Concentration and financial stability in the property-liability insurance sector: global evidence

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Abstract

Purpose – This paper aims to examine the effect of concentration in the insurance sector on insurer stability for a large set of developed and developing countries. In particular, the authors test whether concentration reduces financial fragility in the insurance sector ("concentration-stability view") or decreases stability in the insurance sector ("concentration-fragility view").

Design/methodology/approach – The authors use a data set of 14,402 firm-year observations of property-liability insurers who appear in A.M. Best's Statement File Global database during the period 2004-2012. They use regression analyses to examine the effect of concentration on the stability of insurance firms and apply different measures of concentration.

Findings – The results provide empirical support for the "concentration- fragility view"; that is, higher levels of concentration are associated with decreases in the insurance sector's financial stability.

Research limitations/implications – The results have important policy implications, given that a primary purpose of insurance regulation is to protect policyholders against insurance firm defaults.

Originality/value – No previous research analyzes how recent trends in competition and consolidation, which have led to changes in insurance market concentration, affect the stability of insurance firms around the world. This research is the first paper that provides evidence on the relation between concentration and stability in the insurance sector.

Keywords Insurance, Stability, Risk management, Concentration

Paper type Research paper

Introduction

Recent trends in the insurance sector included the opening and liberalization of formerly closed insurance markets. For example, the deregulation process, which aimed to create a single European insurance market in the European Union, led to a higher degree of competition and consolidation in the European insurance sector (Fenn *et al.*, 2008). Other insurance markets around the world also experienced processes of deregulation and consolidation and, thus, changes in the competitive environment of the insurance industry (Eling and Luhnen, 2010) due to, for example, an increase in mergers and acquisitions (M&As) within the sector. Overall, these developments led to dramatic changes in the insurance sectors worldwide and, in particular, increased the level of concentration in the insurance sector.

From a classical insurance theory perspective, increases in concentration that result in a few large insurance firms are desired, as this increases the risk pools and leads to more predictable losses. However, if such increases in concentration come at the cost of lower financial stability in the insurance sector, such developments might harm both the insurance firms and policyholders. Given that insurance customers are highly risk sensitive, decreases in the insurance firms' financial stability leads to lower insurance purchases and, hence,

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decreases in the insurers' incomes (Wakker *et al.*, 1997; Epermanis and Harrington, 2006). In addition, such decreases are not desired from a regulatory perspective, given that a primary objective of insurance regulators is to prevent the default of insurance firms to protect insurance customers (Klein, 1995). Moreover, the financial stability of insurance firms is crucial for the overall economy, given their vital role as intermediaries and investors (IAIS, 2011). Against this background, we analyze the effect of concentration in the insurance sector on the insurers' financial stability for a large set of countries. In particular, we analyze whether such concentration reduces financial fragility in the insurance sector ("concentration-stability view") or decreases stability in the insurance sector ("concentration-fragility view").

Several papers analyze how consolidation and competition affect the insurers' efficiency (Cummins *et al.*, 1999). Moreover, Mühlnickel and Weiß (2015) analyze how consolidation in the international insurance industry affects the acquiring insurers' contribution to systemic risk. However, no research analyzes how recent trends in competition and consolidation, which have led to changes in insurance market concentration, affect the stability of insurance firms around the world. Given the trend of further consolidation in the insurance sector, testing the "concentration-stability view" against the "concentration-fragility view" in the insurance sector yields valuable findings for insurance regulators and executives.

We use an unbalanced data panel consisting of insurers that appear in A.M. Best's Statement File Global database during the period 2004-2012[1]. The data set contains 14,402 firm-year observations of insurers from 29 developed and developing countries. We use regression analyses to examine the effect of concentration on the stability of insurance firms. For robustness, different measures of concentration are used. Following Uhde and Heimeshoff (2009), we measure concentration by commonly used measures (the market share of the five largest insurers, the market share of the three largest insurers and a Herfindahl–Hirschman index) and insurer stability by the firms' Z-score. The Z-score has been used in various papers to measure the financial stability of banks (Laeven and Levine, 2009) and insurance firms (Shim, 2011).

Our results indicate that higher levels of concentration lead to less stable insurance firms; that is, we find empirical support for the "concentration-fragility view". This holds for all measures of concentration used throughout our analyses. This finding is consistent with the studies from the banking sector that also find a destabilizing effect of concentration on the stability of banks (Uhde and Heimeshoff, 2009) and with Mühlnickel and Weiß (2015).

We contribute to the literature by being the first paper that provides evidence on the relation between concentration and stability in the insurance sector, a topic that has been extensively investigated in the banking literature (Uhde and Heimeshoff, 2009). Our analysis also yields valuable insights on the costs and benefits of liberalization and integration in the insurance industry in terms of financial stability. In the European Union, the assumption behind the creation of a single market is that increased competition will decrease costs and increase consolidation through M&As and will lead to scale economies that make firms more efficient and profitable (Fenn *et al.*, 2008). However, given that increases in concentration reduce the insurance sector's stability, further regulatory measures that lead to more open markets should be examined. A primary objective of insurance regulators is to protect policyholders against the default of insurance firms (Klein, 1995). Reduced stability as a consequence of increased concentration, however, contradicts this goal. Hence, the results are valuable for insurance regulators around the world. Moreover, our findings are valuable for non-insurance firms, given the insurance firms' role as institutional investors. The insurance firms' assets account for approximately 12 per cent of global financial assets (IAIS,

2012), making them a major source of funds for the overall global economy. Hence, reduced stability in the insurance sector directly affects the funding in other industrial sectors.

This paper proceeds as follows. In the next section, we provide a review of the relevant literature and formulate the hypothesis to be tested. In the third section, we describe the data and methodology that we use for our empirical analysis. The results appear in the succeeding section and the conclusion follows.

Previous literature and hypothesis development

Several papers examine whether concentration and competition increase or decrease stability in the banking sector. In particular, measures of concentration have been used as a proxy for competition[2]. However, previous papers question whether competition can be adequately measured by concentration. They state that concentration is not necessarily a reliable indicator of competition (Beck *et al.*, 2006b). For example, M&A activities that increase concentration could indicate a high level of competition, not a lack thereof. A country with a few firms in a contestable market environment can be more competitive than a market that consists of firms in segmented monopolies. The level of competition increases in the case where close substitutes exist for products and when firms interact more aggressively. Therefore, measuring competition is difficult and popular measures of competition suffer from shortcomings (Schaeck and Cihak, 2014)[3]. Hence, we focus on measuring the effect of concentration instead of competition. Increases in concentration can be the result of the entry of new firms or via the consolidation among smaller firms, or both.

Previous papers (Uhde and Heimeshoff, 2009; Schaeck and Cihak, 2007; Beck *et al.*, 2006a) analyze whether concentration reduces financial fragility in the banking sector ("concentration-stability view") or decreases stability in the banking sector ("concentration-fragility view"). Proponents of the "concentration-stability view" state that banks in more concentrated banking systems may earn higher profits and therefore have higher capital buffers that reduce their exposure toward shocks (Boyd *et al.*, 2006). Furthermore, larger banks have higher franchise values (Uhde and Heimeshoff, 2009), leading to higher opportunity costs when going bankrupt. This might deter excessive risk-taking that could endanger their franchise values (Park and Peristiani, 2007). In addition, larger banks in more concentrated banking systems might realize higher economies of scale and scope due to more diversified loan portfolios (Boyd and Prescott, 1986). Moreover, banking systems with fewer large banks may be easier to monitor (Uhde and Heimeshoff, 2009). This could lead to more effective regulation and, hence, decrease the risk of system-wide contagion (Allen and Gale, 2000). Proponents of the "concentration-fragility view" state that large financial institutions would rather be considered as "too big to fail" because they are more likely to receive public guarantees (Mishkin, 1999). Thus, bank managers could be induced to engage in risky activities, leading to higher moral hazard problems. Moreover, higher risk diversification of large banks in more concentrated banking systems may lead to lower managerial efficiency and less effective corporate control (Cetorelli *et al.*, 2007). Similarly, Hicks (1935) states that managers in monopolistic firms have a "quiet life" free from competition, which allows them to extract monopoly rents by reducing their efforts (Fenn *et al.*, 2008). Finally, larger banks are more complex and therefore less transparent (Beck *et al.*, 2006a).

In the insurance sector, several studies analyze the impact of competition, concentration and consolidation on insurance firms. Consolidation can, on the one hand, promote efficiency (Cummins *et al.*, 1999) and consequently lead to more stable firms. In addition, insurers in more concentrated markets benefit from reduced competition and therefore attain monopoly rents (Mühlnickel and Weiß, 2015). Moreover, larger insurers increase their risk pools, which

should lead to risk reductions and hence lower default risk. On the other hand, large insurers in more concentrated markets can be considered as "too big to fail", which can lead to excessive risk-taking by managers. In addition, mergers, in general, increase the firms' default risk (Furfine and Rosen, 2011). Moreover, several studies examine how concentration affects the business of insurance firms in an international context. Fenn *et al.* (2008) analyze how changes in the level of competition in the European insurance market affect the efficiency of firms. The presumption is that competition drives down costs by reducing X-inefficiency, and consolidation will further reduce costs through scale economies. However, the resulting increase in market power can also have negative consequences for efficiency. Furthermore, the effect of liberalization might be limited due to the fact that local insurance firms may retain advantages against foreign competitors due to, for example, cultural heterogeneity and informational advantages (Fenn *et al.*, 2008). Mühlnickel and Weiß (2015) analyze the effects of consolidation on the acquirers' systemic-risk contribution in the international insurance industry. They find that consolidation in the insurance sector can have a destabilizing effect on the insurance sector. In addition, Fields *et al.* (2012) find that enhanced competition decreases the publicly listed insurers' risk-taking, while Altuntas *et al.* (2015a, 2015b) empirically document that insurers in countries with higher levels of concentration demand more reinsurance because the local insurers that have market power purchase less reinsurance.

Thus, the previous literature shows that the effects of bank concentration are ambiguous. In addition, previous papers in the insurance sector have documented both positive and negative consequences of concentration for insurance firms. Because we do not have a strong indication concerning whether concentration affects the stability of insurance firms either positively or negatively, we state the following hypothesis in the null form:

H1. Concentration does not affect the stability of insurance firms.

Data and methodology

Data

Our analyses are based on an unbalanced data panel consisting of insurance firms that appear in A.M. Best's Statement File Global database. The initial data set comprises all property-liability insurance companies in that data set during the period 1999-2012. We restrict our analyses to property-liability firms, given the significantly different business models of life insurers and property-liability insurers. Moreover, the property-liability sector provides a better environment for our research as property-liability insurance is more difficult to substitute than life insurance. For example, given that banks compete with life insurers in offering certain services, measuring the competitive environment and therefore the degree of concentration is more difficult in the life insurance industry[4].

Given that the database includes observations without even basic information about a company, we exclude observations where the company description is missing. In addition, we exclude specialized reinsurers[5], as our focus is primarily on the stability of primary insurance firms. Moreover, we exclude companies with negative values for direct premiums written, premiums earned, total assets, equity capital or investment positions.

Next, we exclude companies with missing data on the basic accounting variables used to calculate the firm-level variables for the regression analysis (cf. the Appendix for a full list). Finally, we exclude extreme outliers from the two samples. First, we eliminate firm-year observations with reported non-life insurance premiums in excess of the overall premium volume of the corresponding country's non-life insurance market[6]. In addition, we eliminate observations if the return on equity (ROE) has a value above one or below minus

one (Berger and Ofek, 1995). To minimize the impact of outliers, all firm-level variables are winsorized at the 1st and 99th percentiles[7].

Given that A.M. Best's Statement File Global is known to have a home country bias (in that US insurers are overrepresented in the database), we limit the number of unique US insurance companies in our sample to 42 per cent, which corresponds to the average global market share of US insurers throughout the observation period[8]. Insurance companies are selected randomly from the US insurers in our data set until the total number of US insurers accounts for 42 per cent of insurance companies in our sample[9]. All other US insurers are removed from the data set[10]. We test for sample selection bias and cannot reject the null hypothesis that the chosen set of US property-liability insurers is representative of the universe of US property-liability insurers[11]. Given that the data set contains countries with observations from only a few insurers, our results might capture a firm-level, as opposed to a country-level, effect. To ensure that we do not capture a country-level effect, we drop the countries with fewer than 50 firm-year observations from our sample. As our measure of financial stability includes the standard deviation of the return on assets (ROA) over the past five years in the denominator, our observation period starts in 2004. Our final sample of property-liability insurance companies consists of 14,402 insurer-year observations from 29 different countries over the period 2004-2012.

Methodology

We use the following OLS-regression model to examine how concentration affects the stability of insurance firms:

$$Financial\ Stability_{i,j,t} = \alpha + \beta\ Concentration_{j,t} + \sum \gamma_k X'_{i,j,k,t} + \sum \delta_l Y'_{j,l,t} + \varepsilon_{i,t} \quad (1)$$

where i indexes firms, j indexes countries and t indexes years.

Financial Stability$_{i,j,t}$ of insurer i in country j in year t is proxied by the firm's Z-score. This measure has been used in related papers as a proxy for a financial institution's financial stability (Boyd *et al.*, 2006; Berger *et al.*, 2009; Laeven and Levine, 2009; and Uhde and Heimeshoff, 2009 for studies from the banking sector and Rauch *et al.*, 2015; Pasiouras and Gaganis, 2013; and Shim, 2011 for studies from the insurance sector)[12]. The Z- score is defined as a firm's ROA plus its capital ratio divided by the standard deviation of its ROA[13]:

$$Z - score_{i,j,t} = \frac{ROA_{i,j,t} + \frac{Equity_{i,j,t}}{Assets_{i,j,t}}}{\sigma(ROA)_{i,j,t}} \quad (2)$$

The Z-score expresses the number of standard deviations that a firm's ROA has to fall so as to just deplete equity capital (Houston *et al.*, 2010). Hence, it measures the firm's distance from insolvency. Following Laeven and Levine (2009) and Houston *et al.* (2010), we use the logarithm of the Z-score in our analysis, given that our Z-score measure is right-skewed. For brevity, we use the label "Z-score" in referring to the natural logarithm of the Z-score throughout our analyses (Laeven and Levine, 2009). Following Rauch *et al.* (2015) and Shim (2011), we use the standard deviations of ROA over the past five years to calculate σ(ROA) for the insurance firms.

For robustness, we follow Stiroh (2004a), Turk-Ariss (2010) and Rauch *et al.* (2015) and use the firms' risk-adjusted ROE (RAROE), an alternative measure of financial stability for

banks and insurance firms[14]. RAROE is defined as ROE divided by its standard deviation for the past five years[15]:

$$RAROE_{i,j,t} - \frac{ROE_{i,j,t}}{\sigma(ROE)_{i,j,t}} \quad (3)$$

This ratio measures the amount of profit per unit of risk (Stiroh, 2004b). σ(ROE) measures the volatility of the ROE[16]. Highly volatile ROE indicates a high degree of risk because a large negative ROE can easily erode the firms' equity and therefore lead to firm default. However, if high volatility is backed by a high ROE, the firm can handle such volatile business models and is less prone to default[17].

$X'_{i,j,k,t}$ denotes a vector of k firm-specific control variables that have been found to affect the stability of insurance firms in previous research.

$Y'_{j,l,t}$ denotes a vector of l country-specific control variables. β, γ and δ are the coefficients to be estimated, where β is the main coefficient of interest. Standard errors are adjusted for firm-level clustering[18]. Year-dummies and country fixed-effects are included in all regression models.

We use several measures of $Concentration_{j,t}$ for each country j in different regression models to ensure the robustness of our results regarding different measures of concentration (Uhde and Heimeshoff, 2009). First, we include *Top 5*, defined as the market share of the five largest insurers. The ratio is calculated as the sum of premiums earned for the five largest insurers in a country divided by the industry's premiums written (Altuntas *et al.*, 2015a, 2015b). Similarly, we include *Top 3*, defined as the market share of the three largest insurers. The ratio is calculated as the sum of premiums earned for the three largest insurers in a country divided by the industry's premiums written. Finally, we include *Market HHI*, a Herfindahl–Hirschman index computed as the sum of the squared market shares of a country's insurers.

$X'_{i,j,k,t}$ denotes a vector of k firm-specific control variables that have been found to affect the stability of insurance firms in previous research. We include a measure of *Reinsurance*, defined as the ratio of reinsurance ceded to reinsurance premiums assumed plus direct premiums. Reinsurance is a primary risk management mechanism in the insurance industry and enables insurers to retain desirable insurance risks and transfer undesirable risks to reinsurers (Adiel, 1996). The purchase of reinsurance protects insurance firms from idiosyncratic losses, thereby reducing the probability of default (Shiu, 2011). Similarly, Sharpe and Stadnik (2007) predict an inverse relationship between reinsurance purchases and the insurer's likelihood of financial distress.

Many studies include a measure of profitability to capture its effect on an insurer's financial stability. BarNiv and McDonald (1992), Lee and Urrutia (1996), Kramer (1996) and Sharpe and Stadnik (2007) find significant positive effects. More profitable insurers have a higher financial stability because their financial strength increases when premiums and investment income exceed their claims and other expenses. Moreover, higher profitability may indicate more efficient management and therefore lower failure risks. We therefore include the firms' *ROE* defined as the ratio of net income to equity capital, to measure profitability.

Moreover, we include the standard deviation of the insurer's loss ratio (*SD loss ratio*) to proxy for the quality of underwriting rigor (Ambrose and Seward, 1988). The loss ratio measures the insurers' price adequacy. Insurers with relatively higher losses and costs associated with settling claims have a higher probability of incurring financial distress (Kleffner and Lee, 2009). A higher volatility of underwriting results contributes to higher

levels of instability (BarNiv and McDonald, 1992). *SD loss ratio* is defined as the standard deviation of the ratio of the sum of net claims incurred to the sum of earned premiums in the past five years[19]. In addition, we include the insurers' *Expense ratio* to measure the firms' operating efficiencies. Chen and Wong (2004, p. 484) and Sharpe and Stadnik (2007, p. 388) provide empirical evidence for a negative relationship between the insurers' efficiency and their financial strength. *Expense ratio* is the ratio of net operating expenses to premiums written.

We include *Leverage*, which is defined as the ratio of premiums earned to capital surplus. Sharpe and Stadnik (2007) find that higher levels of capitalization are associated with lower financial distress in the insurance sector. Cummins and Nini (2002) state that safer insurance firms can demand higher prices and therefore keep their solvency at higher levels than their less capitalized competitors.

In addition, we include *Investment income*, measured by the ratio of investment income to premiums earned, to measure the effectiveness and efficiency of the insurers' investment decisions (Chen and Wong, 2004). Kim *et al.* (1995) and Kramer (1996) provide empirical evidence that lower investment incomes lead to lower levels of financial stability. Moreover, we control for the insurer's *Size* (measured by the natural logarithm of the insurer's total assets). Berry-Stölzle *et al.* (2010) state that the insurer's asset size represents bigger risk pools, which leads to less volatile claim payments. Gaver and Pottier (2005) explain the historically higher insolvency rates of small insurers by the operating efficiencies of larger insurers, which benefit from economies of scale and scope.

We account for the insurer's organizational form by including a dummy variable equal to one if the firm is a mutual insurance company (*Mutual*). According to Lamm-Tennant and Starks (1993), following agency and adverse selection theories, mutual insurers should have a higher level of financial stability than stock insurers. The future cash flows are less risky for mutual insurers and stock insurers write relatively more business in lines and states with higher risks. In addition, the incentive to increase the risks after issuing policies should be much lower for mutual insurers compared to stock insurers due to their organizational structure. Cummins *et al.* (1995 and 1999) find that mutual insurers have a lower probability of insolvency. On the other hand, Liebenberg and Sommer (2008) state that mutual insurers are less profitable and, therefore, due to less effective corporate control mechanisms, could have higher owner-manager agency costs. This could negatively affect their stability. Finally, we include *Group*, a dummy variable equal to 1, if the insurer is affiliated, and 0 otherwise. Kleffner and Lee (2009) state that the impact of group membership on default risk is ambiguous. On the one hand, affiliated insurers may be rescued by their parent companies to protect the reputation of the group (Cummins *et al.*, 1999). This response may promote their stability. On the other hand, group affiliation may decrease the financial stability in the case where the parent company needs investment capital (Harrington, 1981).

$Y'_{j,t}$ includes country-level factors that have been found to affect the stability of financial firms in previous research. We include gross domestic product (*GDP*) *per capita*, the natural logarithm of the GDP per capita based on purchasing power parity. Insurance firms in less economically developed countries have lower levels of capitalization (Holzheu and Lechner, 2003; Outreville, 1990; Beenstock *et al.*, 1988). Thus, the stability of such firms may be greatly affected by the entry of foreign competitors from more developed markets. Insurance firms in developed markets are better capitalized and, due to the existence of long-established insurance firms with strong brand names, they may be better protected against competitors. On the other hand, competitive pressures among insurers may be more pronounced in developed markets due to greater openness and liberalization. This will force firms to operate at lower capital levels and drive out inefficient insurers in the market, thus significantly

destabilizing the insurance sector. In addition, we include *Inflation* (the growth in the consumer price index), as it might affect firm profitability, which is positively related to financial stability (Uhde and Heimeshoff, 2009). Finally, we include *Real interest rate*, defined as the lending interest rate adjusted for inflation, as measured by the GDP deflator (Uhde and Heimeshoff, 2009). Interest rates strongly affect insurance firms, given the interest-sensitive nature of their assets and liabilities (Brewer *et al.*, 2007). Moreover, Browne *et al.* (1999) show that insurer insolvencies are significantly related to changes in interest rates. Thus, interest rates can seriously affect the insurance sector's stability[20].

Results

Descriptive statistics

Table I provides descriptive statistics of our dependent variable of interest, *Z-score* and its components (ROA, Capital to asset ratio and SD of ROA) for each country included in our sample. In addition, the number of firm-year observations and the number of unique insurance firms for each country are included. The table indicates that our measure of

Country	Z-score	ROA	Mean Capital to asset ratio	SD of ROA	Firm-year observations	Number of unique firms
Argentina	2.2190	0.0425	0.3408	0.0497	139	43
Australia	2.2299	0.0601	0.2986	0.0420	135	27
Austria	2.6735	0.0443	0.2740	0.0241	60	10
Belgium	2.2948	0.0277	0.3164	0.0385	287	47
Brazil	2.0509	0.0446	0.3256	0.0497	87	26
Canada	2.5105	0.0469	0.3444	0.0366	1,132	169
Chile	2.2596	0.0296	0.3313	0.0457	149	22
China	1.9798	0.0079	0.3369	0.0567	108	37
Denmark	2.3545	0.0421	0.5246	0.0597	319	62
Ecuador	2.5630	0.0155	0.3322	0.0336	68	11
Finland	2.5209	0.0438	0.4046	0.0374	138	20
France	2.5058	0.0387	0.2392	0.0258	601	118
Germany	2.6115	0.0336	0.3213	0.0317	1,564	220
India	2.5299	0.0075	0.3512	0.0342	90	18
Indonesia	2.5890	0.0589	0.4150	0.0418	61	42
Ireland	2.1985	0.0504	0.3770	0.0519	241	53
Italy	2.3070	0.0230	0.2374	0.0308	464	81
Japan	2.4925	−0.0024	0.3263	0.0472	193	39
Mexico	2.1701	0.0421	0.3665	0.0508	82	29
The Netherlands	2.3205	0.0406	0.3501	0.0433	218	54
Norway	2.5774	0.0392	0.5504	0.0441	100	19
Pakistan	1.6894	0.0673	0.5116	0.1133	73	17
Portugal	2.5764	0.0283	0.2709	0.0290	107	20
South Korea	1.9718	0.0210	0.1614	0.0328	88	15
Spain	2.7378	0.0590	0.4654	0.0410	956	163
Sweden	1.9793	0.0292	0.4072	0.0683	342	66
Switzerland	2.7786	0.0348	0.2733	0.0230	240	52
UK	2.4484	0.0383	0.3718	0.0383	428	90
USA	2.6491	0.0372	0.4312	0.0404	5,932	947

Notes: Mean values are based on the pooled sample; insurer characteristics denote the *Z-score* and its components; all firm-specific variables are winsorized at the 1st and 99th percentiles; data are for the years 2004 through 2012; a detailed description of the variables is provided in the Appendix

Table I.
Descriptive statistics of country and insurer characteristics

financial stability (Z-score) displays a wide variation for the insurance firms in our sample across countries. The same holds for its components.

Table II provides descriptive statistics for the firm-level characteristics of the full sample, as well as for the sub-samples consisting of firms with Z-score levels below and above the sample median. Table II also facilitates the examination of factors associated with a higher level of financial stability (a Z-score above the median) on a global scale. Simple comparisons of means and medians indicate that insurers with Z-scores above the sample median appear to use more reinsurance, are more profitable, show less volatile loss ratios and have less leverage and higher investment income compared with insurers with Z-scores below the sample median. Similar comparisons also indicate that mutual and affiliated insurers appear to be more stable, compared with stock and unaffiliated insurers. Moreover, the table indicates that insurance firms in countries with higher levels of insurance market concentration (indicated by *Top 5*, *Top 3* and *Market HHI*) show lower degrees of financial stability.

Empirical results

Table III shows the results of equation (1) for the full sample. Models 1-3 include different measures of concentration to ensure the robustness of our results (*Top 5*, *Top 3* and *Market HHI*). Moreover, while Models 1-3 exclude country-level control variables, they are included in Models 4-6. The dependent variable in all models is the firms' Z-scores.

The results indicate that, for all measures of concentration, the coefficient is negative and significant in all regressions in the full sample of insurance firms. This indicates that higher levels of concentration are negatively related to the dependent variable, Z-score. Thus, we find empirical support for the "concentration-fragility view": higher levels of concentration in the insurance sector are associated with decreases in the sector's financial stability. This finding is consistent with the studies from the banking sector that also find a destabilizing effect of concentration on the stability of banks (Uhde and Heimeshoff, 2009) and with Mühlnickel and Weiß (2015), who find a destabilizing effect on the systemic-risk contribution in the insurance sector[21].

Moreover, the control variables are in line with the theoretical predictions. We find that the insurance firms that are more profitable and have less volatile loss ratios, lower leverage ratios and higher investment incomes show higher levels of financial stability. In addition, the results indicate that mutual insurance firms and group members have higher Z-score levels. However, the country-level control variables appear to have a negligible effect on insurer stability.

In addition, Table IV presents the results of equation (1) using RAROE, instead of Z-score, as the dependent variable to measure financial stability. Consistent with Table III, Models 1-3 exclude the country-level control variables, which are included in Models 4-6. The results indicate that they do not depend on the chosen measure of financial stability. We find that higher levels of concentration lead to lower levels of financial stability for the insurance firms. This holds for all measures of concentration used in our analyses.

These results have important policy implications for the regulation of insurance firms. A primary objective of insurance regulators is to protect policyholders against the default of insurance firms (Klein, 1995). Thus, policymakers aim to create environments that lead to stable insurance firms. Given the insurers' role as risk intermediaries in the economy, reduced stability is not desired by regulators, given that insurance customers prefer to purchase policies from stable insurance firms (Wakker *et al.*, 1997). However, our results indicate that the recent trend toward concentration does not have unambiguous positive consequences, but rather a destabilizing effect on insurance firms.

Table II. Univariate comparison between insurers with low and high Z-score

Full sample (N = 14,402)	Mean	Median	SD	Firms with Z-score below median (N = 7,201) Mean	Median	Firms with Z-score above median (N = 7,201) Mean	Median
Firm-specific variables							
Reinsurance	0.279	0.200	0.265	0.265	0.191	0.293***	0.209***
ROE	0.110	0.106	0.177	0.095	0.104	0.125***	0.106***
SD loss ratio	0.099	0.054	0.156	0.123	0.067	0.076***	0.044***
Expense ratio	0.251	0.207	0.354	0.257	0.209	0.244**	0.206***
Leverage	1.291	1.005	1.081	1.534	1.252	1.047***	0.781***
Investment income	0.214	0.077	1.354	0.170	0.067	0.258***	0.089***
Size	12.082	12.078	1.929	12.070	12.047	12.094	12.112
Mutual	0.200		0.400	0.183		0.218***	
Group	0.688		0.463	0.679		0.697**	
Concentration variables							
Top 5	0.250	0.190	0.177	0.264	0.204	0.236***	0.166***
Top 3	0.180	0.140	0.133	0.191	0.145	0.169***	0.117***
Market HHI	295.883	129.800	436.896	320.191	156.223	271.576***	93.365***
Macro-economic variables							
GDP per capita	3.695	3.744	0.365	3.657	3.703	3.733***	3.791***
Inflation	0.024	0.023	0.017	0.025	0.023	0.023***	0.023
Real interest rate	0.033	0.028	0.035	0.034	0.028	0.032**	0.026

Notes: Descriptive statistics are presented for the full sample, for the subsample of firms with *Z-score* below the sample median and for the subsample of firms with *Z-score* above the sample median. N denotes firm-year observations. Statistical significance of differences is based on a t-test for means, and a Wilcoxon signed-ranks test for medians; *, **and ***denote statistical significance at the 10, 5 and 1% levels, respectively. All firm-specific variables are winsorized at the 1st and 99th percentiles. Data are for the years 2004 through 2012. A detailed description of the variables is provided in the Appendix

Table III.
The impact of concentration on Z-score

Variable	(1) Z-score	(2) Z-score	(3) Z-score	(4) Z-score	(5) Z-score	(6) Z-score
Top 5	−0.19606** (0.09033)			−0.20049** (0.09025)		
Top 3		−0.29119** (0.12758)			−0.29745** (0.12788)	
Market HHI			−0.00007** (0.00003)			−0.00007** (0.00003)
Reinsurance	−0.04616 (0.05957)	−0.04615 (0.05957)	−0.04636 (0.05958)	−0.04551 (0.05958)	−0.04549 (0.05958)	−0.04569 (0.05958)
ROE	1.11486*** (0.06358)	1.11513*** (0.06360)	1.11431*** (0.06358)	1.11606*** (0.06362)	1.11633*** (0.06363)	1.11549*** (0.06361)
SD loss ratio	−1.60573*** (0.10448)	−1.60578*** (0.10446)	−1.60589*** (0.10452)	−1.60651*** (0.10440)	−1.60657*** (0.10437)	−1.60669*** (0.10442)
Expense ratio	−0.03037 (0.05562)	−0.03034 (0.05560)	−0.03042 (0.05561)	−0.03000 (0.05559)	−0.02997 (0.05557)	−0.03005 (0.05558)
Leverage	−0.35129*** (0.01836)	−0.35127*** (0.01836)	−0.35125*** (0.01836)	−0.35160*** (0.01837)	−0.35158*** (0.01837)	−0.35156*** (0.01837)
Investment income	0.06758*** (0.01130)	0.06761*** (0.01130)	0.06760*** (0.01130)	0.06761*** (0.01130)	0.06765*** (0.01130)	0.06764*** (0.01130)
Size	−0.00853 (0.00852)	−0.00855 (0.00852)	−0.00853 (0.00852)	−0.00845 (0.00853)	−0.00848 (0.00853)	−0.00846 (0.00853)
Mutual	0.06086* (0.03535)	0.06091* (0.03535)	0.06084* (0.03535)	0.06077* (0.03535)	0.06082* (0.03535)	0.06074* (0.03535)
Group	0.05835* (0.03480)	0.05845* (0.03480)	0.05859* (0.03480)	0.05863* (0.03480)	0.05872* (0.03480)	0.05885* (0.03480)
GDP per capita				0.01480 (0.18060)	0.01560 (0.18022)	0.01520 (0.18051)
Inflation				0.93645 (0.92053)	0.96241 (0.92210)	1.02326 (0.92451)
Real interest rate				−0.79878 (0.50592)	−0.79297 (0.50651)	−0.76946 (0.50568)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.26441	0.26445	0.26438	0.26461	0.26465	0.26458
Number of obs.	14,402	14,402	14,402	14,402	14,402	14,402
Number of countries	29	29	29	29	29	29

Notes: This table presents ordinary-least squared regression models with *Z-score* as dependent variable. The models differ with respect to the used concentration and macro-economic measures. All firm-specific variables are winsorized at the 1st and 99th percentiles. The regression models include country fixed-effects (Country FE) and year fixed-effects (Year FE). Standard errors are adjusted for firm-level clustering and appear in parenthesis below each coefficient estimate. The correlation matrix of independent variables is not reported to conserve space. However, we test for multicollinearity among the explanatory variables in the models using variance inflation factors (VIFs). The mean VIF in the regression models ranges from 1.27 to 1.29, which is well below the benchmark of 10, indicating that multicollinearity does not appear to be a concern (Belsley *et al.*, 2005; Chatterjee and Hadi, 2013). Data are for the years 2004 through 2012; *, **and ***denote statistical significance at the 10, 5 and 1% levels, respectively. A detailed description of the variables is provided in the Appendix

Table IV. The impact of concentration on RAROE

Variable	(1) RAROE	(2) RAROE	(3) RAROE	(4) RAROE	(5) RAROE	(6) RAROE
Top 5	−0.63872** (0.24972)			−0.64360*** (0.24860)		
Top 3		−0.97813*** (0.34961)			−0.99709*** (0.34698)	
Market HHI			−0.00015* (0.00009)			−0.00016* (0.00009)
Reinsurance	−0.07392 (0.11003)	−0.07380 (0.11003)	−0.07522 (0.11004)	−0.07141 (0.11000)	−0.07121 (0.11000)	−0.07252 (0.11000)
ROE	8.68236*** (0.16742)	8.68342*** (0.16746)	8.67957*** (0.16739)	8.68050*** (0.16733)	8.68162*** (0.16737)	8.67785*** (0.16729)
SD loss ratio	−1.68859*** (0.15162)	−1.68881*** (0.15162)	−1.68842*** (0.15167)	−1.69120*** (0.15181)	−1.69149*** (0.15181)	−1.69116*** (0.15186)
Expense ratio	0.01093 (0.06235)	0.01102 (0.06233)	0.01066 (0.06235)	0.00989 (0.06255)	0.00998 (0.06253)	0.00968 (0.06256)
Leverage	−0.25489*** (0.03823)	−0.25481*** (0.03823)	−0.25488*** (0.03824)	−0.25580*** (0.03829)	−0.25574*** (0.03829)	−0.25578*** (0.03830)
Investment income	0.05995*** (0.01394)	0.06009*** (0.01393)	0.05991*** (0.01395)	0.06047*** (0.01388)	0.06062*** (0.01387)	0.06046*** (0.01388)
Size	0.01207 (0.01719)	0.01197 (0.01719)	0.01222 (0.01719)	0.01160 (0.01721)	0.01149 (0.01721)	0.01172 (0.01721)
Mutual	−0.20271*** (0.06467)	−0.20253*** (0.06467)	−0.20304*** (0.06468)	−0.20380*** (0.06470)	−0.20362*** (0.06470)	−0.20409*** (0.06470)
Group	0.09046 (0.06993)	0.09077 (0.06994)	0.09113 (0.06996)	0.08913 (0.06990)	0.08942 (0.06990)	0.08976 (0.06993)
GDP per capita				0.58720 (0.38473)	0.59313 (0.38420)	0.56915 (0.38937)
Inflation				4.26736* (2.36162)	4.34398* (2.36389)	4.53469* (2.36885)
Real interest rate				1.28831 (1.08925)	1.30110 (1.08979)	1.39745 (1.08938)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.45715	0.45723	0.45695	0.45756	0.45766	0.45739
Number of observations	14,402	14,402	14,402	14,402	14,402	14,402
Number of countries	29	29	29	29	29	29

Notes: This table presents ordinary-least squared regression models with *RAROE* as dependent variable. The models differ with respect to the used concentration and macro-economic measures. All firm-specific variables are winsorized at the 1st and 99th percentiles. The regression models include country fixed-effects (Country FE) and year fixed-effects (Year FE). Standard errors are adjusted for firm-level clustering and appear in parenthesis below each coefficient estimate. The correlation matrix of independent variables is not reported to conserve space. However, we test for multicollinearity among the explanatory variables in the models using variance inflation factors (VIFs). The mean VIF in the regression models ranges from 1.35 to 1.36, which is well below the benchmark of 10, indicating that multicollinearity does not appear to be a concern (Belsley *et al.*, 2005; Chatterjee and Hadi, 2013). Data are for the years 2004 through 2012; *, ** and *** denote statistical significance at the 10, 5 and 1% levels, respectively. A detailed description of the variables is provided in the Appendix

Conclusion

We examine the effect of concentration in the insurance industry on the stability of insurance firms for a large set of developed and developing countries. While prior studies tested the "concentration-stability view" against the "concentration-fragility view" in the banking sector (Uhde and Heimeshoff, 2009), previous papers on the impact of the concentration of insurance firms focused on efficiency (Cummins *et al.*, 1999; Fenn *et al.*, 2008), the contribution of systemic risk (Mühlnickel and Weiß, 2015), risk-taking (Fields *et al.* 2012) and reinsurance purchases (Altuntas *et al.*, 2015a, 2015b). To the best of our knowledge, our study is the first to examine the effects of concentration on the stability of insurance firms.

We use a data set of 14,402 firm-year observations of insurers from 29 countries during the period 2004-2012, which appear in A.M. Best's Statement File Global database. We use regression analyses and several measures of concentration to analyze how different levels of concentration affect the stability of insurance firms worldwide.

Our results provide empirical support for the "concentration-fragility view", that is, higher levels of concentration are associated with decreases in the insurance sector's financial stability. This holds for all measures of concentration included in our analysis. The results remain consistent for different measures of financial stability and concentration.

Our study does suffer from data limitations. Specifically, while related studies (Bharath and Shumway, 2008) use risk measures based on the firms' market value of equity, such measures cannot be estimated, given that the vast majority of firms in our database are not stock-listed. Hence, we have to rely on measures based on book values. Moreover, figures in our data set may differ substantially depending on the underlying framework (e.g. IFRS, US GAAP).

Our findings have important policy implications. The recent trend in concentration in the insurance sector was caused by the liberalization of the formerly closed national insurance markets. For example, the motivation behind the creation of a single insurance market in Europe was that higher competition would reduce costs through lower X-inefficiency and, as a consequence, through scale economies. However, our results indicate that concentration negatively affects insurance firms around the world. Against the background that the primary objective of insurance regulators is to protect policyholders from insurance firm defaults (Klein, 1995) and that the insurance customers prefer to purchase policies from stable insurance firms (Wakker *et al.*, 1997), our results are valuable to all policymakers when assessing the success of increasing competition in the insurance market and further liberalization measures. For example, future mergers in the insurance industry should be evaluated more carefully prior to the regulator's approval with respect to the consequences for the sector's stability. In addition, capital surcharges for large, market dominant insurance groups might counteract the decrease in financial stability due to higher concentration.

Notes

1. See Altuntas *et al.* (2015) and Altuntas *et al.* (2015) for further information on the data set. *The authors would like to thank Allianz SE for their support in providing the A.M. Best's Statement File-Global database used in this study.*
2. In addition, De Nicolo *et al.* (2004) distinguish between *internationalization* (the increasing number of banks and other financial institutions that operate across national borders) and *conglomeration* (a larger number of financial groups whose activities combine those of the bank and nonbank financial firms).
3. In particular, measuring concentration in the financial services industry is difficult, given that it is difficult to measure the productive activity of financial institutions (De Nicolo *et al.*, 2004).

4. We classify an insurance company as a property-liability insurer if the company has positive non-life insurance earned premiums and zero-life insurance earned premiums. This also removes diversified insurers, which write both property-liability and life insurance, from the sample.
5. Specialized reinsurers are companies that primarily reinsure other insurance companies; canonical examples include Gen Re, Munich Re and Swiss Re.
6. Data for the countries' non-life insurance market premiums are obtained from *Swiss Re's Sigma publications*.
7. See Cox (1998) for a discussion of winsorizing and for references to the relevant statistical literature.
8. The market share of US property-liability insurers is based upon the aggregate US nonlife insurance premiums as a fraction of the aggregate global nonlife premiums as reported in *Swiss Re's Sigma publications*.
9. Our results remain consistent if we keep all US insurers in our sample.
10. We replicate the selection procedure with different random seeds and can verify that our main results from Tables III and IV are not sensitive to the choice of random seeds.
11. As a robustness test, we follow Altuntas *et al.* (2015) and sort US insurers into quintiles based on total assets and then randomly select insurance companies from these quintiles until the total number of US insurers accounts for 42% of insurance companies in our sample, and we remove all other US insurers. By doing so, we ensure that the size distribution of US insurers stays unchanged. The results remain stable. Even if we run the analyses with all US insurers in the data set, our results remain stable. To conserve space, we do not report the tables in the paper; however, they are available from the authors upon request.
12. Several prior studies from the banking sector have focused on real episodes of banking crises to measure the effect of concentration, instead of firm-level measures of financial soundness (Beck *et al.*, 2006a). However, given the insurance sector's limited ability to create systemic risk and, therefore, the absence of insurance-caused crises, we prefer to focus on firm-level measures of stability.
13. The Z-score is an inverse measure of financial stability; that is, a higher Z-score indicates higher financial stability.
14. Related studies (e.g. Bharath and Shumway, 2008) use risk measures based on the firms' market value of equity. Given that the vast majority of firms in our database are not stock-listed, such measures cannot be estimated, and we therefore have to rely on measures based on the book values of equity.
15. For both the Z-score and the RAROE, we use a rolling window regression for each individual firm to have an estimator of the standard deviation of the ROA (ROE) of the previous 5 years for each firm-year observation.
16. For robustness, we repeat our analyses and include σ(ROE) as a measure of financial soundness in our analyses. The results remain consistent.
17. Like the Z-score, RAROE is an inverse measure of financial stability; that is, a higher RAROE indicates higher financial stability. In particular, higher (lower) ROE indicate higher (lower) profitability and capital accumulation and hence lower (higher) risk. Higher (lower) σ(ROE) indicate more (less) volatile earnings and hence higher (lower) risk.
18. To avoid bias in our standard errors due to within-firm correlations across time, we adjust the standard errors for firm-level clustering. Petersen (2009) writes that "Cluster standard errors are robust to heteroscedasticity" (p. 438) and standard errors clustered by firm "are robust to any form of within-cluster correlation" (p. 459). We also test for multicollinearity among the explanatory variables in the models using variance inflation factors (VIFs). The mean VIF in all regression models is well below the benchmark of 10, indicating that multicollinearity does not appear to be a concern (Belsley *et al.*, 2005; Chatterjee and Hadi, 2013).
19. We use a rolling window regression for each individual firm to have an estimator of the volatility of the loss ratio of the previous 5 years for each firm-year observation.

20. In addition, a variety of additional factors might affect the insurance firms' stability, such as the quality of its risk management and governance. However, such measures are not available in our global data set.
21. As a robustness test, we eliminate US insurers from our data set to check whether our results remain stable. By doing so, we lose 5,932 firm-year observations, which equates to about 42% of the data set. However, the main results are the same as reported in Table III.

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Appendix

Variable name	Variable description and source
Firm-specific variables	
Z-score	Natural logarithm of (ROA + Capital to asset ratio)/Standard deviation of ROA over past 5 years. Source: A.M. Best's Statement File Global
RAROE	Risk-adjusted ROE: (ratio of net income to equity capital)/Standard deviation of ROE over past 5 years. Source: A.M. Best's Statement File Global
Reinsurance	Ratio of reinsurance ceded to reinsurance premiums assumed plus direct premiums. Source: A.M. Best's Statement File Global
ROE	Ratio of net income to equity capital. Source: A.M. Best's Statement File Global
SD loss ratio	Standard deviation of the net claims incurred divided by premiums earned over past 5 years. Source: A.M. Best's Statement File Global
Expense ratio	Ratio of net operating expenses to premiums written. Source: A.M. Best's Statement File Global
Leverage	Ratio of premiums earned to capital surplus. Source: A.M. Best's Statement File Global
Investment income	Ratio of investment income to premiums earned. Source: A.M. Best's Statement File Global
Size	Natural logarithm of the insurer's total assets. Source: A.M. Best's Statement File Global
Mutual	Dummy variable equal to 1, if the insurer is a mutual and 0 otherwise. Source: A.M. Best's Statement File Global
Group	Dummy variable equal to 1, if the insurer is affiliated and 0 otherwise. Source: A.M. Best's Statement File Global
Concentration variables	
Top 5	Market share of the 5 largest insurers. It is calculated as the sum of premiums earned for the 5 largest insurers in the sample divided by the industry's premiums written. Source: A.M. Best's Statement File Global, and Swiss Re *Sigma* publications
Top 3	Market share of the 3 largest insurers. It is calculated as the sum of premiums earned for the 3 largest insurers in the sample divided by the industry's premiums written. Source: A.M. Best's Statement File Global, and Swiss Re *Sigma* publications
Market HHI	Herfindahl–Hirschman Index computed as the sum of the squared market shares of a country's insurers. Source: A.M. Best's Statement File Global, and Swiss Re *Sigma* publications
Macro-economic variables	
GDP per capita	Natural logarithm of the GDP per capita based on purchasing power parity. Source: World Development Indicators
Inflation	Annual inflation rate. Growth in Consumer Price Index (CPI). Source: World Development Indicators
Real interest rate	Lending interest rate adjusted for inflation as measured by the GDP deflator. Source: World Development Indicators

Table AI. Description and sources of firm-specific, concentration and macro-economic variables

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