Sample description

The sample consists of the top 100 largest global (re)insurance groups by total assets in the end of 2017. Most of these groups have the headquarters (HQ) holding company which is an insurer. This applies to 91 internationally active insurance groups, i.e. life and health, property and casualty, reinsurance, insurance brokerage or multiline. The other 9 are large

⁴ This and next sections build on and extend the earlier joint initial work with Kristina Micic.

subsidiaries (subgroups) of non-insurance corporate groups, including asset management (3), conglomerates (4), and managed health care (2). Though the latter category is part of a larger corporate structure rather than an independent insurance group, the significance of these companies for the global insurance market is often larger than that of some smaller insurance-groups. This justifies their inclusion in our dataset. One prominent example of this kind is Warren Buffet's Berkshire Hathaway where large insurance and reinsurance subgroup is part of a non-financial conglomerate in the US. Its reinsurance operations rank it one of the top five global reinsurance players. Another example is Japan Post Insurance which is a subsidiary of the Japanese Post Holding, a national postal service. Yet, it is one of the largest life insurance companies in Japan.

Our sample is representative of the global insurance market. The total assets of insurance companies in the sample are USD 26 trillion. The total consolidated assets of the corresponding groups are more than USD 28 trillion. The discrepancy arises due to different methods in insurance consolidation.

The corporate structure and financials information is obtained from the S&P Global Market Intelligence platform. In (rare) cases of S&P MI gaps, the complementary information on total assets was obtained from the annual reports of the companies. The estimates of the domestic and global insurance market size are calculated using the OECD Insurance Statistics. OECD collects data for 35 OECD member countries⁵ and 27 non-member economies.⁶ The assessment of insurance market penetration and the insurance coverage gaps relies on the data compiled by OECD and Swiss Re.

S&P Global Market Intelligence platform (S&P MI) reports group's organizational chart and its major subsidiaries and/or major investments. Using these data, we construct corporate hierarchies (corporate trees) for each of the insurance groups (or subgroups in case of the non-insurance parent company). A hierarchy is a vertical ownership and affiliate structure, where the ultimate parent of a group, i.e. its headquarters (HQ), has either direct or indirect connection with its subsidiaries. In the direct connection, the HQ directly owns the company. In the indirect connection a company is owned by an entity located at a level below HQ which in turn can be either directly owned by the HQ or can have another immediate parent.

In the corporate structure, the *nodes* of the tree are individual companies and the *direct connections* are the ownership links between the two companies. We also define a company *level* as its distance, measured by the number of connections, from the HQ. The companies directly owned by the HQ are on the first level, the companies owned by them are on the second level, etc.

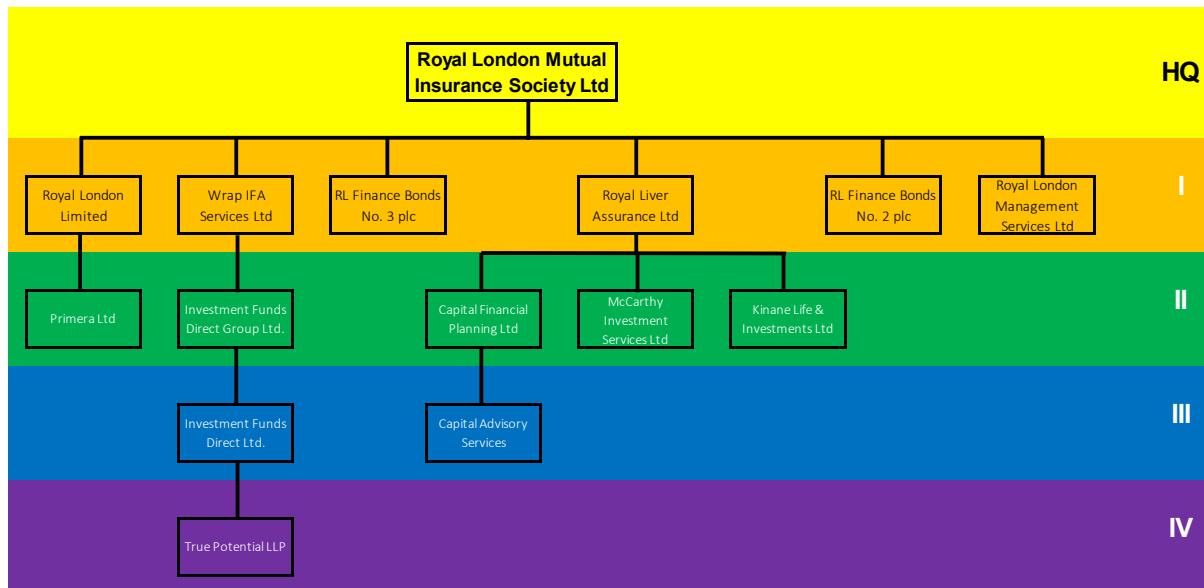
⁵ Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.

⁶ Argentina, Bolivia, Brazil, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, Honduras, Hong Kong SAR, India, Indonesia, Lithuania, Malaysia, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, Russia, Singapore, South Africa, Sri Lanka, Thailand, Tunisia and Uruguay.

There are two caveats on the completeness of the corporate trees. The group trees reported by S&P MI consists only of insurance companies and parents of insurance companies. It implies that in case an insurance entity owns a non-insurance entity which in turn owns another insurance entity, the latter one would not be recorded in our description of a corporate tree. Another feature of the data is that subsidiaries and affiliates are included in the corporate hierarchy either if 50% or more are owned by the parent with a) “an intent to derive operational or synergistic value from the company” or b) “only an intent to derive financial value from the company”; or if less than 50% is owned by the parent but the parent “has effective control of the company” (S&P MI).

To illustrate the nature of the dataset, we present one sample observation, a group corporate tree of Royal London Mutual Insurance Society Ltd, in Figure 1. Each of the groups in our sample are recorded in a similar format. The Royal London Mutual group consists of HQ and 14 subsidiaries. It has 6 subsidiaries reporting directly to HQ, which we label Level I subsidiaries. Three of them have subsidiaries down the corporate tree, with 5 subsidiaries located on Level II, 2 located on Level III and one located on Level IV. As we discuss further in the Summary Statistics section below, this example represents one of the simpler trees.

Figure 1. Corporate tree example.



For each company in a corporate tree we collect information about its country of residence, industry and identification number, type of ownership (i.e. majority subsidiary or majority investment), and ownership by the immediate parent (in per cent). In addition, where possible, we collect company’s balance sheet and income statement information, its rating by the major rating agencies and a ticker if it is publicly traded. We use all available company identifiers to be able to enrich the data in future research. Whenever possible, we record a Legal

Entity Identifier (LEI) of a company.⁷ At the group HQ level, we collect balance sheet and income statement information as presented in the insurance groups' annual reports.

There is substantial geographic and business diversity among the subsidiaries of the top insurance groups. On aggregate, the subsidiaries operate in 117 countries and a variety of insurance and non-insurance businesses. To build the indices of business and geographic complexity of a group, we condense the information in broad yet meaningful categories. We apply the geography and industry classification presented in Table 1 below.⁸

Table 1. Geography and Industry Classification.

Panel A.

INDUSTRY	LINES OF BUSINESS
Insurance	multiline, property & casualty, life & health, insurance brokerage companies
Reinsurance	reinsurance companies
Other financial	asset management companies, banks, mortgage brokers, hedge funds, other companies involved in financial services provision
Other non-financial	all others not classified in the above categories including those for which the industry is unknown (unknown accounts for only 8% of the total count of subsidiaries)

Panel B.

REGION	COUNTRIES
Advanced Asia and Pacific	Australia, Japan, New Zealand
Advanced Euro area	Austria, Belgium, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal, Spain
Advanced other Europe	Denmark, Liechtenstein, Norway, Sweden, Switzerland, United Kingdom
Advanced North America	Canada, United States
Developing Africa and Middle East	Algeria, Botswana, Burkina Faso, Cameroon, Côte d'Ivoire, Egypt, Ghana, Israel, Kenya, Kuwait, Lesotho, Madagascar, Malawi, Mali, Morocco, Mozambique, Namibia, Nigeria, Oman, Qatar, Saudi Arabia, Senegal, South Africa, Swaziland, Tanzania, Uganda, United Arab Emirates, Zambia, Zimbabwe
Developing Asia and Pacific	Azerbaijan, Cambodia, China, Chinese Taipei, India, Indonesia, Kazakhstan, Lao People's Democratic Republic, Malaysia, Nepal, Pakistan, Philippines, South Korea, Sri Lanka, Taiwan, Thailand, Vietnam

⁷ We refer to the Financial Stability Board for further information on LEI, <https://www.fsb.org/work-of-the-fsb/policy-development/additional-policy-areas/legalentityidentifier/>

⁸ In geography classification in Table 1 Panel B, we list only those countries in which the top 100 insurers have active subsidiaries. Countries listed are only those where active subsidiaries of the sampled groups are present.

Developing Europe	Bulgaria, Croatia, Czech Republic, Hungary, Latvia, Lithuania, Montenegro, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Turkey, Ukraine,
Developing Latin America and Caribbean	Argentina, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Jamaica, Mexico, Paraguay, Peru, Trinidad and Tobago, Turks and Caicos Islands, Uruguay, Venezuela
Offshore centres	Aruba, Bahamas, Bahrain, Barbados, Bermuda, British Virgin Islands, Cayman Islands, Gibraltar, Hong Kong SAR, Lebanon, Macao SAR, Netherlands Antilles, Panama, Singapore

3.2 Summary statistics

Our sample provides comprehensive overview of the global insurance industry. The total assets of insurance companies in our sample are USD 26 trillion. The total consolidated assets of the corresponding groups exceed USD 28 trillion. For comparison, the total asset size of the global insurance market is around USD 25 trillion in 2016 (OECD, 2016).

The headquarters of the 100 groups in the sample are located in 21 different countries. Table 2 reports the complete list of the HQ locations by country and the total consolidated assets of groups with HQ located in each country. It reveals that 82% (by number count) of global insurance groups are headquartered in the advanced markets in Asia, Europe and North America. Their assets represent 85% of total assets of the groups in the sample. Among the emerging markets insurance groups headquartered in China accounts for 52% of total assets in emerging markets. The insurance market is rather concentrated. In the sample, the top 9 insurance groups accounted for 25% of the consolidated total assets the sample.⁹

The corporate trees of the top 100 insurance groups consist of more than 8,000 subsidiaries located in 117 countries and territories. Table 2 provides the summary statistics of the distribution of headquarters.

Table 2. HQ Geography.

HQ country	Number of HQs	Group total assets (USD bn)
United States	28	6,851
Japan	12	5,812
United Kingdom	11	3,025
China	8	2,171
France	5	1,912
Switzerland	5	1,117
Germany	4	1,653

⁹ The largest 10 insurance groups are Allianz (Germany), Assicurazioni Generali (Italy), Aviva (UK), AXA (France), Legal and General Plc (UK), MetLife (USA), Nippon Life (Japan), Ping An (China), Prudential Financial (USA), Prudential plc (UK).

Canada	3	1,141
Chinese Taipei	3	667
Italy	3	996
Netherlands	3	858
South Korea	3	512
Australia	2	190
Hong Kong SAR	2	304
Sweden	2	193
Belgium	1	124
Bermuda	1	100
Denmark	1	87
India	1	397
Norway	1	80
Spain	1	81
Total	100	28,271

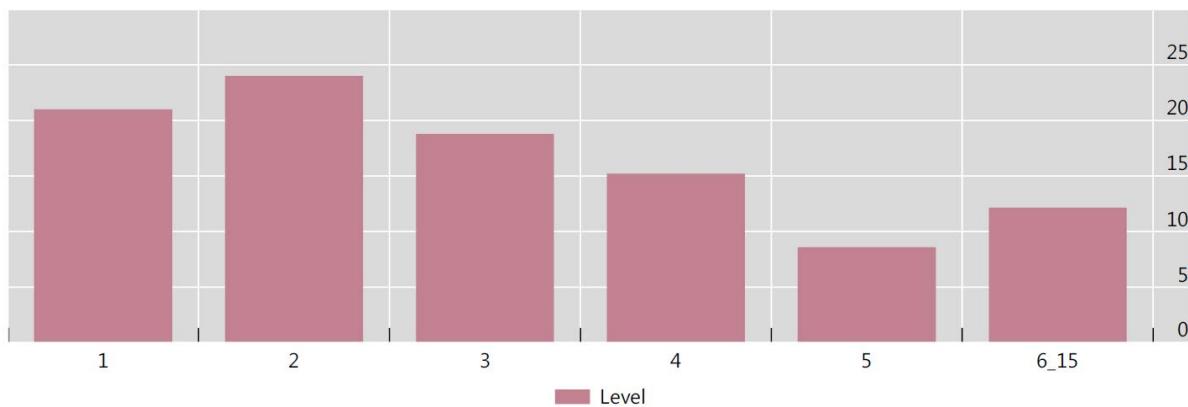
Sources: S&P Market Intelligence, companies' websites.

As we will discuss in detail below, there is a lot of diversity in the structure, business focus and the internationalization of the insurance group. Table 3 reports that on average the insurance group corporate tree consists of five levels though its depth can reach up to 15 levels. However, as Figure 1 reveals, for 88% of groups the structure does not exceed five levels. In terms of the number of subsidiaries in the group, there is a significant degree of variation around the average of 82 subsidiaries. As for the level of internationalization, foreign subsidiaries average at 46, which is slightly higher than a half of the total number of subsidiaries. Groups are also very diverse in terms of their business focus, measured by the number of non-insurance subsidiaries.

Table 3. Summary statistics on group tree structure.

	Average	St.Dev.	Min	Max
Levels	5	3	1	15
No. of subsidiaries	82	125	1	980
No. of subsidiaries outside home country	46	68	0	317
No. of subsidiaries in non-insurance business	38	90	1	746

Figure 1. Distribution of majority subsidiaries/investments across levels



4. Distinctive features of global groups

In this section, we present key stylized facts about the diversity of the structure of the major insurance groups in terms of their international presence and business focus. To illustrate the richness of the business models and organization structures, we spotlight on the insurance groups with HQs in the core insurance markets – China, Continental Europe, Japan, United Kingdom and United States.¹⁰

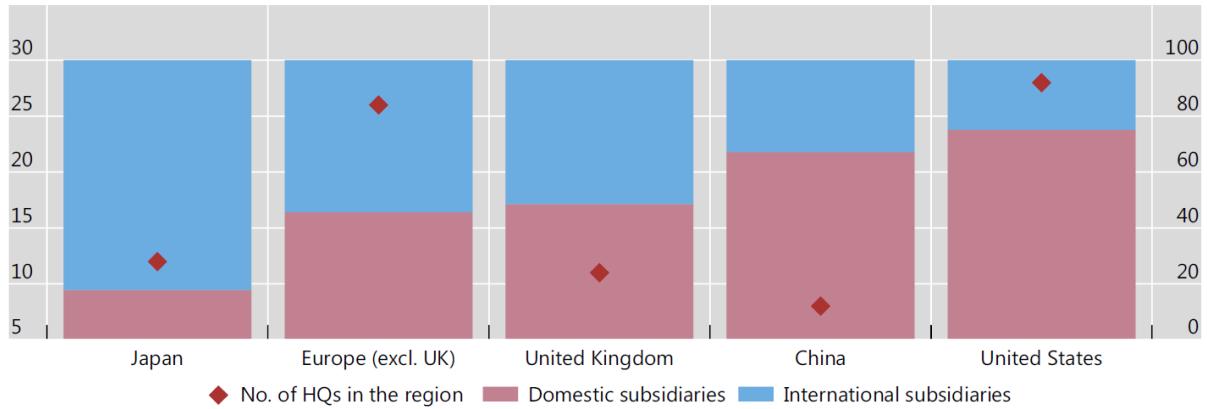
4.1 International footprint of insurance groups

The major insurance groups vary a lot in the degree of internationalization, i.e. the importance of foreign subsidiaries in the corporate structure. Figure 5 depicts the distribution between home and foreign subsidiaries for groups with HQs in the core insurance markets. The red dots correspond to the left scale and show the number of HQs in each of the regions, reflecting the importance of the European and the US groups in the global insurance market. The bars correspond to the right scale and show the distribution of the aggregate number of the domestic and international subsidiaries for the regional insurance groups. On the two extremes of the range are the insurance groups headquartered in Japan and the US. While the Japanese groups on average have 80% of international subsidiaries, the US groups have only 20% of the foreign subsidiaries. In the middle of the range are the EU and the UK insurance groups which split their business equally between the domestic and international markets. As for the Chinese insurance groups, their focus is 70% domestic and 30% international. The domestic market focus of the Chinese HQ insurance groups can be explained by the low level of maturity and the growth potential of the insurance markets in China. Similarly, the Japanese insurance groups operate in a mature saturated market and thus need to expand internationally to new markets for growth. At the same time, the contrast between the internationalization of the European and the US insurance groups is a bit puzzling, given the

¹⁰ For a comprehensive view of the Chinese market, we enrich it by including insurance groups in Hong Kong, Macao and Taiwan.

similarities between the level of their economic and financial development and the degree of integration into the global economy.

Figure 5. Subsidiaries home and abroad for selected HQ locations.



* China includes Hong Kong SAR, Chinese Taipei, Macao SAR

Zooming into the destinations where the major insurance groups establish their foreign subsidiaries, Figure 6 presents the aggregate location matrix for groups in the core markets. Different sections of the pie chart correspond to the share of subsidiaries in the locations. The numbers in each section of the pie chart label the count of subsidiaries in the location.

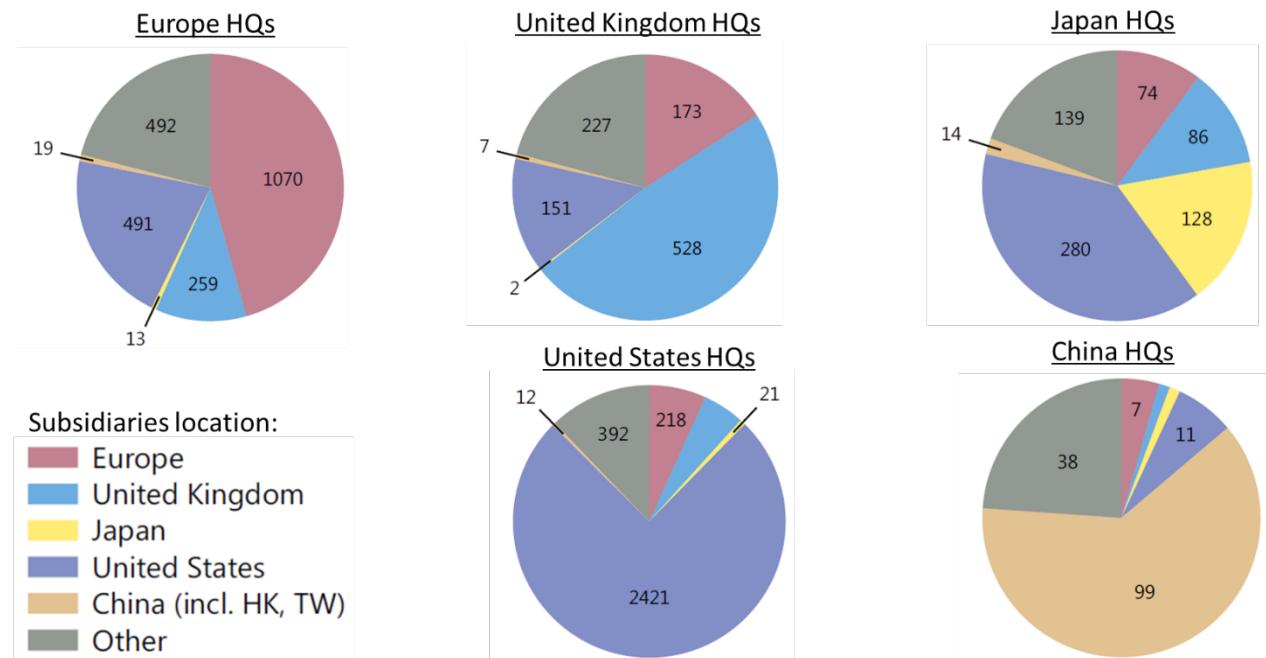
Figure 6 reveals that the most popular location for foreign subsidiaries of the Japanese and European insurance groups is the US. Among all foreign subsidiaries, 47% of subsidiaries of Japanese insurance groups and 39% of subsidiaries of the European insurance groups operate in the US insurance market. For comparison, the share of the US located subsidiaries of the UK insurance groups is only 14%. By contrast, the groups in the core insurance markets operate less than 0.5% of their subsidiaries in Japan. Figure 6 also indicates the strong degree of interconnectedness between the insurance markets in Continental Europe and the UK, with a higher exposure of the UK insurance group to Continental Europe of 16% than the Continental Europe to the UK of 11%. The exposure of the US to each of the European regions, the EU and the UK, is about 8%.

We find that the current network of interconnections in global insurance market is highly asymmetric. While the Japanese and the European groups have significant exposure to the US, the US and Chinese and the UK insurance groups have limited connections to the other core insurance markets. Thus, while the shocks in the US can have a significant effect on the operations of the domestic and foreign subsidiaries Japanese and European insurers, shocks in Japan and Europe are likely to have limited direct impact on the insurance markets in the US. However, shocks in Japan and Europe may have a significant impact on the operations of the subsidiaries of the insurance groups from these countries in other markets, particularly emerging economies. The structure of interconnections among the insurance groups in the core insurance markets unveiled by our data raises interesting questions about the role of the

global insurance groups in the international transmission of domestic market shocks and monetary policy.

To run a parallel between our findings and the analysis of propagation of market shocks and domestic monetary policy through global banks (see, e.g., Cetorelli and Goldberg (2012)), the mechanisms of transmission are likely to be different for insurers than for banks. Market volatility and monetary policy rates affect insurers' assets by changing the investment returns and liabilities by changing the regulatory reserves (Niehaus (2018), Kojien and Yogo (2021, 2015)). Then reallocation of capital within insurance groups to support underperforming or undercapitalize subsidiaries in one market can translate into the real economic effects in the other part of the group by affecting the insurance supply or by asset reallocations in insurers' investments.

Figure 6. Location matrix for major insurance markets.

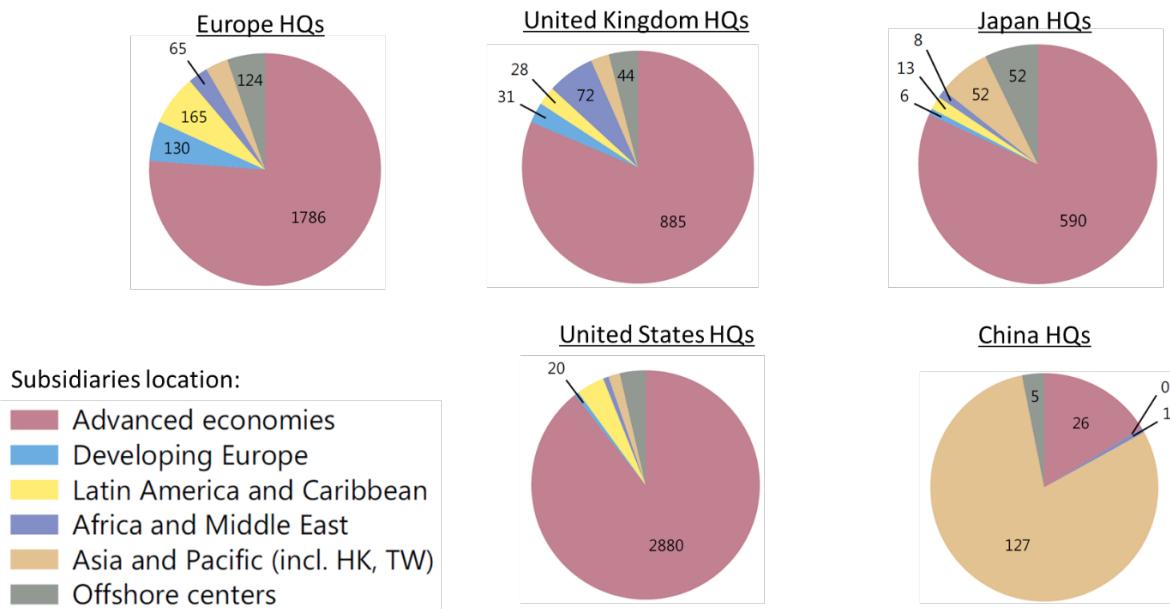


Another aspect of the structure of the global insurance groups relevant for assessing their ability to contribute to the global risk sharing is the distribution of the foreign subsidiaries between advanced and emerging markets. Figure 7 reports the location matrix of the insurance groups in the major insurance markets across various geographies. We find that most subsidiaries of the insurance groups remain in advanced economies rather than adventure to emerging markets. The highest share (and count) of subsidiaries in emerging markets are owned by the European insurance groups and amount to 17% of subsidiaries. The share of subsidiaries in emerging markets among the Japanese and the US insurance groups is only 7%.

Figure 7 also unveils a considerable role of offshore subsidiaries in the functioning of the global insurance groups. The use of offshore locations is particularly pronounced among the Japanese groups with 7% of offshore subsidiaries among all subsidiaries and followed by insurance groups in Continental Europe with 5% of offshore subsidiaries. Though at lower level of 3%, offshore subsidiaries are also common in insurance groups in the other core markets. Further analysis is needed to explain the differential intensity of using of offshore subsidiaries by insurance groups across markets. However, the likely purpose of these subsidiaries are tax and legal structure optimization.

In sum, our data shows that there is a substantial variation in the international focus of the major insurance groups. While Japanese, European and UK insurance groups are very international with a diverse set of host countries for their subsidiaries, the US and Chinese insurance groups are primarily focused on their domestic markets. Also, we find that insurance remains the advanced economies business. Even though global insurance groups have subsidiaries in emerging markets, the share of these subsidiaries in the corporate structure of major groups is relatively small and their position in a group is peripheral. We provide further analysis of the factors that affect the insurance group entry in emerging market in Section 6. The analysis also uncovers a substantial use of offshore centers in the core insurance business.

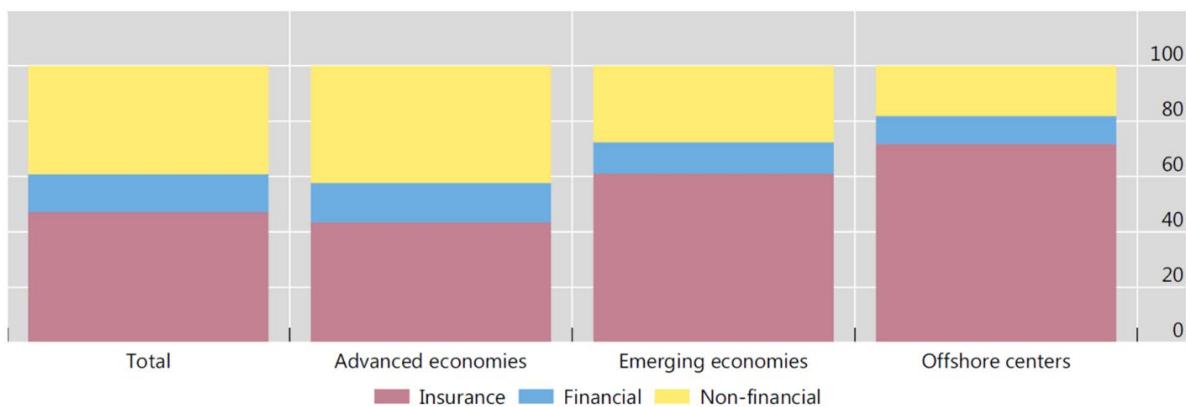
Figure 7. Location matrix for advanced and emerging economies and offshore centers



4.2 Business focus of insurance groups

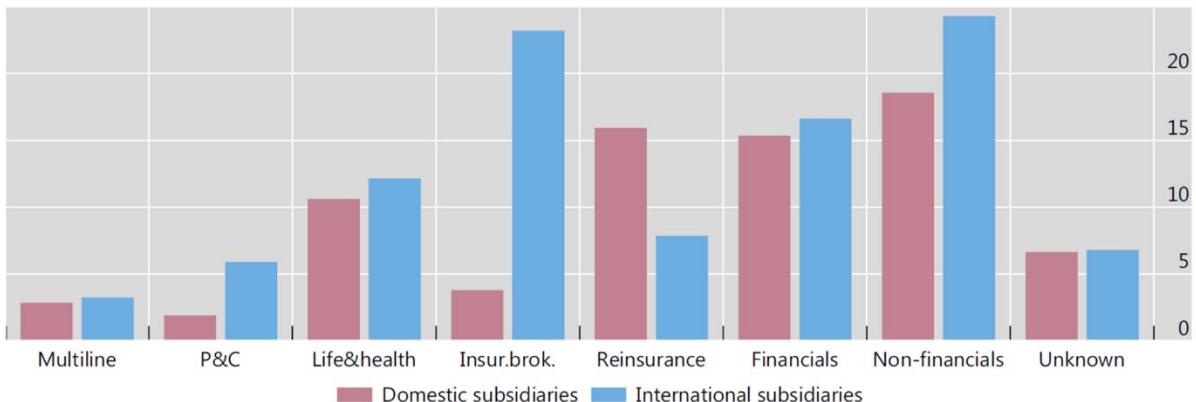
The diversity of the business focus of subsidiaries within the insurance group is another important element of the group structure. Figure 8 reports the business area of subsidiaries by location aggregated to advanced and emerging economies and offshore centers. It shows that the insurance groups have substantial amount of businesses besides the core insurance business. In aggregate, insurance subsidiaries account for about 50% of the total number of subsidiaries followed by non-financial subsidiaries (40%) and other financial businesses (10%). The share of insurance subsidiaries is slightly lower in the advanced economies and it is more prominent in emerging markets and offshore centers. These data suggest that the insurance groups expand to emerging market primarily for the purpose of doing insurance business. Also, the data indicates that the offshore subsidiaries are used primarily for facilitating insurance and reinsurance business of the major insurance groups.

Figure 8. Business area of subsidiaries by location



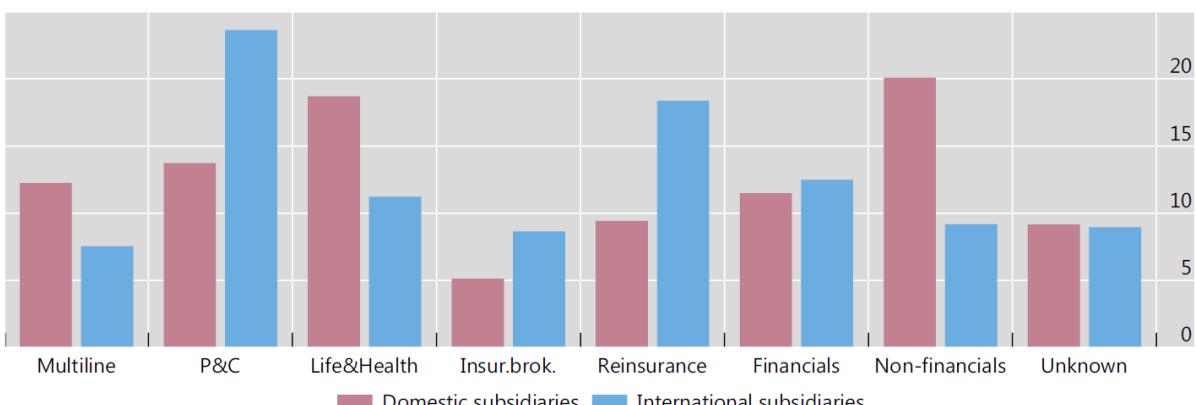
Next, we present the results for the major insurance markets. Figure 9 depicts the composition of the subsidiaries' business focus for the UK headquartered insurance groups and distinguishes between the domestic and international subsidiaries. Domestically, the UK insurance groups have a significant share of reinsurance, financial and non-financials subsidiaries. Internationally, their subsidiaries are in insurance brokerage and non-financial businesses. Overall, the business focus of the subsidiaries of the UK insurance groups is in insurance brokerage and reinsurance rather than the primary insurance business in life and non-life insurance. The UK insurance groups also have a substantial number of non-insurance subsidiaries in both financial and non-financial sectors. These results suggest that the UK insurance groups are focused on the primary insurance business domestically but operate reinsurance and insurance brokerage businesses internationally.

Figure 9. Subsidiaries business lines: UK HQs



These results contrast with the structure of the European headquartered insurance groups. Unlike their UK peers, the European insurers expand to the foreign markets with the primary insurance business. As an illustration of the scope of primary insurance business abroad, a Swiss HQ group Zurich AG, one of the largest global insurers, has 45% of its non-life portfolio business in auto policies in the US market. Figure 10 provides the details on the business focus of European insurance groups. It shows that the primary focus of subsidiaries of the European insurance groups is indeed in non-life insurance and reinsurance market segments. Overall the business profile of the European insurance groups is rather balanced both domestically and internationally. Their domestic operations are more tilted to life and health insurance and nonfinancial subsidiaries. The international focus is in non-life insurance and reinsurance. The share of non-core insurance business in either financial or non-financial segments is less pronounced compared to the UK groups, both domestically and internationally.

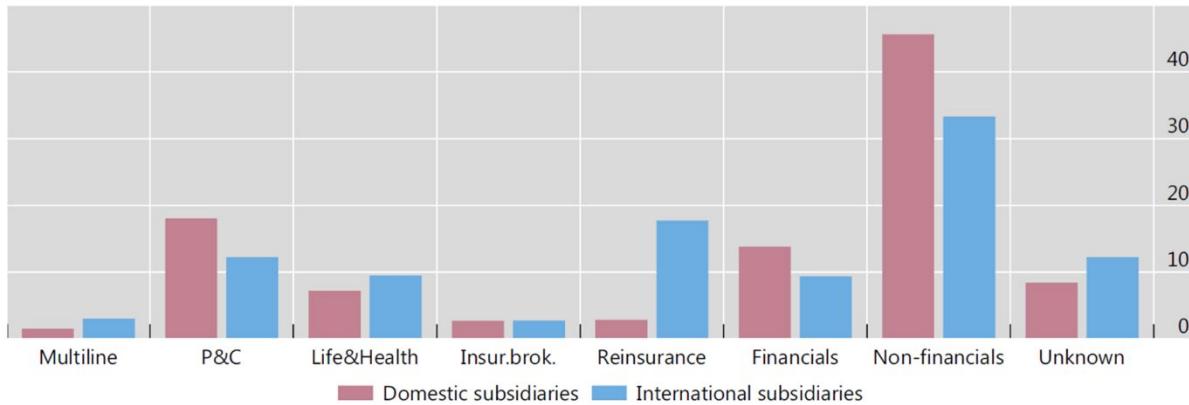
Figure 10. Subsidiaries business lines: European HQs



The US groups, unlike the European peers, have a distinct number of non-financial subsidiaries in their group structure. As Figure 11 illustrates, non-financial subsidiaries account for more than 40% of the domestic subsidiaries and more than 30% of international subsidiaries. One distinct group in terms of the diverse mix of insurance and non-insurance businesses is the Berkshire Hathaway, the Warren Buffet's conglomerate. Figure 11 also shows

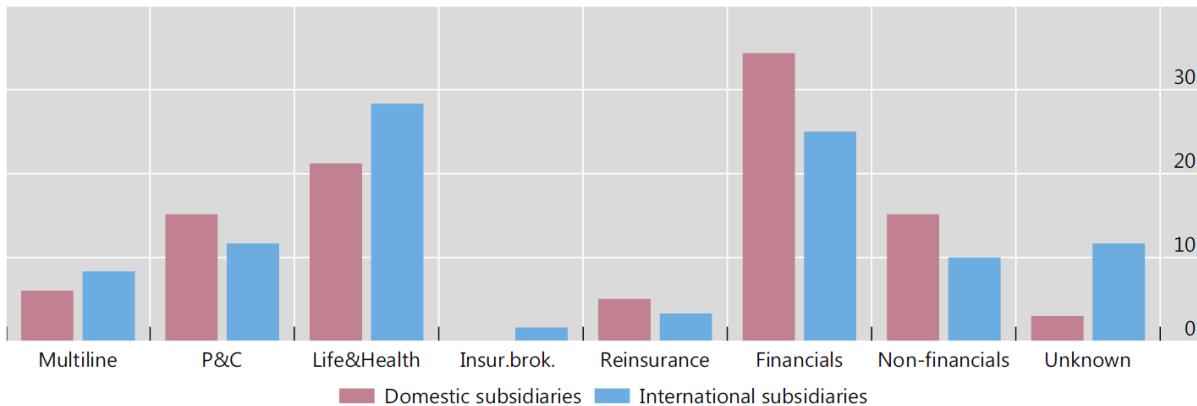
that the reinsurance subsidiaries of the US insurance groups are often located abroad. In part driven by regulation, Bermuda is the common location for the reinsurance subsidiaries of the US groups.

Figure 11. Subsidiaries business lines: US HQs



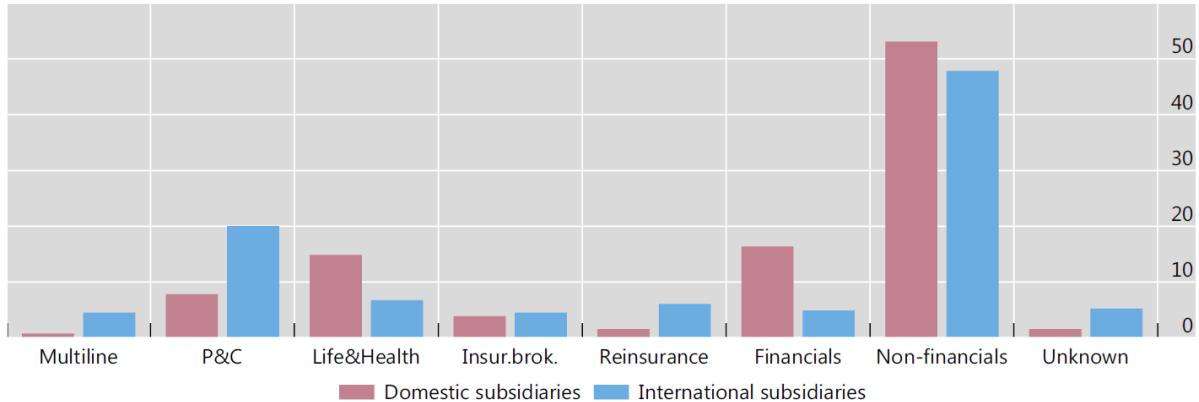
The business profile of the Chinese insurance groups indicates that they emerge as providers of a range of financial services in addition to insurance. Figure 12 shows that Chinese insurance groups have a high share of subsidiaries in life insurance and financial services. The share of life insurance is more pronounced than the share of non-life, and it is also the main focus of the Chinese insurance groups foreign subsidiaries. One interesting finding is that the share of reinsurance subsidiaries is surprisingly small.

Figure 12. Subsidiaries business lines: China HQs



Finally, the business focus of the Japanese insurance groups depicted on Figure 13 reveals a strong presence of the non-financial subsidiaries in Japanese insurance groups, both domestically and abroad. The share of the non-financial subsidiaries is the highest for the Japanese insurance groups which sets them distinct from the groups in the other major market. In terms of the primary insurance business, the most domestic subsidiaries of Japanese groups are in life insurance while their foreign subsidiaries are in the non-life insurance business. Domestic life insurance business is also complemented by a significant share of other financial services.

Figure 13. Subsidiaries business lines: Japan HQs



Overall, the data demonstrates that there is substantial diversity in business models in mature insurance markets. European insurance groups are primarily focused on the core life and non-life insurance business, both domestically and internationally. As for the UK groups, their expertise has been traditionally in reinsurance and insurance intermediation. The US and Japanese insurance group usually have a high share of non-insurance subsidiaries, making them comparable to diverse conglomerates with a mix of different businesses under the same HQ holding company. The Chinese groups appear as broader financial service providers with a high share of savings and pension purpose life insurance products.

5. Measures of complexity and their relation to group size

The complexity of an insurance group has multiple dimensions. We use several metrics which aim to capture different aspects of the group structure. The total number of subsidiaries, the number of levels in the corporate tree of a group and the variety of activities across businesses and locations are all relevant features of the group complexity. Often the complexity of a financial institution is associated with its size, particularly in the context of too-big-to-fail (TBTF) debates.

To quantify the groups' geographic and business complexity we use the indices which measure the dispersion of group's subsidiaries across the categories. Our approach follows Cetorelli and Goldberg (2014) who analyze the geographic and business focus dimensions for banking groups operating in the US. Then we also evaluate the relationship between complexity and size of the insurance group. We compare the significance of the complexity/size for banks and insurers.

The index of geographic complexity of a group j , GC_j , is a Herfindahl index based on subsidiary regions R defined in Table 1, Panel B. It is calculated as

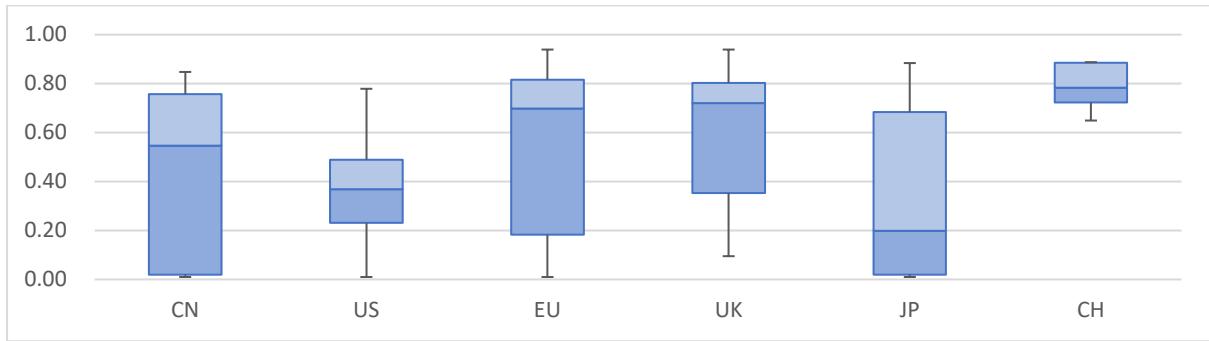
$$GC_j = \frac{R}{R-1} \left(1 - \sum_{r=1}^R \left(\frac{\text{count}_j^r}{\text{totalcount}_j} \right)^2 \right),$$

where R is the total number of regions ($R=9$), totalcount_j is the total number of subsidiaries of the insurance group j and count_j^r is the number of subsidiaries of group j in region i . GC

index values range from 0 to 1, where 0 is the lowest complexity and 1 is the highest complexity.

Figure 14 presents the result for insurance groups from a selected number of countries. The top and the bottom whiskers identify the region's maximum and minimum level of geographic complexity, the box is the range between the 25 to 75 quantiles, and the line inside the box is the median value. The index values are in line with the qualitative observations in the previous section. The GC index shows the highest level of geographic complexity for the EU, Swiss (CH) and the UK insurance groups and the lowest level of complexity for the US and Japanese insurance groups, with Chinese groups laying in the middle of the range.

Figure 14. Geographic complexity by HQ country



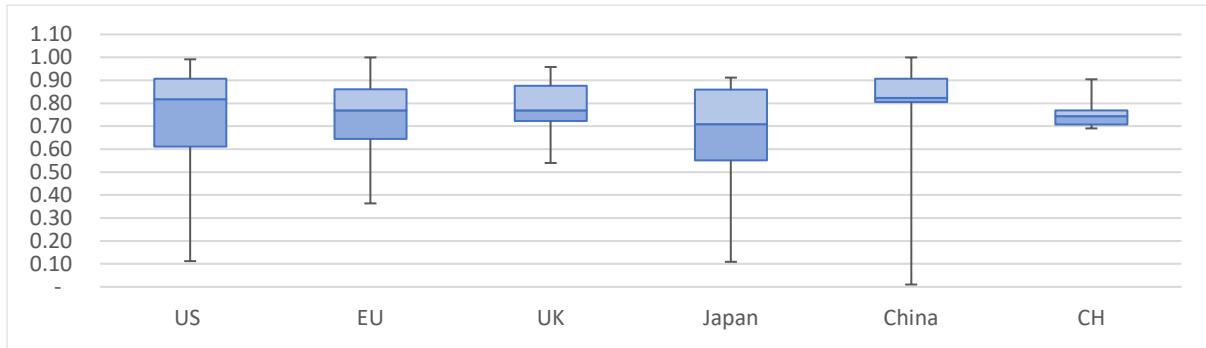
Similarly, we calculate the index for the business complexity of insurance groups. The index of business complexity BC is based on subsidiaries types defined in Table 1 Panel A. It is defined as

$$BC_j = \frac{T}{T-1} \left(1 - \sum_{i=1}^T \left(\frac{count_j^i}{totalcount_j} \right)^2 \right)$$

where T is the number of types ($T=4$), $totalcount_j$ is the total number of subsidiaries in the insurance group j and $count_j^i$ is the number of subsidiaries in type of business i for the insurance group j . Index values range from 0 to 1, where 0 is the lowest complexity and 1 is the highest complexity.

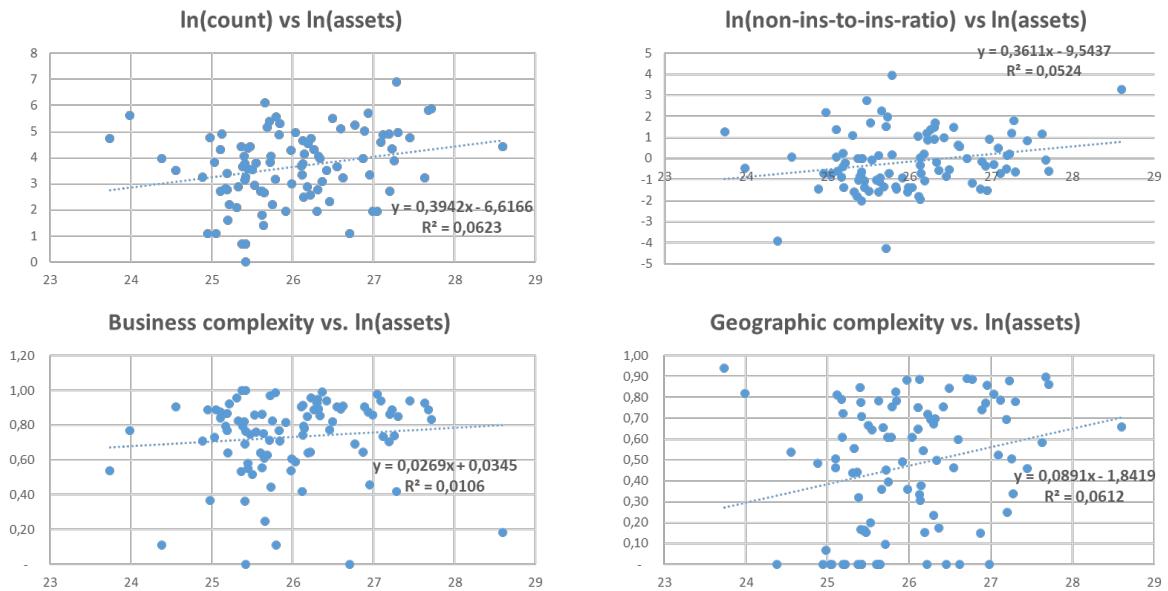
The results presented in Figure 15 show that the insurance groups in the EU, Japan and the US have relatively high variation in business complexity. By contrast, the US and Swiss insurance group have relatively comparable and low level of business complexity.

Figure 15. Business complexity by HQ country



Next we evaluate the relationship between the insurance group complexity and its size. A simple way to assess it is to consider the predictability of complexity measures by size. Figure 16 shows a set of four regressions. In addition to the business and geographic complexity measures presented in this section (bottom two panels), we also perform the test using a simple count of subsidiaries and the ratio of insurance to non-insurance subsidiaries (top two panels). Two findings emerge. Consistent with TBTF discussions, the relationship between size and complexity is positive and significant. That is, groups with bigger size tend to have a more complex corporate structure. However, the low level of R^2 in all four regressions indicates that the size alone is a poor predictor of complexity.

Figure 16. Relationship between insurance group complexity and its size.



A relevant benchmark to compare the relationship between size and complexity in insurance is its counterpart in banking. In Table 4 we present the comparison of the regression results for the indices of geographic and business complexity for insurers and banks using the results for the banking groups obtained in Cetorelli and Goldberg (2014).¹¹ We find that the relationship between size and complexity is weaker for insurers than for banks. For all

¹¹ We thank Nicola Cetorelli for sharing the indices of bank complexity derived in their analyses in Cetorelli and Goldberg (2014).

measures of complexity discussed above, i.e. total count of subsidiaries, the share of non-insurance to insurance subsidiaries and the business and geographic complexity indices, the ability of size to predict complexity measured by R^2 is much higher for banks than for insurers. The comparison suggests that the analysis of group complexity separately from group size is even more relevant for insurance groups than for banking groups.

Table 4. Size and complexity in insurance and banking, R^2

Measure	Banks	Insurers
ln(count) vs ln(assets)	0.786	0.062
Nonbank-to-bank ratio vs ln(assets)	0.172	-
Nonins-to-ins ratio vs ln (assets)	-	0.052
Business complexity vs ln (assets)	0.016	0.011
Geographic complexity vs ln(assets)	0.226	0.061

6. Group structure and performance

In this section we assess the relationship between insurance group complexity and its performance. To provide the preliminary tests of the effect of insurance group structure on its performance, we regress the common characteristics of market performances, Tobin q and return on assets (ROA), on the measures of the group structure discussed in the previous sections including geographic and business complexity, the number of insurance subsidiaries, the share of non-insurance and financial subsidiaries and the group size (total assets). Such analysis requires market valuations and hence is feasible only for the insurance groups that are publicly traded. In our sample of 100 insurance groups this applies to 62 groups. The other third of groups in the sample are either mutual insurance companies or privately held companies.

The results of the analysis are reported in Table 5. Panel A reports the estimation of several regression specifications of the relationship between Tobin q and the insurance groups characteristics. In column (1) we include all group characteristics, that is, the group size (log of groups' total assets), the total count of insurance subsidiaries, the share of non-core business including the non-insurance business and financial business as well as the measures of business and geographic complexity. In columns (2) to (5) we isolate different characteristics of the group structure to assess their individual contribution to the relationship between structure and performance. In column (6) we add the standard controls for the macroeconomic environment in the country of the insurance group HQ location, the long term and short term interest rates and the GDP growth.

Across all specifications that include the measure of business complexity, we find that it is positively related to the valuation of insurance groups. By contrast, it appears that the geographic complexity does not explain the groups' Tobin q. In all specifications, the estimated coefficients of the geographic complexity explanatory variable are not statistically significant and close to zero. As for the other characteristics of the insurance group structure, the larger total number of subsidiaries and the share of non-insurance business are positively

related to the insurance group's Tobit q. However, the significant coefficient obtains only in one specification (6). We also find that the share of financial business or the share of non-insurance business in the insurance group do not explain performance in our regression specifications. While the non-insurance business share is positive and statistically significant (though not economically large) in the specification (2) that tests the relationship between the shares of insurance, non-insurance and financial businesses and Tobin q, the significance is lost when the share of non-insurance business is combined with our business complexity index. As for the group size, we no not find a significant relationship with Tobin q.

We also use returns on assets (ROA) as an alternative measure of group performance. The results are presented in Table 5 Panel B. Similar to the analysis of Tobin q, we consider six distinct specifications to be able to distinguish the effect of different aspects of the insurers business model on ROA of the insurance group.

We find that ROA is positively related to the group's business complexity across all specifications. At the same time, ROA is not significantly affected by the insurance group's the geographic complexity. These results are consistent with the findings when performance is measure by Tobin q suggesting that the business complexity rather than the geographic complexity affect the group performance. We also find that ROA is positively related to the total number of subsidiaries in the group. As for the total size of the group it has a negative effect on its ROA, though the results are not significant across all specifications and in terms of the economic significance the coefficients are close to zero.

To put our findings in perspective, corporate finance theory has identified several mechanisms by which complexity (positively or negatively) affects performance, as discussed in Section 2. In an influential paper, Leaven and Levine (2007) find that banks that perform diverse activities, i.e., lending and no-lending financial services, experience a diversification discount. That is, the market valuations of financial conglomerates with multiple activities are lower than if those businesses operated the activities on stand-alone basis. Leaven and Levine (2007) argue that the result is consistent with theories that point to the agency problems created by engaging in multiple activities and suggest that the economies of scope are not sufficient to produce a diversification premium. Our analysis indicates that the balance turns in favor of diversification across business activities for insurance companies. As suggested by estimation results in Table 5, across all specification and for two measures of performance, Tobin q and ROA, the insurance group performance is positively related to its the business complexity. However, further research is necessary to explore the exact mechanism how the value is created by diversification between insurance and non-insurance businesses.

Table 5. Group structure and performance

This table analyses the relationship between insurance groups' complexity measures on the Tobin's Q of an insurance group. The sample consists of 62 publicly traded global insurance groups. *Tobin's q* and *Total assets* (in USD bn) are the averages of reported values for all quarters available from end 2016 to end 2017 in Bloomberg. *Non-insurance business* is the ratio of the number of non-insurance to insurance subsidiaries in a group. *Financial business* is the ratio of non-insurance financial subsidiaries to insurance subsidiaries. *Business complexity* and *geographic complexity* are the Herfindahl indices of complexity.

Standard errors in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels

Panel A: TOBIN's Q						
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.973*** (0.0586)	1.027*** (0.0506)	0.954*** (0.0554)	0.975*** (0.0541)	0.982*** (0.0504)	0.922*** (0.0514)
Total Assets (log)	-0.00110 (0.00981)	-0.00135 (0.00930)	0.00479 (0.00905)	0.00226 (0.00913)	0.00257 (0.00890)	-0.00425 (0.00819)
# subsidiaries / 100	0.0103 (0.00699)					0.0153*** (0.00563)
Non-insurance business	2.99e-05 (0.00165)	0.00243* (0.00132)		0.000120 (0.00163)		0.000506 (0.00138)
Financial business	0.00868 (0.0108)	-0.00217 (0.00953)		0.00914 (0.0105)		0.0129 (0.00895)
Business complexity	0.121** (0.0586)		0.125*** (0.0441)	0.133** (0.0586)	0.124*** (0.0442)	0.148*** (0.0523)
Geographic complexity	0.0354 (0.0372)		0.0433 (0.0359)			0.0320 (0.0361)
Long Term Interest Rate						-0.00132 (0.0163)
Short Term Interest Rates						0.00301 (0.0164)
GDP growth (% Annual)						0.0185* (0.0106)
Observations	62	62	62	62	62	62
R-squared	0.183	0.057	0.140	0.135	0.118	0.118

Panel B: Return on Assets (ROA)

	(1)	(2)	(3)	(4)	(5)	(6)
Intercepts	1.673** (0.678)	2.119*** (0.646)	1.246* (0.701)	1.349* (0.680)	1.482** (0.634)	1.558** (0.759)
Total Assets (log)	-0.288** (0.114)	-0.216* (0.119)	-0.166 (0.115)	-0.163 (0.115)	-0.184 (0.112)	-0.324** (0.121)
# subsidiaries / 100	0.289*** (0.0809)				0.337*** (0.0833)	
Non-insurance business	-0.0257 (0.0191)	0.0147 (0.0169)		-0.0191 (0.0205)		-0.0255 (0.0204)
Financial business	0.0266 (0.125)	-0.175 (0.121)		-0.00991 (0.131)		0.0545 (0.132)
Business Complexity	1.731** (0.678)		1.612*** (0.558)	1.948** (0.736)	1.609*** (0.557)	1.890** (0.774)
Geography Complexity	0.325 (0.431)		0.364 (0.455)			0.211 (0.533)
Long Term Interest Rates						-0.227 (0.241)
Short Term Interest Rates						0.266 (0.242)
GDP growth (% Annual)						0.120 (0.156)
Observations	62	62	62	62	62	62
R-squared	0.348	0.086	0.177	0.186	0.168	0.463

7. Complexity and global risk sharing

Higher group complexity can bring the benefits of diversification and deepen the internal capital market of the insurance group which enables insurance groups to enter less developed and more risky insurance markets with larger insurance protection gaps. However, complexity can also be a response to alleviate the regulatory barriers and capital controls. Relatedly, it can be motivated by regulatory arbitrage between various domestic insurance regulatory regimes. In this section we present some preliminary findings that explore the relationship between the insurance group complexity and global risk sharing, focusing on the domestic macroeconomic and regulatory factors that affect insurance groups incentives to set up foreign subsidiaries.

As a starting point, using the data on the location and business focus of about 8,000 subsidiaries of the major insurance groups in our sample, we estimate how the aggregate number of subsidiaries of the major groups in a particular country depends on its macroeconomic environment and domestic insurance market characteristics. We use the total number of subsidiaries in a country by the major insurance groups as a proxy for the appeal of a country's insurance market for international insurance groups. As explanatory variable, we include standard macroeconomic indicators such as the country's GDP growth, GDP per capita, the sovereign credit rating, capital controls and the financial development index. The macroeconomic variables are obtained from the World Bank and the IMF.¹² For the characteristics of its insurance market we consider insurance density, insurance penetration, the share of foreign insurers in the domestic insurance market as well as the insurance regulatory regime. The insurance market density and penetration and the share of foreign insurers in the market are obtained from OECD insurance statistics database.¹³

Insurance regulatory regimes vary significantly even among the major insurance markets, with even higher degree of diversity globally. We construct a simple index for the regulatory regime for the complete sample of 117 countries using the characteristics of regulatory regimes across countries reported by national supervisors, the International Association of Insurance Supervisors and the International Monetary Fund assessments. Our ranking is based on criteria specified below in Table 6.

Table 6. Supervisory regimes classifications

Supervisory regime	Rank	Definition
No requirements	1	No framework
Minimum capital	2	The supervisor requires minimum capital to establish and operate an insurance company
Formula, no risk weight	3	The supervisor uses a formula aggregating assets and liabilities to establish capital requirements, but there is no risk-weights
Risk Based capital	4	The supervisor uses risk-based assessment of capital needs
Economic capital US	5	US and Canada style - The capital requirement is based on a comprehensive risk-based assessment of the balance sheet and includes stress-test based capital requirements
Economic capital SII	6	Solvency II style - The capital requirement is based on a comprehensive risk-based assessment of the balance sheet and includes stress-test based capital requirements

In Table 7 we report the estimation results of three specifications, (1) the total number of insurance subsidiaries, (2) the subsidiaries in the life sector and (3) subsidiaries in the non-life

¹² The country GDP growth and GDP per capita is available at <https://data.worldbank.org/>. The IMF financial development index is available at <https://data.imf.org/?sk=F8032E80-B36C-43B1-AC26-493C5B1CD33B>

¹³ OECD insurance statistics database is available at <https://stats.oecd.org/Index.aspx?DatasetCode=INSIND>

sector. To account for possible non-linearities of the relationships between the decision to enter a given market and the country's credit rating and the regulatory regime, we consider a quadratic specification for these variables. The results show that the IMF financial development index is one of the key determinants of the insurance group setting a subsidiary in a given country. Country's credit rating is marginally significant, and the relationship is non-linear for non-life insurance. Countries with higher ratings are more attractive to insurance groups to set up their subsidiaries but at a decreasing marginal rate. The regulatory regime variables are not significant, though the coefficients have expected signs with more developed risk-based regulatory regime attracting more foreign subsidiaries. Finally, insurance penetration (which is calculated as the ratio of total insurance premiums to gross domestic product) is a factor that affects where insurance groups set their foreign non-life insurance subsidiaries. As for the life insurance business, the country GDP per capital is positively associated with the number of foreign subsidiaries.

Table 7. Domestic insurance market and insurance groups entry.

The table analyzes the relationship between the characteristics of the domestic insurance markets and the total number of insurance subsidiaries of the major insurance groups in this market. The *Financial Development Index* is the IMF index value in 2017. The *Credit Rating* is the sovereign credit rating by Moody's aggregated in 5 categories with higher category referring to a higher rating. *Regulatory Regime Rank* is the domestic regulatory regime rank constructed as reported in Table 6. *Insurance penetration* is the ratio of insurance premiums to GDP in 2017.

Standard errors in parentheses. ***, ** and * indicate statistical significance at 1%, 5% and 10% level.

VARIABLES	Total subsidiaries (1)	Life subsidiaries (2)	Non-life subsidiaries (3)
GDP Growth (%)	-10.33 (20.24)	-0.613 (1.731)	-8.014 (17.49)
GDP Per Capita (Current USD)	0.00469 (0.00366)	0.000513* (0.000301)	0.00461 (0.00286)
Financial development index	936.2*** (351.8)	88.48*** (29.36)	602.6* (310.2)
Credit Rating	414.8 (283.2)	41.94* (24.31)	447.6* (246.9)
Credit Rating^2	-59.59 (46.69)	-5.988 (4.004)	-68.18* (40.82)
Regulatory Regime Rank	217.6 (286.7)	23.50 (24.57)	196.8 (247.9)
Regulatory Regime^2	-31.66 (32.74)	-3.207 (2.805)	-30.51 (28.33)
Insurance Penetration - Total	1.018 (11.41)		
Insurance Penetration - Life		-0.582 (0.945)	
Insurance Penetration - Non-Life			65.95** (25.25)
Constant	-1,363* (768.9)	-140.5** (65.72)	-1,291* (662.4)
Observations	79	79	79
R-squared	0.189	0.226	0.257

One of the features of the global insurance groups is a high number of offshore subsidiaries. To explore the motivation for the insurance group to set up the subsidiaries in the offshore

financial centers and the relationship between the insurance group business and geographic complexity and offshore operations, we estimate how the number of the offshore subsidiaries in a group as well as their share in the total number of subsidiaries is related to the possible motives of setting up these subsidiaries. Our set of explanatory variables includes the number of regulatory regimes in which the group is operating as well as the average regulatory regime and the diversity of regulatory regimes of group's subsidiaries (calculated as the standard deviation of the regulatory regimes of group subsidiaries). In addition, we include the measure of Capital Control as reported by IMF. We also include the measures of group business and geographic complexity.

The results are reported in Table 8. We estimate that the total number of offshore subsidiaries in an insurance group is positively related to the number of the regulatory regimes in which the insurance group is operating. Also, it is negatively related to the diversity of regulatory regimes. Insurance groups are also more likely set up offshore subsidiaries if they operate a larger number of subsidiaries in countries with high capital controls. At the same time, business complexity does not affect the number of offshore subsidiaries, while the relationship between the number of offshore subsidiaries and the geographic complexity is negative.

Interestingly, the share of offshore subsidiaries in the insurance group is lower for groups operating in countries with higher average regulatory regimes. However, it is higher for groups with larger number of subsidiaries in high capital control countries.

Table 8. Offshore subsidiaries and regulatory and capital control regimes.

The table reports the regression results of the number and share of off-shore subsidiaries in the sample of the major 100 insurance groups and the regulatory regime and capital control characteristics, as well as the insurance group complexity. *Number of Regulatory Regimes* measures the total number of regulatory regimes in which the group is operating, the *Diversity of Regulatory Regimes* is the standard deviated of the regulatory regimes of the group subsidiaries, the *Average Regulatory Regime* is the mean regulatory regime. *High Capital Control* country is a country with capital control index equal to 3.

Standard errors in parentheses. ***, ** and * indicate statistical significance at 1%, 5% and 10% level.

VARIABLES	Number of Offshore Subsidiaries (1)	Share of Offshore Subsidiaries (2)
Number of Regulatory Regime	1.651*** (0.579)	-0.00178 (0.0111)
Diversity of Regulatory Regime	-3.942** (1.972)	0.0455 (0.0378)
Average of Regulatory Regime	-0.893 (0.892)	-0.0832*** (0.0171)
Total Number of Subsidiaries	0.0164*** (0.00367)	-0.000169** (7.05e-05)
No. of Subsidiaries in High Capital Control	0.196* (0.116)	0.00463** (0.00223)
Business Complexity	-1.459 (1.699)	0.00399 (0.0326)
Geographical Complexity	-6.158*** (2.163)	-0.0349 (0.0415)
Constant	8.196 (5.749)	0.498*** (0.110)
Observations	100	100
R-squared	0.664	0.426

In the last set of results, we assess whether insurance groups with higher business and geographic complexity are more capable to provide insurance in countries with higher insurance protection gaps. We use the Swiss Re (2019) classification of countries by the level of insurance protection gap and define the set of countries with high protection gap (HPG) as those that belong to the top 30% according to Swiss Re protection gap classification. Then we analyze how the total number of subsidiaries and the share of subsidiaries of the insurance group in a country with high protection gap depends on the group's business and geographic complexity. We also control for the total number of subsidiaries in a group, the total group size and the number of reinsurance subsidiaries in the group. The intensity of the reinsurance business in a group proxies for the size of the internal capital market.

The results are reported in Table 9, Panel A and Panel B. In Panel A the dependent variable is the total number of subsidiaries in HPG group of countries, distinguishing between three specifications: the total number in both life and non-life business and a breakdown in life and non-life subsidiaries. The estimation results show that the participation in HPG insurance markets is not significantly affected by the group business complexity, but it is negatively affected by groups' geographic complexity. We also find that larger groups (in terms of group assets) are more prone to expand in the life insurance sector of the HPG countries.

In Panel B we report the regression results of the share of subsidiaries in HPG countries on the measures of business and geographic complexity and other explanatory variables. Similar to Panel A, we consider three specifications, the aggregate share for life and non-life business in HPG as well as the breakdown between the life and non-life insurance business. We find that in this specification the participation in HPG markets is positively related to business complexity, particularly for life insurance business, while the group's geographic complexity does not have a significant effect.

The results of Table 9 suggest that business and geographic complexity does not imply that insurance groups are more capable to reduce the insurance protection gap. This observation is also in line with the descriptive analysis in Section 2 where we report that most subsidiaries of insurers in major insurance markets reside in advanced economies rather than emerging markets.

Table 9. Group structure and insurance protection gap.

Panel A: Number of subsidiaries in high protection gap countries			
VARIABLES	Total Subsidiaries in HPG (1)	Life Subsidiaries in HPG (2)	Non-life Subsidiaries in HPG (3)
Total Size	0.0600*** (0.0120)	2.51e-05 (0.00349)	0.0600*** (0.0105)
Total assets, USD bn	0.00617 (0.00380)	0.00294*** (0.00110)	0.00323 (0.00332)
No of Reinsurance	0.0606 (0.109)	0.0209 (0.0316)	0.0397 (0.0952)
Business Complexity	-0.718 (5.776)	-2.268 (1.678)	1.550 (5.053)
Geographical Complexity	-23.18*** (4.702)	-4.283*** (1.366)	-18.90*** (4.114)
Constant	18.37*** (3.691)	4.704*** (1.072)	13.67*** (3.229)
Observations	100	100	100
R-squared	0.563	0.276	0.564

Panel B: Share of subsidiaries in high protection gap countries			
VARIABLES	Total Subsidiaries in HPG (1)	Life Subsidiaries in HPG (2)	Non-life Subsidiaries in HPG (3)
Number of subsidiaries in the group	-0.000582* (0.000312)	-0.000399** (0.000153)	-0.000184 (0.000243)
Total assets, USD bn	5.76e-05 (9.85e-05)	8.53e-06 (4.83e-05)	4.91e-05 (7.70e-05)
No of Reinsurance	-0.00196 (0.00282)	0.000317 (0.00138)	-0.00228 (0.00221)
Business Complexity	0.267* (0.150)	0.318*** (0.0734)	-0.0518 (0.117)
Geographical Complexity	-0.0962 (0.122)	-0.00635 (0.0598)	-0.0898 (0.0954)
Constant	0.276*** (0.0958)	0.0312 (0.0469)	0.245*** (0.0748)
Observations	100	100	100
R-squared	0.100	0.234	0.041

8. Conclusion

The analysis of the structure and complexity of the top 100 global insurance groups highlights that the business models of insurance groups are very diverse across regions. We show that the business strategy of insurance groups and their international diversification are driven by the characteristics of their regional insurance market. However, some patterns are global. Insurance remains the business of the developed economies with most international subsidiaries of insurance groups in advanced economies operate in other advanced economies (or offshore centers) rather than emerging markets.

Our analysis also suggests a potential transmission channel of macroeconomic shocks through the performance of the group subsidiaries between regions. We find that due to the current structure of groups a market stress in the US is likely to affect the performance of the European and Japanese insurers but would have a limited impact on the groups with HQs in the UK and China. Also, we find that the US and the Chinese insurance groups are isolated from the rest of the world.

The analysis of the relationship between group complexity and its size shows that the two measures are complementary. Furthermore, the correlation between group size and complexity is weaker for insurance groups compared to banking groups. Next, we explore the relationship between group complexity and its performance. We find that group performance is positively related to business complexity and the total number of subsidiaries in the group. However, it is unrelated to the geographic complexity.

We also explore the relationship between the group complexity and its contribution to the global risk sharing. We find that the major insurance groups tend to set up subsidiaries in regions with higher level of financial development and higher sovereign rating. We also provide some evidence that the offshore subsidiaries of insurance groups are set up to overcome the operation across multiple regulatory regimes and to circumvent the operation in high capital control countries. Regarding the role of insurance group complexity to reduce insurance protection gap, we find some evidence that business complexity increases the tendency of insurance group to participate in life insurance sector of countries with high protection gap.

Our analysis is a first step to explore the drivers and the consequences of the structure of the global insurance market, and to provide motivation for future research. Understanding the drivers behind the positive relationship between the group business complexity and its performance as well as the relationship between the insurance group structure and the map of regulatory regimes and regulation sound like promising direction for future research.

References

- Altuntas, Muhammed, Berry-Stölzle, Thomas R. and Sabine Wende, 2015, Does one size fit all? Determinants of insurer capital structure around the globe. *Journal of Banking & Finance*, 61, 251-271.
- Bank of England, 2014, Procyclicality and structural trends in investment allocation by insurance companies and pension funds: A Discussion Paper by the Bank of England and the Procyclicality Working Group. Retrieved December 7, 2019, from <https://www.bankofengland.co.uk/-/media/boe/files/paper/2014/procyclicality-and-structural-trends-in-investment>
- Berry-Stölzle, Thomas R., Hoyt, Robert E. And Sabine Wende, 2012, Capital Market Development, Competition, Property Rights, and the Value of Insurer Product-Line Diversification: A Cross-Country Analysis, *The Journal of Risk and Insurance*, 80(2), 423-459.
- Bianco, Magda and Giovanna Nicodano, 2006, Pyramidal groups and debt, *European Economic Review*, 50(4), 937-961.
- Cetorelli, Nicola, McAndrews, James and James Traina, 2014, Evolution in Bank Complexity, *Economic Policy Review*, *Federal Reserve Bank of New York*, issue Dec, 85-106.
- Cetorelli, Nicola and Linda S. Goldberg, 2014, Measures of global bank complexity, *Economic Policy Review*, *Federal Reserve Bank of New York*, issue Dec, 107-126.
- Chodorow-Reich, G., A. Ghent, and V. Haddad, 2016, Asset insulators, Working Paper.
- Cole, Cassandra R., Ferguson, William L., Lee, Ryan B. and Kathleen A. McCullough, 2012, Internationalization in the Reinsurance Industry: An Analysis of the Net Financial Position of U.S. Reinsurers, *The Journal of Risk and Insurance*, 79(4), 897-930.
- Desai, Mihir A., Foley, C. Fritz and James R. Hines, 2004, A Multinational Perspective on Capital Structure Choice and Internal Capital Markets, *The Journal of Finance*, 59(6), 2451-2487.
- Ibragimov, R., D. Jaffee, and J. Walden, 2009. Non-diversification traps in markets for catastrophe insurance. *Review of Financial Studies*, 22, 959–993.
- Ibragimov, R., D. Jaffee, and J. Walden, 2011. Diversification Disasters. *Journal of Financial Economics*, 99(2), 333–348.
- Ito, Hiro and Robert N. McCauley, 2019, A disaster under-(re)insurance puzzle: Home bias in disaster risk-bearing, BIS working papers, No 808.
- Jaffee, D., and T. Russell, 1997. Catastrophe Insurance, Capital Markets, and Uninsurable Risks. *Journal of Risk and Insurance*, 64, 205–230.
- Herring, Richard and Jacopo Carmassi, 2012. The Corporate Structure of International Financial Conglomerates: Complexity and its Implications for Safety and Soundness. The Oxford Handbook of Banking (1 ed.) Edited by Allen N. Berger, Philip Molyneux, and John O. S. Wilson. DOI: 10.1093/oxfordhb/9780199640935.013.0008

Laeven, Luc and Ross Levine, 2007, Is there a diversification discount in financial conglomerates? *Journal of Financial Economics*, 85, 331-367.

Luciano, Elisa. and Giovanna Nicodano, 2014, Guarantees, Leverage, and Taxes. *The Review of Financial Studies*, 27(9), 2736-2772.

Nicodano, Giovanna and Luca Regis, 2019, A trade-off theory of ownership and capital structure, *Journal of Financial Economics*, 131, 715-735.

Niehaus, Greg, 2018, Managing Capital via Internal Capital Market Transactions: The Case of Life Insurers, *The Journal of Risk and Insurance*, 85(1), 69-106.

Outreville, J. Francois, 2008, Foreign affiliates of the largest insurance groups: location-specific advantages. *The Journal of Risk and Insurance*, 75(2), 463-491.

Zanjani, G., 2002. Pricing and capital allocation in catastrophe insurance. *Journal of Financial Economics*, 65, 283–305.

Appendix. Summary Statistics.

Table A1. Host Countries Characteristics Summary Statistics.

	count	mean	sd	min	max
No Subsidiaries with Holding	121	67.63636	328.9017	1	3455
No Subsidiaries (Life)	121	7.528926	29.03793	0	302
No Subsidiaries (Non Life)	121	59.27273	297.3658	0	3125
GDP Growth (Annual %)	118	3.044364	3.031155	-15.67141	9.88759
GDP Per Capita (Current) USD\$	118	19748.6	22159.52	0	107361.3
Financial development index (2017)	110	.4176	.2260703	.091	.932
Insurance Penetration - Total	84	5.16306	5.72408	.27	38.829
Insurance Penetration - Life	84	3.024488	4.871173	.19	35.64
Insurance Penetration Non Life	84	2.07744	2.39969	.03	16.65
Credit Rating (1-5)	102	2.872549	1.105088	1	5
Credit rating^2	102	9.460784	6.389458	1	25
Regulatory Regime Rank (1-6)	121	3.867769	1.303471	1	6
Regulatory Regime^2	121	16.64463	10.83194	1	36

Table A2. Host Country Characteristics Correlation Table.

	Insurance Penetration Total	Insurance Penetration Non Life	Insurance Penetration Life	GDP Per Capita Growth	GDP Per Capital (Current USD)	GDP Growth Annual (%)	Financial development index	Regulatory Regime Rank	Credit Rating	Regulatory Regime^2	Credit Rating^2	Insurance Density (Total)	Insurance Density (Life)	Insurance Density (Non-Life)	Share of Foreign Market	Share of Domestic Market
Insurance Penetration Total	1,000															
Insurance Penetration Non Life	0,439	1,000														
Insurance Penetration Life	0,850	0,221	1,000													
GDP Per Capita Growth	-0,254	-0,144	-0,049	1,000												
GDP Per Capital (Current USD)	0,772	0,578	0,529	-0,261	1,000											
GDP Growth Annual (%)	-0,157	-0,184	0,029	0,902	-0,226	1,000										
Financial development index	0,504	0,513	0,273	-0,315	0,705	-0,329	1,000									
Regulatory Regime Rank	0,467	0,469	0,294	-0,235	0,689	-0,306	0,773	1,000								
Credit Rating	-0,490	-0,510	-0,345	0,054	-0,727	0,109	-0,584	-0,597	1,000							
Regulatory Regime^2	0,472	0,472	0,294	-0,238	0,696	-0,301	0,762	0,996	-0,586	1,000						
Credit Rating^2	-0,434	-0,454	-0,323	-0,013	-0,636	0,064	-0,539	-0,551	0,977	-0,537	1,000					
Insurance Density (Total)	0,968	0,331	0,856	-0,267	0,735	-0,144	0,384	0,368	-0,409	0,375	-0,344	1,000				
Insurance Density (Life)	0,944	0,203	0,872	-0,247	0,659	-0,116	0,307	0,304	-0,338	0,311	-0,282	0,990	1,000			
Insurance Density (Non-Life)	0,681	0,888	0,394	-0,263	0,836	-0,233	0,642	0,560	-0,617	0,566	-0,537	0,622	0,504	1,000		
Share of Foreign Market	0,013	-0,197	0,090	0,218	-0,098	0,076	-0,183	0,004	-0,011	-0,025	-0,014	0,085	0,127	-0,180	1,000	
Share of Domestic Market	-0,013	0,197	-0,090	-0,218	0,098	-0,076	0,183	-0,004	0,011	0,025	0,014	-0,085	-0,127	0,180	-1,000	1,000

Table A3. Offshore Business Analysis Summary Statistics.

	count	mean	sd	min	max
Number of subsidiaries in offshore centres	100	4.18	5.816	0	28
Share of offshore subsidiaries in the group	100	.0593639	.0854206	0	.5882353
Number of regulatory regimes	100	2.78	1.33772	1	6
Diversity of regulatory regimes	100	.4661176	.3446425	0	1.527525
Average regulatory regime	100	5.200919	.4424873	3.333333	6
No of subsidiaries in countries with high capital control	100	2.14	3.77129	0	19
Total number of subsidiaries	100	81.83	124.6714	1	981
Business Complexity	100	.2977711	.2195064	.0046296	1
Geographic Complexity	100	.5608935	.2883616	.0534058	1

Table A4. Offshore Business Analysis Correlation Table.

	Number of Regulatory Regime	Regulatory Regime^2	Diversity of Regulatory Regime	Average of Regulatory Regime	Total Size	No of Subsidiary with High Capital control	Business Complexity	Geographical Complexity
Number of Regulatory Regime	1,000							
Regulatory Regime^2	0,976	1,000						
Diversity of Regulatory Regime	0,807	0,750	1,000					
Average of Regulatory Regime	-0,265	-0,244	-0,334	1,000				
Total Size	0,491	0,506	0,367	-0,267	1,000			
No of Subsidiary with High Capital control	0,504	0,503	0,251	-0,015	0,446	1,000		
Business Complexity	-0,188	-0,176	-0,167	-0,085	0,064	-0,051	1,000	
Geographic Complexity	-0,782	-0,749	-0,753	0,165	-0,341	-0,460	0,235	1,000

Table A5. Insurance Protection Gap Summary Statistics.

	count	mean	sd	min	max
No of Subsidiary on High Protection Gap Group	100	12.3	17.22548	1	89
No of Subsidiary on High PG -Life-	100	2.63	3.889003	0	21
No of Subsidiary on High PG - NonLife-	100	9.67	15.09636	0	74
Share of subsidiary High Protection Gap (Total)	100	.255421	.3114368	.0084746	1
Share of subsidiary High Protection Gap (Life)	100	.0947165	.1654098	0	1
Share of subsidiary High Protection Gap Non-Life	100	.1607045	.235825	0	1
Number of subsidiaries in the group	100	81.83	124.6714	1	981
Corporate group consolidated total assets, USD bn	100	285.5194	328.4732	20.4	2631.6
No of Reinsurance	100	7.77	13.80225	0	77
Business Complexity	100	.2977711	.2195064	.0046296	1
Geographical Complexity	100	.5608935	.2883616	.0534058	1

Table A6. Insurance Protection Gap (HPG) Correlation Table.

No of Subsidiaries in HPG Group (Total)	No of Subsidiaries in HPG, Life	No of Subsidiaries in HPG Non-Life	Share of Subsidiaries in HPG (Total)	Share of Subsidiary in HPG, Life	Share of Subsidiaries in HPG, Non-Life	Total Number of Subsidiaries	Total Assets USD bn	No of Reinsurance subsidiaries	Business Complexity	Geographical Complexity
No of Subsidiaries in HPG Group (Total)										
	1,000									
No of Subsidiaries in HPG, Life	0,627	10000,000								
No of Subsidiaries in HPG Non-Life	0,980	0,457	1,000							
Share of Subsidiaries in HPG (Total)	0,122	0,179	0,093	1,000						
Share of Subsidiary in HPG, Life	-0,099	0,163	-0,155	0,667	1,000					
Share of Subsidiaries in HPG, Non-Life	0,230	0,122	0,231	0,853	0,180	1,000				
Total Number of Subsidiaries	0,622	0,203	0,657	-0,224	-0,251	-0,120	1,000			
Total Assets USD bn	0,345	0,350	0,303	0,018	-0,042	0,054	0,247	1,000		
No of Reinsurance subsidiaries	0,456	0,262	0,452	-0,213	-0,224	-0,124	0,553	0,160	1,000	
Business Complexity	-0,081	-0,214	-0,037	0,172	0,395	-0,050	0,064	0,018	-0,216	1,000
Geographical Complexity	-0,591	-0,448	-0,559	0,050	0,176	-0,058	-0,341	-0,289	-0,376	0,235
										1,000