

## SUMMARY

**T**his chapter describes major insurance sector developments over the past decade and assesses changes in the systemic importance of insurers. Insurance firms play an important role as providers of protection against financial and economic risks and as financial intermediaries.

The chapter shows that across advanced economies the contribution of life insurers to systemic risk has increased in recent years, although it clearly remains below that of banks. This increase is largely due to growing common exposures to aggregate risk, caused partly by a rise in insurers' interest rate sensitivity. Thus, in the event of an adverse shock, insurers are unlikely to fulfill their role as financial intermediaries precisely when other parts of the financial system are failing to do so as well. The higher common exposures do not seem to be driven by marked changes in insurers' investment portfolios, although smaller and weaker insurers in some countries have taken on more risk.

The findings suggest that supervisors and regulators should take a more macroprudential approach to the sector. Doing so is necessary if supervision is to go beyond guarding against the solvency and contagion risks of individual firms and take on the systemic risk arising from common exposures. Steps that would complement a push for stronger macroprudential policies include the international adoption of capital and transparency standards for the sector. In addition, the different behavior of smaller and weaker insurers warrants attention by supervisors.

## Introduction

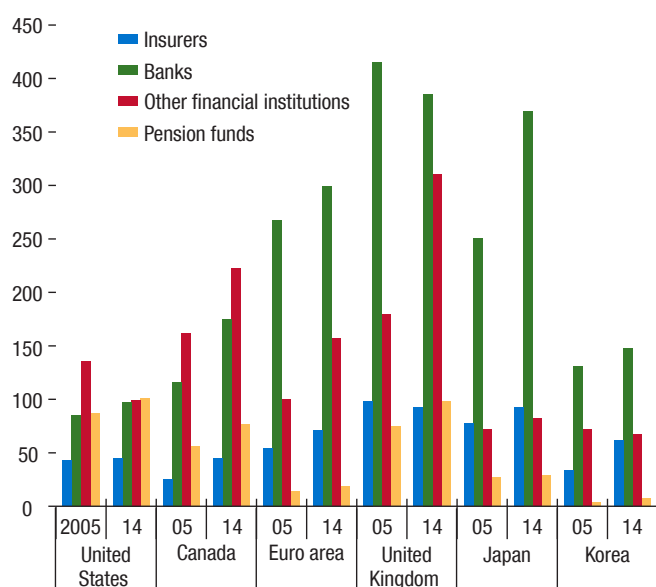
Insurance companies—life insurers as well as providers of property and casualty, health, and financial coverage—perform important economic functions and are big players in financial markets (Figure 3.1). They enable economic agents to diversify idiosyncratic risk, thereby supplying the necessary preconditions for certain business activities (Liedtke 2011; Box 3.1). They are a major source of long-term risk capital to the real economy, and are among the largest institutional investors, holding about 12 percent of global financial assets, or \$24 trillion (of which life insurance accounts for 85 percent). Their long-term investment horizon can in principle enable them to act as a shock absorber in financial markets.

The financial crisis put the insurance sector on the map as a source of systemic financial risk. Before the global financial crisis of 2007–09, insurers were not thought to pose significant systemic risks. Insurers have longer-term liabilities than banks, greater diversification of assets, and less extensive interconnections with the rest of the financial system. It was assumed that the functions of any failed firm would be relatively easily picked up by others (high substitutability). However, the near-collapse of the insurer AIG during the crisis prompted a rethinking of the sector’s systemic risk contribution. A number of insurance firms were subsequently among the financial institutions designated as globally systemically important (International Association of Insurance Supervisors [IAIS] 2013a; Box 3.2).

Various studies have highlighted the changing nature of insurance activities and their contributions to systemic risk (Billio and others 2012). For example, the way in which their product offerings and investments have evolved may be exposing insurers to greater aggregate, non-diversifiable risk (Acharya and others 2009). The rise of such exposures would increase the risk that insurers perform poorly when other parts of the financial sector are hit, potentially inducing correlated trading and fire sales. Studies also point to tightening linkages with banks as insurers have become more active in capital markets (Dungey, Luciani, and Veredas 2014; Peirce 2014). In some countries, insurance companies are seen as more vulnerable

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**Figure 3.1. Selected Countries: Relative Size of Financial Intermediaries**  
(Percent of GDP)



Sources: Haver Analytics; European Central Bank Statistical Data Warehouse; and IMF staff calculations.

to runs than in the past (Paulson and others 2014). Finally, higher exposures to nontraditional non-insurance activities (such as derivatives trading) may increase the counterparty risks posed by insurers (Acharya and others 2009).

Low interest rates are an important source of risk for insurers, especially for the life sector. The current prolonged period of low interest rates challenges life insurers’ business model because their promised rates of return on long-term contracts exceed the returns on available “safe” assets (sovereign bonds and high-grade corporate bonds). In the major advanced economies, the resulting lower profits and capital buffers may be prompting a “search for yield.” Such effects are likely to be most pronounced for insurers that offer products with more generous and long-running minimum-return guarantees.<sup>1</sup> For nonlife insurers, pressures are generally less severe because they can reprice existing contracts more easily and have shorter investment horizons.

<sup>1</sup>The April 2015 *Global Financial Stability Report* (GFSR) finds that European life insurers in some countries are particularly vulnerable. See also European Systemic Risk Board (2015).

Global policy initiatives are under way to address vulnerabilities and systemic risks in the insurance sector. The IAIS has made progress by clarifying the role of insurance and reinsurance activities in financial stability analysis (IAIS 2011, 2012b), developing a systemic risk assessment of global systemically important insurers (IAIS 2013a), and developing guidance on macroprudential policy (IAIS 2013b, c). Nevertheless, regulatory regimes differ widely across countries, which may lead to regulatory arbitrage (Financial Stability Board 2013).

This chapter reviews some of the key recent developments in the sector and analyzes the systemic risks they pose.<sup>2</sup> The discussion focuses mainly on the advanced economies, given the challenges associated with unconventional monetary stimulus. The chapter does not aim to conduct stress tests for specific companies, assess their solvency, or conduct scenario analyses for the sector. Neither does it investigate in detail the liability side of insurers, such as changes in the products offered by the industry, which can play an important role in shaping risks. Instead, using novel data and methods, the chapter addresses the following questions:

- *How has the insurance sector's contribution to systemic risk changed since the early 2000s? Are insurers becoming more similar? Are they becoming more exposed to common risk factors?*
- *To what extent can the changes be traced to investment behavior, maturity mismatches, business models, and the broader market? Have low interest rates led to increased investments in additional risky securities? Which types of insurers have been prone to take on asset-side risk, and is there evidence of a search for yield or "gambling for resurrection"? Have insurers become more procyclical in their reaction to shocks? Have they become more sensitive to interest rate movements?*
- *What are the implications for regulating and reforming the global insurance sector?*

The chapter's main findings are as follows:

- *The sector's systemic risk contribution has increased as common exposures within the sector and to the rest of the economy have risen—but it remains below that*

<sup>2</sup>This chapter complements recent analytical GFSR chapters focusing on other segments of the financial sector (international banking [April 2014], shadow banking [October 2014], and asset management [April 2015]), and expands on the analysis of European insurers in the April and October 2015 GFSRs.

*of banks.* Results based on a number of methods suggest that the systemic importance of insurers has grown in the advanced economies since the 2007–09 global financial crisis. This increase has been driven mostly by higher commonalities in exposures and greater exposure to market risk through the combined effect of asset and liability positions. Less important has been a rise in the systemic risk stemming from the default risk of individual institutions.

- *The rise in exposures to aggregate risk means that insurers are more likely to be adversely hit jointly with other segments of the financial sector.* In the event of an adverse shock, insurers are unlikely to fulfill their role as financial intermediaries precisely when other parts of the system are also failing to do so. Given insurers' significance as funding sources (for example, in the corporate bond market in the United States), the effects on the real economy could be important.
- *The higher common exposures seem to be driven partly by duration mismatches and broader market forces.* Portfolio compositions do not appear to have become markedly more similar. However, because of imperfect asset-liability matching (duration mismatches), life insurers have become increasingly sensitive to interest rates as interest rates have fallen.<sup>3</sup> Moreover, the observed broad rise in cross-asset correlations (October 2015 GFSR, Chapter 1) likely reflects both temporary and structural factors.
- *Firms do not seem to have actively shifted their portfolios toward riskier categories of assets, but some insurers have engaged in a search for yield.* However, because insurers have not counteracted market forces in their asset choices, even without an overt shift they have become more exposed to aggregate risk. Moreover, firm-level case studies suggest that, as interest rates decline, particular types of firms—smaller life insurers, those with weaker capital positions, and those with higher shares of guaranteed liabilities—tend to take on relatively more risk. The financial crisis did not reveal

<sup>3</sup>Any existing duration mismatch will worsen with a decline in interest rates since the duration of long-term liabilities rises more than that of shorter-term assets. This effect is more pronounced when the level of interest rates is low—that is, any further fall in interest rates will result in a sharper increase in duration mismatches.

evidence of outright procyclical behavior by U.S. insurers, but overall, the international evidence on this issue is mixed. Developments on insurers' liability side (not studied in detail in this chapter) may also have played a part in the rise in systemic risk contributions.

The findings suggest that supervisors and regulators should take a more macroprudential approach to the sector. Doing so is necessary if supervision is to go beyond the solvency and contagion risks of individual firms and take on the systemic risk arising from common exposures. A step that would complement a push for stronger macroprudential policies would be international adoption of capital and transparency standards for the sector. In addition, attention to smaller and weaker firms is also warranted. They are most likely to take on excessive risks—and the solvency problems of smaller entities may result in cascading effects that become systemic.

The chapter proceeds with a discussion of the different concepts of systemic risk posed by insurers, followed by recent developments in insurers' business models, market structures, and performance. Three subsequent sections provide a comprehensive analysis of systemic risks posed by insurers, examine changes in insurers' investment behavior, and analyze detailed case studies. The final two sections assess the regulatory framework and consider policy implications.

## Insurance and Systemic Risk: Conceptual Issues

*Systemic risk in the financial system arises from the danger that some part of the system will become unable to perform its key economic functions and thereby impair the real economy. Insurance firms can contribute to systemic risk through the possibility that an individual firm will fail, with systemic consequences. Another contribution to systemic risk is through common exposures across firms that may endanger financial intermediation of the system as a whole in the event of an adverse shock. In general, the negative externality comes about when insurance companies that decide to take on more aggregate risk do not internalize the possibility that such actions may hinder intermediation in other parts of the financial system. These two types of systemic risk are discussed here.*

## Risk of Individual Default

Systemic risk analysis traditionally has focused on the risks of failure of individual institutions and their potential knock-on effects. From this contagion, or “domino,” view of systemic risk (Acharya 2015), the insurance sector has generally been considered significantly safer than the banking sector (see, for example, Cummins and Weiss 2014), although this notion has been challenged recently (Acharya and others 2009) (Figure 3.2). The domino perspective considers the following six key characteristics when assessing the systemic risk posed by an individual institution:<sup>4</sup>

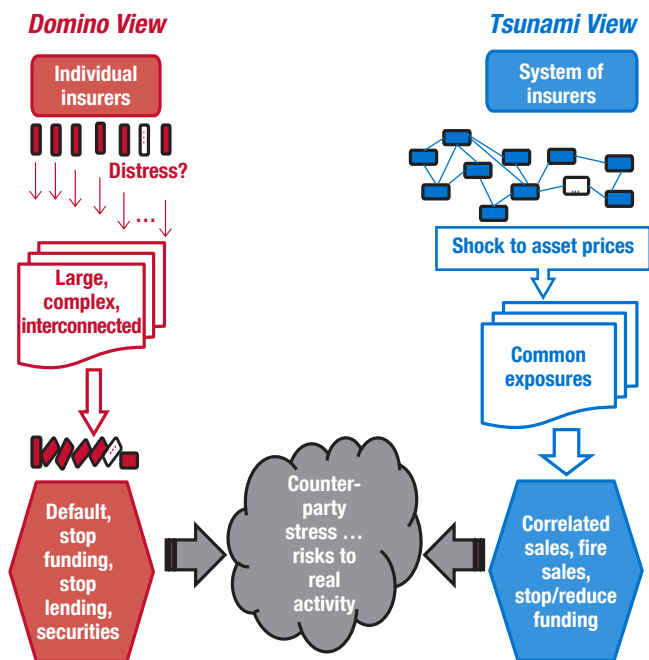
- *Size*—For certain types of insurance businesses, asset size must be large to effectively pool and diversify risks.<sup>5</sup> As a result, however, the asset size of some insurance firms rivals that of the biggest banks and may create too-big-to-fail-type risks.
- *Interconnectedness and integration in financial sector infrastructure*—Although not part of payment or clearing systems, insurers are interconnected through reinsurance relationships and retrocession arrangements (Box 3.3), and with the wider financial sector through various other channels. In many countries, they are important holders of bank debt (Alves and others 2015), and they are often linked to banks through ownership ties or counterparty exposures such as derivatives transactions or securities lending (Cummins and Weiss 2014; Dungey, Luciani, and Veredas 2014; Peirce 2014).<sup>6</sup> This development is likely to be reinforced by the new Total Loss-Absorbing Capacity standard for global systemically important banks, which may induce insurers to buy bail-inable debt. The linkages of the insurance sector with the wider financial system appear to have been

<sup>4</sup>See also Box 3.3, which covers global systemic risk factors for insurers.

<sup>5</sup>Insurers that underwrite large policies with exposures to catastrophes need to be larger than those that underwrite small policies without such exposure. Although reinsurance can reduce the need for large size at the company level, reinsurers themselves require large size.

<sup>6</sup>Life insurers use interest rate derivatives for asset-liability matching, but are not extensive users of other types of derivatives (Bank for International Settlements 2015; Berends and King 2015). Insurers are large players in securities lending markets, accounting for about 10 percent of such activity (Baklanova, Copeland, and McCaughrin 2015). Recent regulatory reform may reduce the availability of cost-effective derivative hedges (Mannix 2014).

Figure 3.2. Systemic Risks in Insurance



Source: IMF staff.

strengthened by its growing participation in capital markets (Baluch, Mutenga, and Parsons 2011).

- **Substitutability**—Typically, insurance companies can cover the gaps left by the failure of any one insurer. Nonetheless, substitutability may be low in market segments in which concentration is very high and thus creates the risk of market frictions in the event of a failure.
- **Leverage**—Too much leverage may pose solvency risks. There is some ambiguity as to how to properly measure leverage among insurers. When considering debt-to-asset ratios, insurance firms' leverage is usually much lower than that of banks (Thimann 2015). However, leverage including insurance liabilities is close to that of banks.
- **Funding liquidity risk**—Insurers are generally less susceptible than banks to the threat of runs because insurers have longer-dated liabilities and stable cash flows. Nevertheless, runs are possible in some markets. Acharya and Richardson (2014) point out that large numbers of life insurance contracts can be “cashed in” (surrendered) by the

insured party. Foley-Fisher, Narajabad, and Verani (2015) find that in 2007, U.S. life insurers became subject to self-fulfilling runs by institutional investors in the agreement-backed securities market.<sup>7</sup> Feodoria and Förstemann (2015) argue that a sharp rise in interest rates could threaten German life insurers with a potentially large increase in early policy cancellations.<sup>8</sup>

- **Complexity**—Insurance companies are typically less complex than banks. In the United States, however, some insurance companies move liabilities to “shadow insurers” in less regulated U.S. states and offshore domiciles, or themselves engage in shadow banking through certain funding agreements and related products (Kojien and Yogo 2013). For property and casualty insurers, the entry into new markets, such as catastrophe bonds, may actually help them mitigate tail risks, which are difficult to model (see Box 3.3).<sup>9,10</sup>

The low-interest-rate environment has raised concerns about the solvency of firms in various insurance markets, and such firms may be induced to take on excessive risks. Vulnerable firms include those that have guaranteed a minimum interest rate on a large proportion of their products or have negative duration gaps (longer maturities for their liabilities than for their assets). European stress tests in 2014 found that insurers in a number of countries were vulnerable to low interest rates because of such gaps (European Insurance and Occupational Pensions Authority 2014). Vulnerable firms have been under pressure to shift risks from

<sup>7</sup>Funding agreement-backed securities are tradable securities backed by funding agreements, that is, guaranteed investment contracts issued by life insurers.

<sup>8</sup>For example, General American Life Insurance Company experienced a run in 1999 (Paulson and others 2014). Rose (2016) discusses the case of the Great Surety Company, which experienced a run during the Great Depression.

<sup>9</sup>In this context, AIG and monoline insurers illustrate the risks from involvement in nontraditional markets, such as guarantee writing on bonds and securitization. Monoline insurers provided financial guarantees (or “wraps”) to bond issuers to enhance the creditworthiness of the issued securities, and later on also for securitization and structured credit markets. A dangerous chain of dependencies developed between the creditworthiness of the monolines and the securities they guaranteed. During the financial crisis, monoline credit ratings were downgraded, which led directly to sharp devaluations and sell-offs of the guaranteed securities (The Geneva Association 2010b).

<sup>10</sup>Climate change is likely to represent a major challenge for non-life insurers and reinsurers (Carney 2015).



their equity holders to their creditors, and possibly gamble for resurrection. Anecdotal evidence points to a search for yield (*Risk Magazine* 2013, 2015), which to some extent has been confirmed by systematic analysis (Becker and Ivashina 2015).

### Beyond Individual Default

The contribution to systemic risk by insurers and other financial firms goes beyond the risks of contagion arising from individual defaults. In the “tsunami” or macroprudential view, even solvent firms may propagate or amplify shocks to the rest of the financial system and the real economy. For example, insurance companies play a critical role in corporate bond markets, and a cessation of funding that may arise from a shock to insurance company balance sheets could have extensive repercussions.<sup>11</sup> Similarly, systemic risk may stem from common exposures of a few large firms or many small ones (Acharya 2015; IMF 2013). If such insurers behave procyclically, they may contribute to price swings on asset markets with possibly detrimental systemic effects (Bank of England 2015).<sup>12</sup>

The insurance sector could be a significant contributor to systemic risk even if no single insurance company were systemically important. In models such as that in Acharya and Richardson (2014), each institution’s contribution to systemic risk can be measured by its propensity to be undercapitalized when the system as a whole is undercapitalized. In such cases, the firm’s systemic importance is based not on its own capital shortfall, but on its contribution to the aggregate capital shortfall.

It is therefore important to assess the degree to which their exposure to aggregate risk has evolved.

- Life insurers should be expected to have a low exposure to aggregate risk because their investments are liability driven, and they aim to closely match the maturities of the cash flows of their assets and liabilities. In other words, their net cash flows should not be highly correlated with the market, and their betas should be low.

<sup>11</sup>Other channels may also play a role. Insurers may, for example, stop lending securities to counterparties (Bank of England 2015).

<sup>12</sup>The tsunami effect could be further compounded by spillovers arising from the network properties of the financial system. More generally, the domino and tsunami views are not mutually exclusive.

- Although insurers are large investors in equities and bonds (see the next section), they can in principle be expected to ride out price fluctuations and even behave in a countercyclical, that is, stabilizing, manner in securities markets.
- However, if firms offer products with nondiversifiable risk, insure against aggregate risk, or become more alike in their asset management, they may develop a common set of net exposures (through their assets and liabilities) to shocks and market risk (Acharya and Richardson 2014; Schwarcz and Schwarcz 2014).<sup>13</sup> Large adverse shocks to these exposures would be reflected in a sharp decline in insurers’ stock prices. Depending on the exact nature of the shock, to restore equity values, regain access to funding, or meet capital requirements (or all three), insurance companies would need to react by, for example, discontinuing their purchases of corporate bonds. Given the correlated nature of these exposures, many companies would want to act in a similar way, which, given the footprint of insurers in this market, could mean a drying up of funding for firms that rely on financing through bonds. More extreme events may prompt correlated sales, and downward price spirals, with disruptive effects (Acharya and others 2009; IMF 2015).
- In sum, a higher correlation of insurers’ stock prices among themselves and with the market implies that more insurers are more likely to be hit by the same shocks at the same time, and they will tend to react more similarly when hit by a shock.

### Trends in Global Insurance Markets

*The role of insurance firms as financial intermediaries in the midst of changing market structures and performance trends provides some preliminary indication of the sector’s systemic importance.*

Insurance firms are important financial intermediaries in the advanced economies and in global financial markets. As measured by premiums written, life and nonlife insurance markets are largest in North America (for the purposes of this chapter, excluding Mexico), Europe, and Japan (Figure 3.3), and they are growing rapidly in emerging market

<sup>13</sup>Regulatory regimes may reinforce such procyclicality.

economies and low-income countries—especially in Argentina, Brazil, China (Box 3.4), and Thailand. In South Africa, life insurance penetration, with premiums written in 2014 reaching 12 percent of GDP, is among the highest in the world. As measured by both premiums written and total assets, the life insurance market is larger than the nonlife market. Life insurers hold large amounts of government and corporate bond debt, and in the United Kingdom and Japan they also hold major stakes in equity markets. Insurers' share in direct lending is small, but it is rising in many countries.

A first look at aggregate figures for size, direct exposures to affiliates and banks, and concentration suggests a relatively benign picture (Figure 3.4). Insurance companies have become larger, but by much less than the largest banks. Investments in affiliates and deposits with banks are a small share—less than 5 percent—of insurers' consolidated balance sheets. On average, insurance sectors have become less concentrated despite continuing mergers and acquisitions. Insurers' debt-equity ratios are generally relatively low; in Europe, where they are the highest, they have slightly decreased.

Liquidity risks are more difficult to assess, but rates of early policy cancellations (lapses) have fallen. In general, lapse rates are contained, and especially so in Europe. In North America, lapse rates have dropped in recent years in line with declining interest rates (because new policies would be concluded at lower rates). On the other hand, anecdotal evidence suggests that lapses on life policies are becoming increasingly likely, as early withdrawal penalties are reduced in some countries.<sup>14</sup>

Insurers have been increasing their nontraditional investments, albeit from a low base. These include investment banking, direct lending, investments via hedge funds, and third-party asset management (IAIS 2011; October 2014 GFSR). In the United States, nontraditional non-insurance assets of nonlife insurers have grown from 3 percent of total assets in 2004 to 8 percent in 2014, and for life insurers from 2.5 percent to 4.5 percent. In Germany, only nonlife insurers

<sup>14</sup>The likelihood of lapsing will vary with economic and market conditions, which help determine the extent to which more attractive alternatives to an existing policy are available. Up to 50 percent of European life insurance policies are estimated to be canceled without penalty (Global Risk Regulator 2016).

have increased their proportion of nontraditional non-insurance assets.

Insurance companies have also been innovating on the liability side. Many insurers are tapping alternative capital markets, such as those for insurance-linked securities, to cover extreme risks or reduce reserve requirements (Box 3.3). A rise in unit-linked products<sup>15</sup> will generally reduce the share of life policies that incorporate guaranteed returns, although variable-rate products with guarantee mechanisms remain popular—including in the United States and some European countries—and may require complex and innovative hedging strategies. Moreover, some unit-linked products may also carry minimum performance guarantees.

### Comovement, Financial Stability, and Systemic Risk

*This section undertakes novel analytical exercises to assess, from various angles, the evolution of commonalities in exposure of the insurance sector and its contribution to systemic risk in advanced Asia, Europe, and North America.*<sup>16</sup>

#### Commonality and Comovement

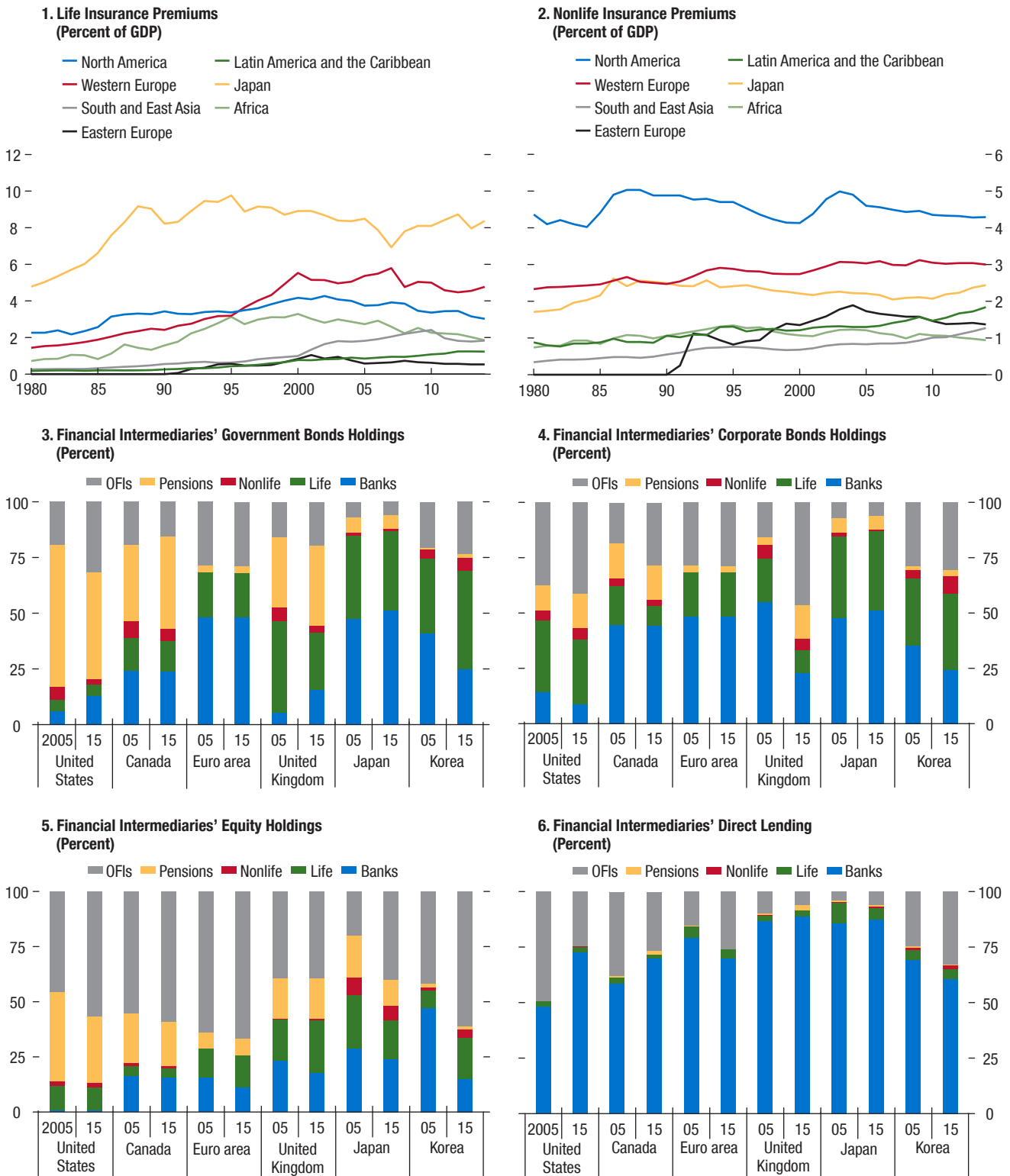
Life insurers' equity price comovements have increased. To assess the degree to which stock returns behave similarly, a dissimilarity index is computed using firm-level equity returns for banks and life and nonlife insurers.<sup>17</sup> The degree of similarity is then measured by the number of clusters, with a lower number of clusters denoting more similarity. The number of clusters among life insurers generally declined from 2006 to mid-2008 (Figure 3.5). In North America and Europe, the global financial crisis reversed this trend in the second half of 2008, but since 2010, life insurance companies have become somewhat more homogeneous again. The development is, however, more marked for the United States. For nonlife insurers and for banks,

<sup>15</sup>Unit-linked products are a form of long-term insurance whereby the policyholder chooses the investment strategy. These products can, but do not necessarily have to, include guarantees.

<sup>16</sup>Among the previous studies are the October 2014 GFSR; Bisias and others (2012); Cummins and Weiss (2014); The Geneva Association (2010a, 2010b, 2011); Houben and Teunissen (2011); Jobst (2014); Jobst, Sugimoto, and Broszeit (2014); Krenn and Oschischnig (2003); and Liedtke (2011).

<sup>17</sup>Similarity is based on two dimensions: temporal correlation and proximity (Chouakria and Nagabhushan 2007; Liao 2005).

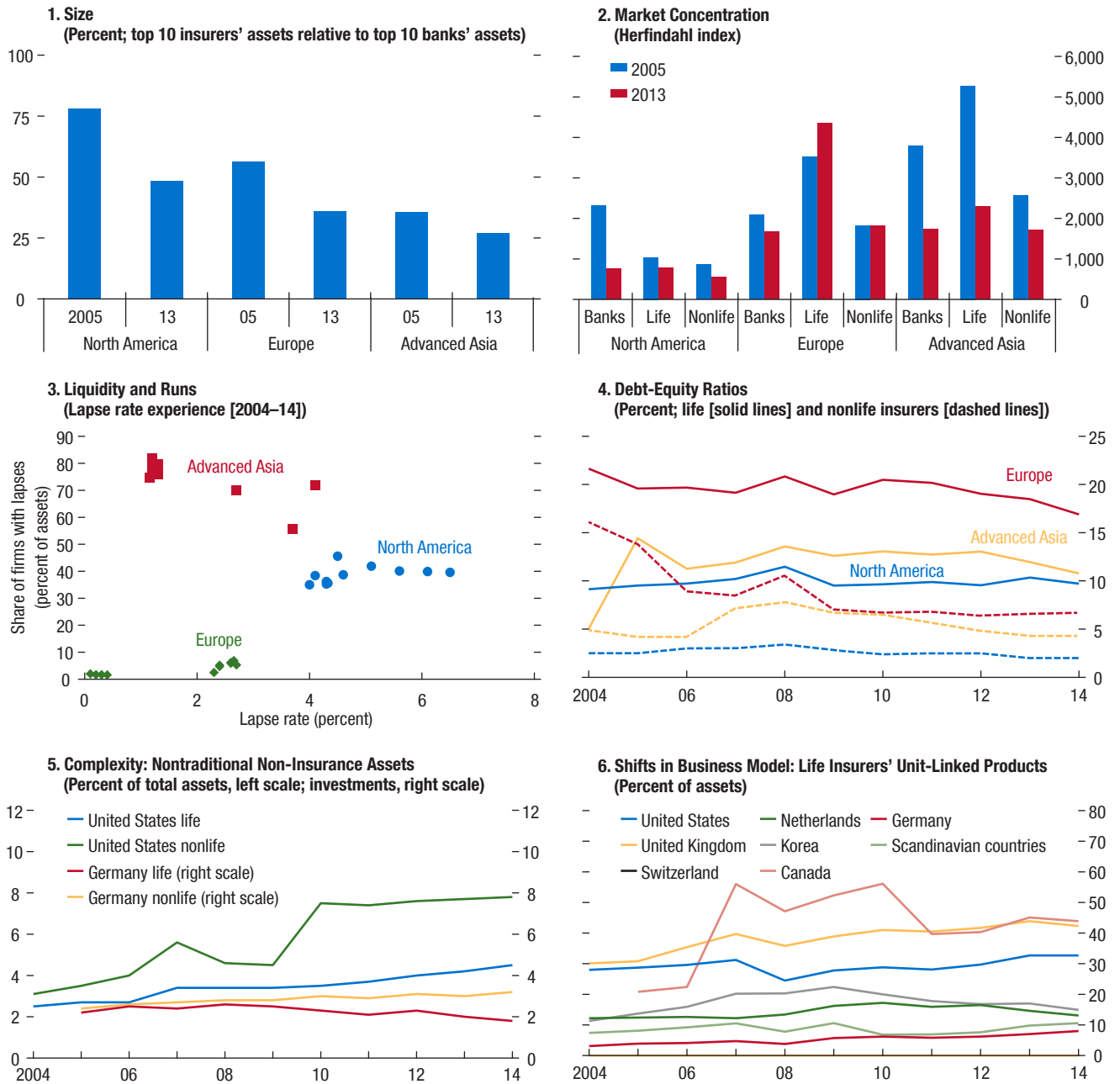
**Figure 3.3. Global Insurance Sector Size and Market Structures**



Sources: Flow of Funds via Haver Analytics database; SwissRe, Sigma Database; and IMF staff calculations.  
 Note: OFIs = other financial institutions.

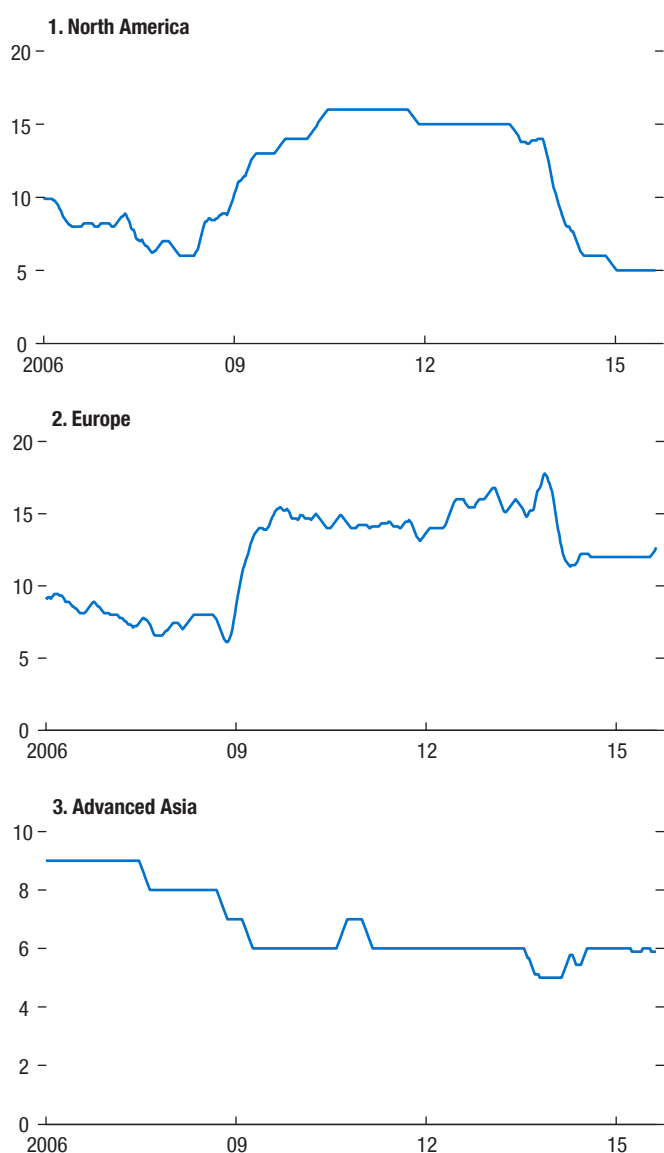


Figure 3.4. Changing Insurance Business Models and Systemic Risk Factors



Sources: A.M. Best, Global Statement File; BVD Bankscope; GDV Statistical Year Books; and IMF staff calculations.  
 Note: Concentration is measured as the median of the Herfindahl indices for countries in North America, Europe, and advanced Asia. A Herfindahl index between 1,500 and 2,500 indicates moderate concentration and an index above 2,500 a high level of concentration. Advanced Asia = Japan, Korea, Hong Kong SAR, Singapore, Taiwan Province of China, Australia, and New Zealand; Europe = Austria, Belgium, Denmark, Finland, France, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, and United Kingdom; North America = United States and Canada; Scandinavian countries = Denmark, Finland, Norway, and Sweden.

**Figure 3.5. Time-Series Clustering of Life Insurers on Equity Returns**  
(Number of clusters)



Sources: Bloomberg, L.P.; and IMF staff calculations.

Note: Lines show the smoothed number of clusters corresponding to a centered nine-week equal-weighted moving average. The analysis was conducted on five-year rolling windows of insurers' equity returns.

the trend is less pronounced, albeit broadly similar (not reported here).<sup>18</sup>

Similarly, common factors have gained in importance as drivers of life insurers' equity performance, but much less so for nonlife insurers in Europe. On average, the share of the first principal component in insurers' common equity price variations rose from 54 percent to 61 percent in the United States, and from 26 percent to 32 percent for European insurers overall (Figure 3.6). It is less important for nonlife insurers in the United States; in Europe, the first principal component explains a much lower fraction in return variation, and this explanatory power has fallen.<sup>19</sup>

### Contribution to Systemic Risk

Life insurers' contribution to systemic risk, as measured by a comparison of value-at-risk measures ( $\Delta\text{CoVaR}$ ), has tended to increase in Europe and North America.<sup>20</sup> In these regions, indices indicate that the average systemic risk contribution has returned to historically high levels (Figure 3.7). It is two to three times higher than in 2006, especially in the life insurance and banking sectors (absolute levels across the sectors are not comparable).<sup>21</sup> In advanced Asia, the systemic risk contribution has increased primarily in the banking sector, but remains subdued for nonlife insurers. The  $\Delta\text{CoVaR}$  patterns show similarities with the cluster analysis, with the systemic risk contribution increasing as the number of clusters falls. Nonlife insurers' systemic risk indices have risen the least in all three countries considered and have remained broadly at their 2006 levels in North America and advanced Asia.

An alternative gauge (SRISK) also suggests that insurers' contribution to systemic risk has grown,

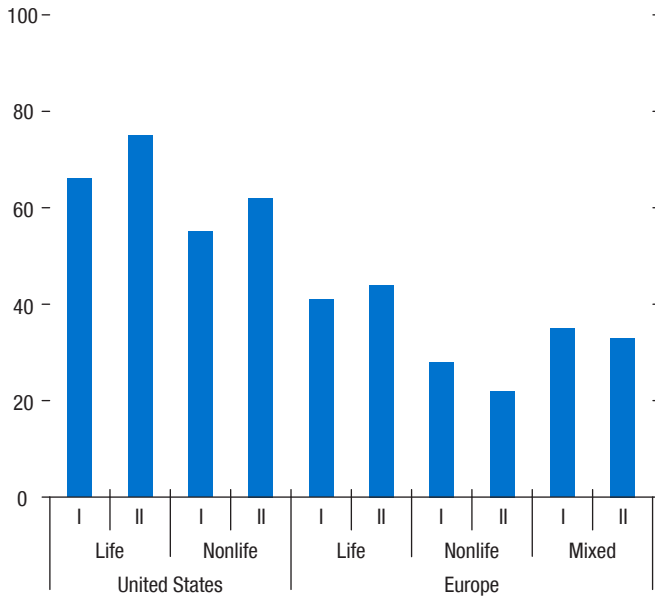
<sup>18</sup>The method implies that number of clusters moves in discrete, sometimes large, jumps.

<sup>19</sup>The contribution of the first principal component does not follow a cyclical pattern, although in Europe it fell somewhat after the global financial crisis.

<sup>20</sup>According to Adrian and Brunnermeier (forthcoming), an institution's CoVaR relative to the system is the value at risk of the whole financial sector conditional on that institution being in a particular state. The difference between the CoVaR conditional on an institution being in distress and the CoVaR conditional on the "normal" state of the institution,  $\Delta\text{CoVaR}$ , captures the contribution of an institution, in a noncausal sense, to overall systemic risk.

<sup>21</sup>One weakness of CoVaR is that it may not necessarily reflect the relative importance of each sector as a potential source of systemic risk, because it depends strongly on the number of firms included in each sector in the estimation. Therefore, Figure 3.7 uses normalized indices, thereby allowing for a comparison of the evolution over time.

**Figure 3.6. Variation of Insurers' Equity Return Due to First Principal Component (Percent)**

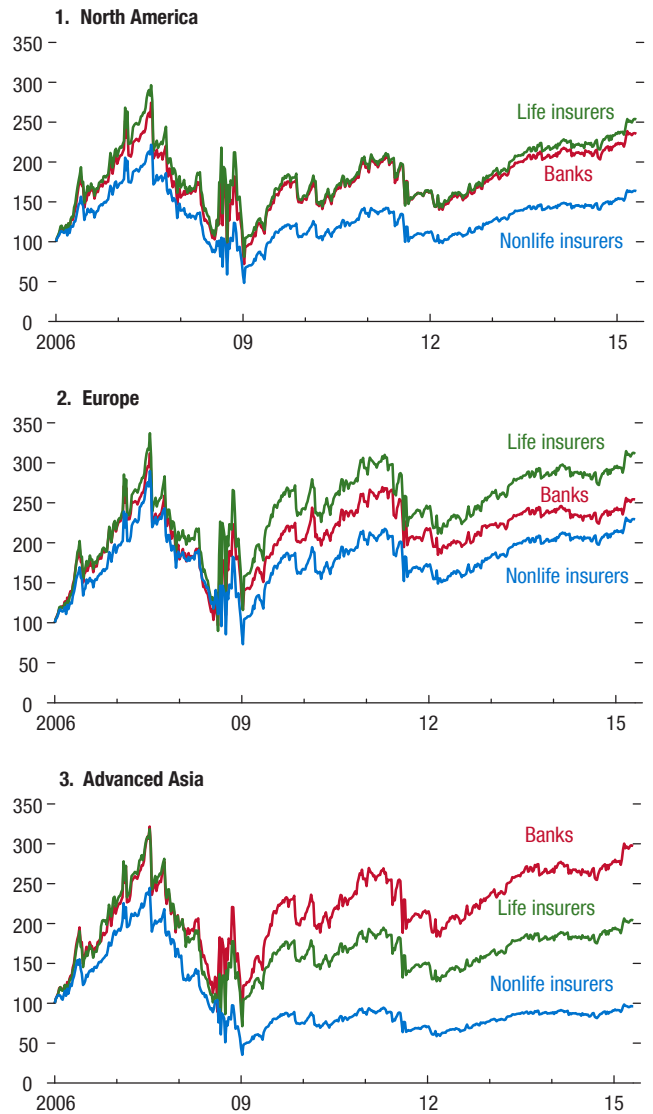


Sources: Bloomberg, L.P.; J.P. Morgan; and IMF staff calculations.  
 Note: Figure shows explanatory power ( $R^2$ ) of first principal component of U.S. and European insurers' equity returns, using daily data (2004 through 2015). Period I is before the crisis, and period II is after the crisis. Crisis is July 2007 through December 2008 for the United States, and July 2009 through December 2011 for Europe.

although remaining smaller than that of banks. The SRISK approach measures systemic risk through a firm's contribution to the aggregate capital shortfall of the financial sector.<sup>22</sup> A capital shortfall occurs if a firm's losses are greater than the excess of its actual capital over its required capital. The capital shortfall is a function of the size of the firm, its leverage, and its expected equity loss, conditional on the market decline. The results show that in general, banks are the most systemic institutions, but in North America, the contribution to systemic risk by life insurers has

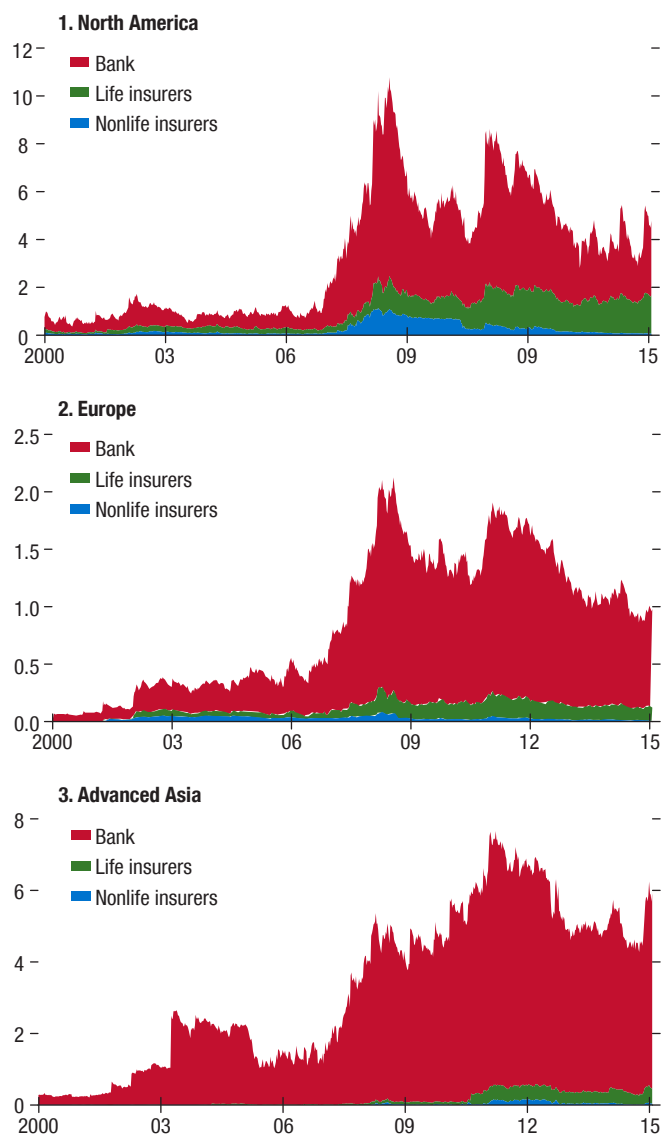
<sup>22</sup>Brownlees and Engle (2015), building on Acharya, Engle, and Richardson (2012), propose quantifying the systemic risk of a firm (SRISK) by its expected capital shortfall conditional on a prolonged market decline. A capital shortfall occurs if a firm's losses are greater than its required capital, and consequently, the firm is said to contribute to systemic risk. The capital shortfall is a function of the size of the firm, its leverage, and its expected equity loss. SRISK does not explicitly model the links between firms, as in the network models analyzed later in the section, but imposes comovements in equity returns implicitly through conditioning on a common risk factor using a bivariate generalized autoregressive conditional heteroscedasticity–dynamic conditional correlation model.

**Figure 3.7. CoVaR Indices (Normalized, 2006 = 100)**



Sources: Bloomberg, L.P.; and IMF staff calculations.  
 Note: Figure shows CoVaR indices constructed by aggregating the average  $\Delta\text{CoVaR}$  of individual firms for all firms in a given sector and region, normalized by their value in the first period. The average  $\Delta\text{CoVaR}$  of an individual firm includes its spillovers to financial firms in advanced economies (238 firms) as well as in emerging market economies (98 firms).  $\Delta\text{CoVaR}$  is estimated from weekly equity returns, for the period from January 1, 2001, to October 23, 2015; the quantile regression was estimated with a window expanding from an initial five-year period. The estimation corrects for the effects of market risk (MSCI World Index) and volatility risk (an average of volatility indices in North America, Europe, and advanced Asia).

**Figure 3.8. Conditional Capital Shortfall**  
(Trillions of U.S. dollars)



Sources: New York University, Stern School of Business, V-Lab; and IMF staff calculations.

Note: Figure shows the contributions to systemic risk of financial institutions on a weekly frequency for the period June 2, 2000, through October 30, 2015, calculated using data from the V-Lab at New York University. The sample comprises 349 firms in advanced and emerging market economies, largely overlapping with the clustering and CoVaR samples.

grown steadily since the global financial crisis (Figure 3.8). This finding is in line with the upward trend of the  $\Delta\text{CoVaR}$  index.<sup>23</sup> Again, nonlife insurers contribute only in a minor way to systemic risk, with no visible increase.

Probability-of-default-based network models complement approaches based solely on equity returns. Focusing on probabilities of default allows the analysis to account explicitly for the effects of capital structure and firm-specific balance sheet characteristics (such as liquidity ratios) on the survival of a firm. In a probability-of-default network, two firms are connected if the partial correlation of their probability of default is nonzero (Chan-Lau and others 2015).<sup>24</sup> Within the network, the most systemic institutions have a higher number of connections.

The results from this model are in line with those of the SRISK analysis. The network was constructed for four different dates (Figure 3.9) to assess the evolution of systemic risk. If all sectors were equally systemic, their relative share among the top systemic institutions would reflect their share in the sample. This is not the case. Banks dominate the systemic risk rankings, but the representation of insurers among the top 100 firms has grown since 2001. In particular, life insurers have tended to be more systemic and nonlife insurers much less systemic than their sample shares suggest.

### Spillovers and Network Centrality

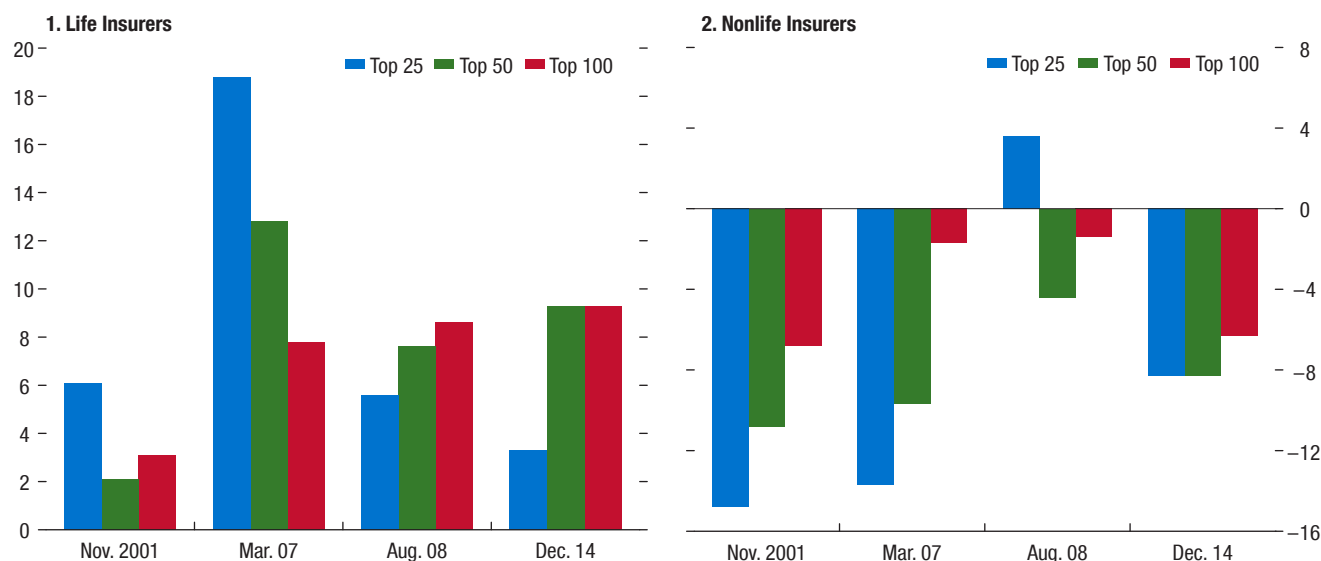
Insurers play an important role as transmitters of spillovers.<sup>25</sup> In Europe and North America, banks and life insurers generally rank highest as transmitters (Figure 3.10). Spillovers from North American nonlife insurers declined substantially after 2010, whereas spillovers from nonlife insurers in Asia increased to a similar degree.

<sup>23</sup>The results for Europe are broadly in line with those reported by Berdin and Sottocornola (2015); Engle, Jondeau, and Rockinger (2015); and European Systemic Risk Board (2015).

<sup>24</sup>Partial correlations remove dependence induced via third parties (Kenett and others 2010).

<sup>25</sup>Spillovers are jointly estimated across regions and measure each region's contribution to the total residual variance of the equity returns of all other regions (Diebold and Yilmaz 2014). To avoid sample selection and survivorship biases, which could arise when using firm-level data with excessive regional or sectoral heterogeneity, the variance decomposition exercise uses regional sector equity index aggregates for North American, Western European, and Asian asset managers, banks, life insurers, nonlife insurers, and reinsurers. See Annex 2.4 in Chapter 2 for a methodological overview.

**Figure 3.9. Forward-Looking Default Correlation Networks**  
(Percent; over- or underrepresentation of insurers)



Sources: Risk Management Institute 2015; and IMF staff calculations.

Note: Figure shows over- or underrepresentation of life and nonlife insurers, in the top 25, top 50, and top 100 firms included in the forward-looking default correlation network. For example, a 5 percent value for the top 100 indicates that there are 5 percent more insurance firms among the top 100 than justified by their sample share. Total sample size ranges between 1,263 and 1,679 firms, including 310 to 410 insurers. Owing to the large number of firms, a regularization adjustment was required to generate fully connected networks, where no firm is an orphan (Oh and others 2014).

The largest cross-region spillovers are those from North American life insurers and asset managers to the European banking and insurance sectors (Figure 3.10). In addition, European banks have a large spillover effect on North American insurers and asset managers, and similarly, European life insurers and reinsurers have a sizable impact on North American life insurers. Significant spillovers transpire from European banks, asset managers, and life insurers to Asian banks, and vice versa, to a lesser extent. A separate analysis for Europe indicates that although insurers were recipients rather than sources of spillovers through the end of the global financial crisis, they have more recently tended to become a source (Box 3.5).

### What Is Behind the Higher Systemic Risk Contributions?

*This section examines potential drivers of the increased systemic importance of life insurers. It first examines their investment behavior using firm-level data from Canada, the United States, Korea, and three European countries. Next, the role of duration mismatches and changed market dynamics are considered.*

### Investment Behavior

Changes in the investment behavior of insurers may have contributed to higher systemic risk through various channels. First, lower interest rates may have induced firms (particularly weaker ones) to take on relatively more risk in an attempt to shift risk from equity holders to creditors and policyholders, and possibly to gamble for resurrection. That behavior would increase solvency risk (and the risk of domino effects). Second, the asset composition of firms' portfolios may have become more similar, increasing their exposure to common shocks (the tsunami risk). Third, even with a broadly unchanged asset composition, firms' portfolios may have become more similar in their exposures to market risk because their assets feature higher betas or higher correlations with common risk factors. Fourth, the procyclicality in their investment behavior may have risen, increasing insurers' tendency to transmit shocks rather than absorb them.

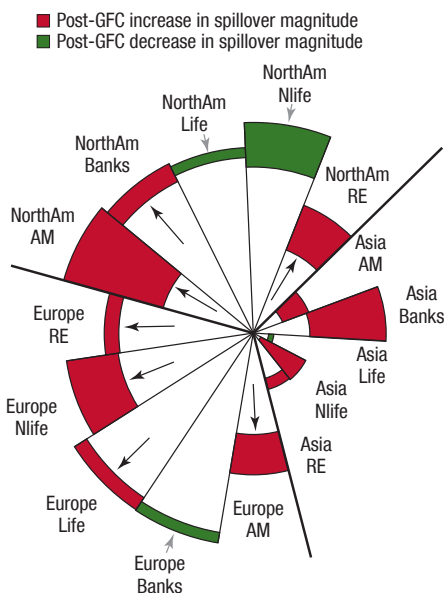
#### "Riskiness" of portfolios

No aggregate risk trend is apparent by asset category for life insurers, but there are differences across firms

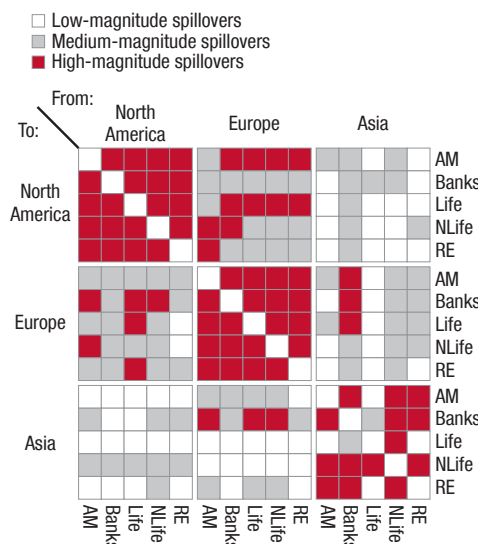


**Figure 3.10. Spillovers between Insurance and Other Financial Sectors**

**1. Change in Spillover Size Pre- and Post-GFC**



**2. Sector-to-Sector Spillovers**



Sources: Datastream; and IMF staff calculations.

Note: Panel 1 shows change in the size of region and sector spillovers between the pre- and post-GFC periods. Segment length corresponds to region/sector spillover index values. Segment width is used to emphasize differences. Panel 2 shows spillover directionality across regions and sectors. AM = asset management; GFC = global financial crisis; Nlife = nonlife; NorthAm = North America; post-GFC = 2010–15; pre-GFC = 2001–08; RE = reinsurance.

and countries. For Canada, Germany, Korea, the Netherlands, Norway, and the United States, detailed information on insurers’ asset positions could be obtained.<sup>26</sup> Contrary to what may have been expected, on average, insurers have been keeping the overall proportion of higher-risk assets in their portfolios roughly constant or have even reduced it, although returns on investment fell (Figure 3.11, panels 1 and 2).<sup>27</sup> For some European countries, this behavior may be related to the advent of Solvency II, which introduces risk-sensitive capital requirements and market-based valuation. Geographical differences, however, appear to be significant (Figure 3.11, panel 3). In a recent survey, insurers in the United Kingdom and northern Europe reported seeing better opportunities in illiquid assets such as infrastructure and real estate, whereas those in southern Europe were more

likely to increase their allocations to equities. Insurers in Germany showed increased interest in exploiting illiquidity premiums.<sup>28,29</sup>

Firm-level data from six advanced economies suggest that less well-capitalized life insurers hold relatively more higher-risk assets, with some increasing such holdings in recent years.<sup>30</sup> Life insurers with capital ratios closer

<sup>26</sup>The degree of granularity varies across countries, but overall, the asset classification is relatively coarse. Since the Norwegian sample consists of only five firms, no formal econometric analysis is undertaken for this market.

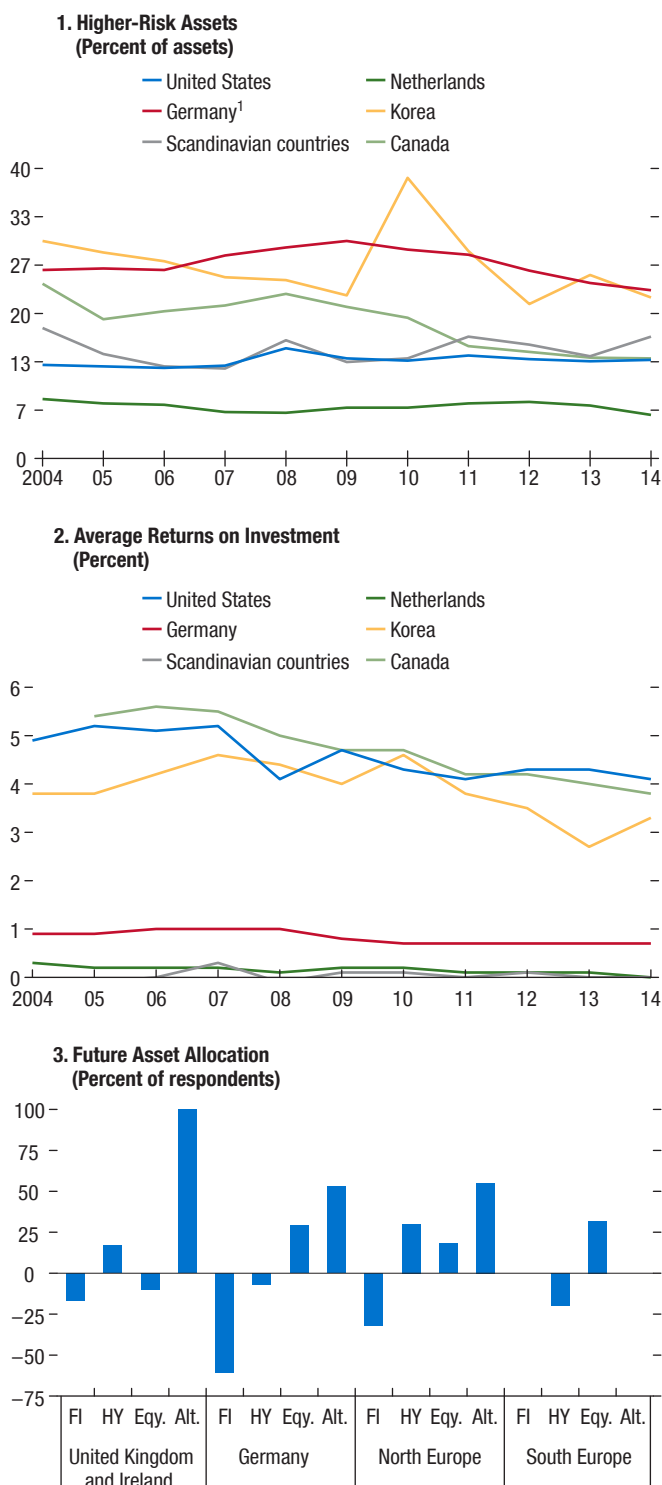
<sup>27</sup>High-yield bonds, shares, mortgages, real estate, affiliate-related investments, loans, and unquoted investments. Under National Association of Insurance Commissioners (NAIC) rules, all these are in the higher-risk (C-1) category.

<sup>28</sup>On average, higher-risk asset holdings are associated with higher exposures to market risk. For U.S. life insurers, and to a lesser extent for European and Asian insurers, changes in higher-risk asset shares (as defined previously) and unlevered market betas (as a measure of insurers’ stock price sensitivity to market movements) are positively correlated. This correlation indicates that across insurers, differences in investment risk-taking are reflected in systematic risk exposures through their stock price betas.

<sup>29</sup>Domanski, Shin, and Sushko (2015) document that German insurers engage in a hunt for duration, which reinforces downward pressure on interest rate levels. In our sample, data for the United States and Norway comprise information on maturities; on average, insurers in these countries lengthened the maturity of their bond holdings.

<sup>30</sup>Research finds that insurers tend to reach for yield in the bond market. Risk-shifting incentives and poor corporate governance have been identified as factors that make insurers more willing to take risks (Becker and Ivashina 2015; Ma and Ren 2012). For nonlife insurers, research suggests a trade-off between underwriting risks and investment risks: during periods when underwriting income is low, they tend to reduce their investment in risky assets, and vice versa.

**Figure 3.11. Life Insurers' Investments**



Sources: A.M. Best Global Statement File; Standard Life 2015; and IMF staff calculations.  
 Note: Alt. = alternative investments; Eqy. = equity; FI = fixed income; HY = high-yield; Scandinavian countries = Denmark, Finland, Norway, and Sweden.  
<sup>1</sup> For Germany, higher-risk assets also include shares in investment funds, which may include bond funds.

to the required minimums allocate significantly more of their investments to higher-risk assets. The low-interest-rate environment has accentuated these differences in Canada, Germany, the Netherlands, and the United States. These findings are consistent with the notion that lower interest rates exacerbate the incentive for weaker insurers to gamble for resurrection (Figure 3.12, panel 1). In addition, granular U.S. data show that life insurers with lower capital buffers also seek higher yields within the highest-rated bond category. Nevertheless, even for these firms, the share of risky asset holdings remains moderate in most cases.

Life insurers with greater proportions of products that guarantee returns engage more in a search for yield. In Germany, such life insurers tend to purchase higher-risk assets (Figure 3.12, panel 2).

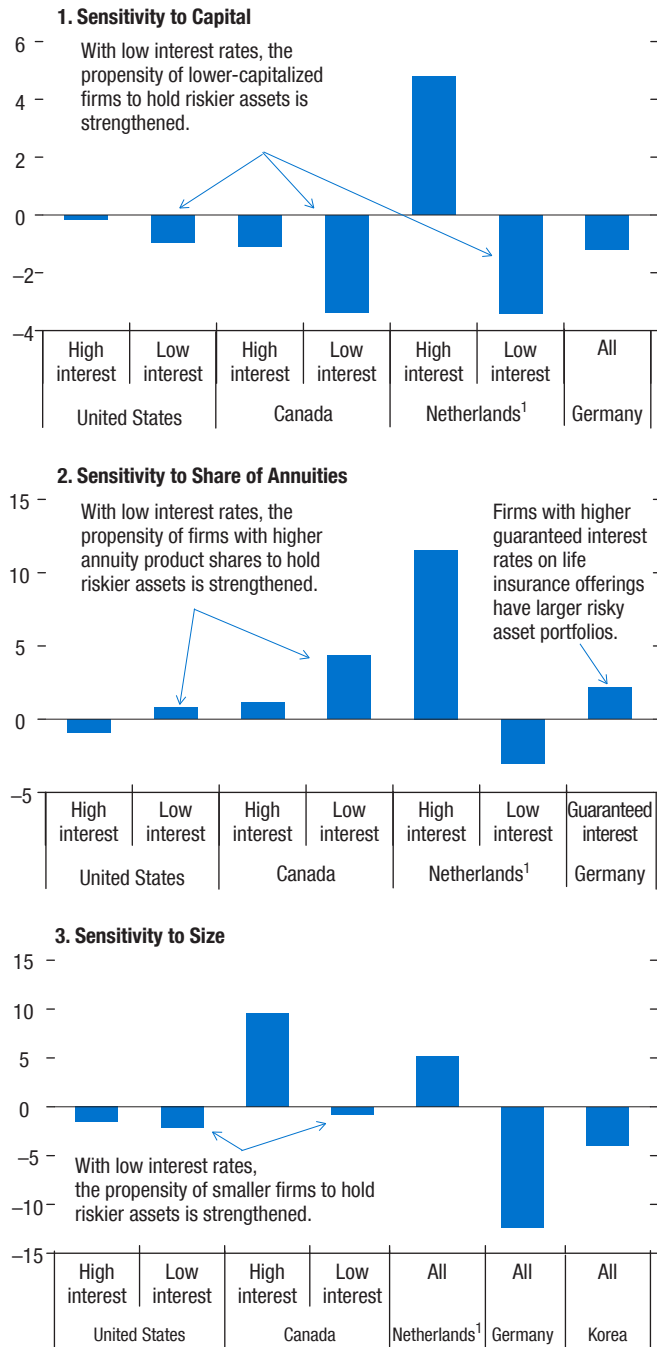
Indirect evidence also comes from North America, where insurers with a higher share of annuity products—which usually offer return guarantees—shift more to riskier assets when interest rates are low. In Norway, firms with larger negative duration gaps (that is, with liabilities that are substantially longer dated than their assets) seem to hold considerably more higher-risk assets, although most have narrowed this gap during the 2012–15 period. Furthermore, detailed U.S. data show that insurers less focused on underwriting and more on investment management (that is, with low net premiums written relative to total liabilities; see Box 3.1) achieved higher average yields within the class of higher-rated bonds (NAIC categories I and II). This finding suggests that they favored higher-yielding securities within the asset class. However, no significant association is found with regard to their investment yield on risky bonds (NAIC categories III–VI).

Smaller life insurers have been behaving differently from larger ones, and in some countries, have increased the share of riskier assets. In four of the five countries analyzed, the relationship between size and risky asset shares is now negative (Figure 3.12, panel 3). In Canada and the United States, smaller insurers in the sample have raised their risky asset holdings in recent years, while larger ones have reduced them (Figure 3.13). In the United States, the difference between the behavior of larger and smaller firms has increased somewhat in the low-interest-rate environment.

**Portfolio similarities by asset category**

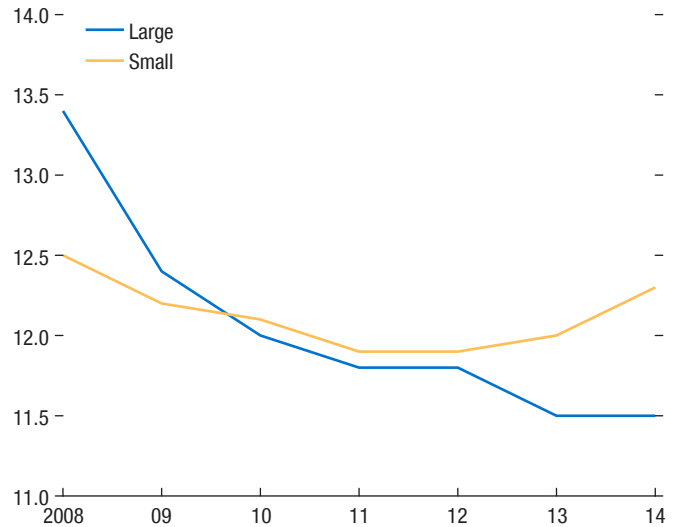
The asset positions of life insurers in Canada, the Netherlands, and the United States do not appear to

**Figure 3.12. Sensitivity of Life Insurers' Risky Assets to Firm-Level Factors**  
(Percent of total assets)



Source: IMF staff calculations.  
Note: Figures show the economic impact of firm factors on the share of higher-risk assets, with differentiation between high- and low-interest-rate environments, where significant.  
<sup>1</sup> For the Netherlands, large insurers (in the high-interest-rate period) are less well capitalized and have more risky assets. They also have less annuities.

**Figure 3.13. U.S. Life Insurers' Higher-Risk Assets**  
(Percent of total assets)



Sources: A.M. Best Global Statement File; National Association of Insurance Commissioners; Standard Life Investments Limited 2015; and IMF staff calculations.  
Note: Large refers to the upper third and small to the lower third of firms ranked by total assets.

have become more similar over time.<sup>31</sup> Hierarchical cluster analysis applied to a cross-section of life insurance companies in each of those countries indicates that the number of clusters appears broadly stable for the period 2002–14 in all three. Hence, at least in these countries, increased similarity in asset holdings does not seem to be the reason for a decline in the number of clusters based on equity returns nor for the associated increased return correlations.

Therefore, the de facto increase in exposures to aggregate risk does not seem to have, in general, been driven by life insurers using similar investment strategies to increase risk. Those higher exposures may instead have been driven by changed market dynamics and structures. Nonetheless, life insurers have not counteracted the increase in aggregate risk exposures. Nonlife insurers, however, appear to have done so over the 2006–15 period, during which their systemic risk contributions have moderated. According to some measures, banks' systemic risk contribution has also declined.

<sup>31</sup>Micro-level data are not available to examine this in detail for other countries.

## Procyclicality

The overall evidence on procyclical behavior is mixed. The analysis for this chapter indicates that U.S. life insurers acted countercyclically in 2008, but lower-capitalized insurers were more prone to sell securities. Between the first and third quarters of 2008, U.S. insurance companies increased their holdings of corporate bonds from 16 percent of their aggregate portfolio to 17.7 percent (Figure 3.14). In contrast, asset holdings at mutual funds and pension funds during this period appear to have either fallen or held steady. Although lower-capitalized insurers tended to sell more bonds during the crisis, the overall contrarian investments by the insurance sector contributed to the stability of the U.S. corporate bond market in that period. This behavior was likely influenced by the relaxation of investment rules in 2009, which alleviated some of the pressure on insurers to sell other assets.<sup>32</sup> Moreover, the data show no clear indication that short-term tactical asset allocation has become more important among U.S. insurers: turnover at the firm level has not increased in recent years.

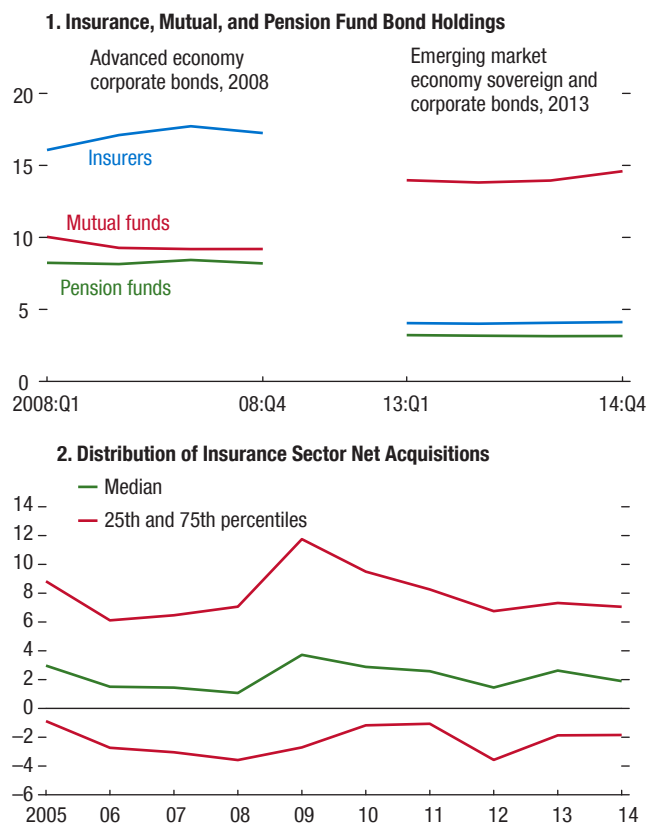
Some previous research finds evidence of procyclicality,<sup>33</sup> although the evidence is not unequivocal.<sup>34</sup> The April 2014 GFSR finds that large institutional investors in emerging market economies, including

<sup>32</sup>Manconi, Massa, and Yasuda (2012) show that in the second half of 2007 the existing rules on commercial mortgage-backed securities (CMBS) forced insurers to compensate for their losses on holdings of securitized CMBS bonds by selling or reducing their buying of lower-rated securitized and corporate bonds. The easing of the rules reduced selling pressure by moderating capital charges applied to losses. Insurers continue to be major investors in CMBS and retail MBS, holding at end-2014 \$208.5 billion in CMBS and \$414.5 billion in retail MBS. See also Becker and Opp (2014) for a critical analysis.

<sup>33</sup>For the United States, see Rudolph (2011); for the Netherlands around the time of the stock market crash of 2002–03, see de Haan and Kakes (2011); for Germany, see Timmer (2016).

<sup>34</sup>For the Netherlands, two studies find evidence of procyclical behavior. Bijlsma and Vermeulen (2015) find that insurers sold distressed euro area sovereign bonds during the 2012 European sovereign debt crisis. Duijm and Steins Bisschop (2015) report similar results for insurers' equity investments during 2006–15, although they attribute the sales in part to the move toward the risk-based Solvency II capital regime. During the stock market crash in 2001, insurers across a range of countries seem to have sold into the falling market (Impavido and Tower 2009; see also the discussion in Papaioannou and others 2013). Manconi, Massa, and Yasuda (2012, p. 516) examine insurers' behavior in 2007 and conclude that they "did not act as strategic liquidity providers at the onset of the crisis." For the United Kingdom, however, the Bank of England (2015) cautioned on evidence of procyclicality, because the observed shift out of equities since 2002 could reflect a structural rather than a cyclical response.

**Figure 3.14. U.S. Insurance Sector Bond Holdings and Turnover (Percent)**



Sources: Lipper Emaxx, National Association of Insurance Commissioners Schedule D; and IMF staff calculations.

Note: Net acquisitions are defined as securities purchased minus sold, relative to last year's outstanding; securities include bonds, common stocks, and preferred stocks.

insurance companies, react less to global shocks around times of "normal" volatility but withdraw more strongly and persistently from a country in response to sovereign downgrades.<sup>35</sup> This may possibly reflect the fact that in liquidity crises, insurers—being less affected by liquidity shocks—take advantage of market conditions to buy underpriced securities, whereas in solvency crises, they do not. However, the October 2015 GFSR reported that securities held in higher concentrations by insur-

<sup>35</sup>In the 2013 market sell-off of emerging market assets, the distress and the increase in U.S. Treasury yields may have been too short-lived to prompt much of a reaction by insurers, whose holdings of emerging market securities remained unchanged; however, the liquidity of bonds held more by insurers fell more strongly (see the April 2015 GFSR).

ance companies suffered a larger decline in liquidity during the global financial crisis and the “taper tantrum” of 2013.

### Other Factors

#### Duration mismatches

The increased stock comovement among life insurers is partly driven by a higher sensitivity to interest rates, which points to the role of duration mismatches. The interest rate on “safe” bonds is one of the factors driving insurers’ stock market returns. Since the global financial crisis, life insurers’ equity prices have become more sensitive to movements in the prices of government bonds, especially in Europe and in the United States. This indicates that markets assess duration gaps to have become more negative (Figure 3.15).<sup>36</sup> When insurers have negative duration gaps (that is, the maturity of liabilities is longer than that of assets) and at least partly guaranteed returns on their liabilities, a decline in interest rates increases their effective leverage.<sup>37</sup> This higher effective leverage can translate into higher market betas.

#### Developments on the liability side

This chapter has not examined insurers’ liabilities in detail, but changes in the mix of products offered and in the degree and types of nontraditional activities may have contributed to their riskiness. For example, credit derivatives exposures have fallen since the crises, but their exact magnitude and nature are difficult to ascertain. Moreover, some markets have seen a rise in the offerings of products with minimum guarantees (investment-oriented life insurance policies and variable annuities), which would increase insurers’ exposures to aggregate risk. As discussed earlier, many insurers are tapping alternative capital markets.

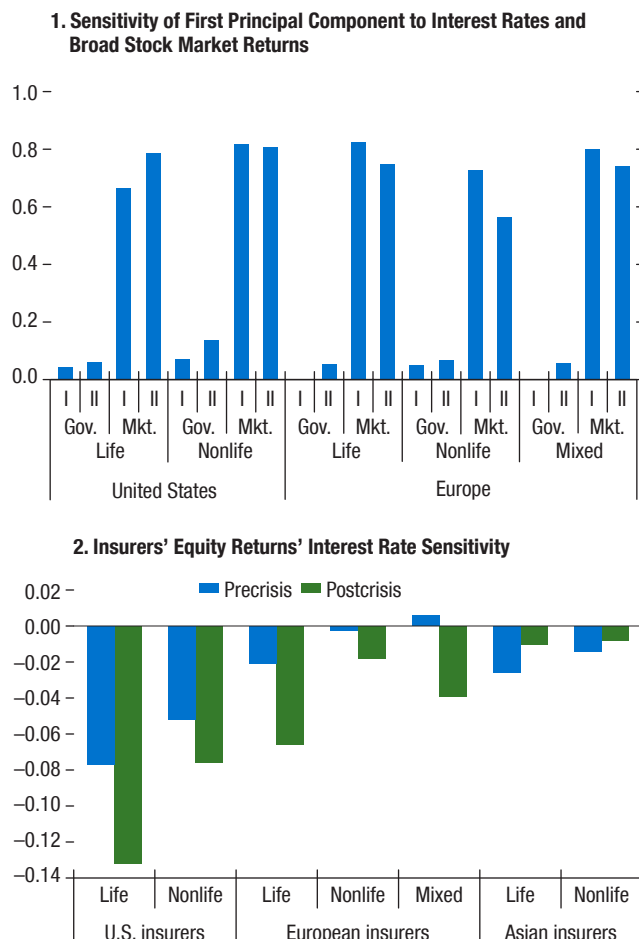
#### Changed market dynamics

The changes in clustering also seem to be associated with broader patterns of cross-asset correlations, representing a combination of temporary and longer-lasting, structural shifts in markets. Cross-asset correlations have been high since the global financial crisis (see April 2015

<sup>36</sup>In earlier work, interest rate sensitivity was found to vary over subperiods between 1975 and 2000 (Brewer and others 2007) as well as since the crisis (Berends and others 2012).

<sup>37</sup>At low interest levels, this effect is accentuated by the convexity of the relationship between duration and interest rates.

**Figure 3.15. Insurers’ Interest Rate and Market Return Sensitivity**



Sources: Bloomberg, L.P.; Datastream; and IMF staff calculations. Note: Panel 1 shows the sensitivity (coefficient) of insurers’ equity returns’ first principal component to government bond yields and the broad stock market return (see also Figure 3.6). Panel 2 shows bond return coefficients, from a regression of insurers’ equity returns on broad stock market and 10-year government bond returns. Gov. = government; Mkt. = market.

GFSR, Chapter 1), but the causes of this phenomenon are not clear. It may reflect a search for yield and, more generally, the lower levels of risk aversion prevalent in recent years (Baker and Wurgler 2007), all of which in turn may be related to the accommodative monetary policies pursued in advanced economies.<sup>38</sup> Arguably, as risk aversion falls, investors become less discriminat-

<sup>38</sup>Guiso, Sapienza, and Zingales (2014) find empirical evidence consistent with a substantial increase in risk aversion following the global financial crisis. Behavioral experiments (Cohn and others 2015) and evidence on the time-varying nature of the equity premium (Campbell, Giglio, and Polk 2013) support this view.



ing about their stock holdings overall, a reaction that translates into higher correlations and higher similarity across equity returns.<sup>39</sup> This situation would be temporary, although likely to persist for some time in many advanced economies. However, structural changes are likely to play a role as well. Market liquidity has become more fragile because of structural changes in the markets and appears to have declined in some market segments (October 2015 GFSR, Chapter 2). Benchmarking and index investing have become more widespread, and the use of derivatives has increased (April 2015 GFSR, Chapter 1). As a consequence, returns across insurers are more likely to be driven by common shocks.

### Insurance Sector Regulation

*This section reviews current insurance regulations and their impact on insurer business models in light of the preceding evidence.*

#### Recent Regulatory Developments

Insurance solvency regulations have become more risk based and thereby have affected insurers' investment choices. Risk-based capital and reserve requirements have been introduced in many countries. The trend started with Canada in 1992 and continued with the United States in 1994, Australia in 1995, Japan in 1996, Singapore in 2004, Switzerland in 2006, and Korea in 2011 (Annex 3.1). The use of internal models, combined with a rising degree of confidence in statistical risk measures, has tended to generate more market-sensitive valuations of exposures and insurance liabilities. Greater market sensitivity has reshaped insurers' offerings of credit and equity products and induced insurers to mitigate interest rate risks from asset-liability mismatches.

An additional development—the move toward market-based accounting principles—may contribute to the shortening of investment horizons of risky investments while extending the maturity of safe assets (Annex 3.1). Previously, valuations of investments other than equities were typically based on cost or book values.

<sup>39</sup>This explanation is consistent with the difference between North America and Europe in the pattern of bank clusterings. The economic recovery in the United States reduced the number of bank clusters to below the level preceding the global financial crisis. In contrast, continued economic uncertainty in Europe has kept the number of bank clusters above precrisis levels.

The 2006 Swiss Solvency Test and the 2016 Solvency II Directive of the European Union effectively introduced market-consistent valuation of the total balance sheet.<sup>40</sup> The valuation of liabilities is affected only by the safe interest rate, whereas the valuation of risky assets is also driven by credit spreads (an issue particularly relevant for assets with long maturities). Therefore, insurers have fewer incentives to invest in return-maximizing risky assets so as to avoid large shifts in capital requirements. At the same time, market-consistent valuation encourages investments in longer-term, low-risk assets, such as sovereign debt and high-grade corporate bonds, and these incentives become stronger the higher the market volatility. However, many solvency regimes currently still allow or require the use of cost accounting for insurance liabilities and for many assets (the so-called cost-based valuation standard).

Wide variations in capital requirements and the use of internal models are among the main problems in developing a global capital framework, although progress is being made. The IAIS continues to make progress in establishing its Common Framework for the Supervision of Internationally Active Insurance Groups, which provides more concrete requirements than those in its insurance core principles (ICPs). Also encouraging is the IAIS work on a framework of policy measures for global systemically important insurers (IAIS 2015a) that is consistent with the recommendations of the Financial Stability Board (see Box 3.2).<sup>41,42</sup>

<sup>40</sup>For example, under Solvency II, the discount rates used to derive fair estimates of liabilities are based on prevailing interest rate swap rates, the "ultimate forward rate," plus a matching or volatility adjustment. The matching adjustment depends on the tightness of the asset-liability matching. The volatility adjustment is intended to dampen the procyclicality of credit and liquidity spread volatility. See also European Central Bank 2015.

<sup>41</sup>These policy measures include the higher loss absorbency (HLA) requirement developed in 2015 (IAIS 2015a). As a foundation for the HLA requirement, the IAIS developed the basic capital requirement in October 2014. From 2019, global systemically important insurers will be expected to hold qualifying regulatory capital that is not less than the sum of the required capital amounts from the basic capital requirement and HLA. In December 2014, the IAIS issued the first consultation paper on group-wide, consolidated risk-based insurance capital standards. In June 2015, it published the Ultimate and Interim Goals and main principles for development of insurance capital standards and a so-called delivery process (IAIS 2015b).

<sup>42</sup>Relatively advanced regulatory regimes, such as Switzerland's Solvency Test and the European Union's Solvency II, rely on internal models. Some other regimes, such as those in Canada and Australia, allow internal models only cautiously, whereas the United States and Japan do not allow them except for catastrophe risk and variable annuities (see IMF 2015).

Compliance with the ICPs has improved over time. The ICPs are a globally accepted framework for regulation of the insurance sector and for the conduct of its business strategies. ICPs allow for significant national discretion in their implementation. Since 2003, international compliance seems to have improved, but more for the regulatory aspects than for business strategies. The high noncompliance rates for disclosure point to the importance of addressing remaining data gaps. Moreover, compliance with ICPs is generally greater in advanced economies than in emerging market economies (Figure 3.16).

### Looking Forward

#### Macroprudential emphasis

Although progress is being made on the micro-prudential front, the empirical analysis suggests that macroprudential perspectives are needed to address risks related to the sectors' increased common exposures.<sup>43</sup> The analysis underscores the notion that systemic risks not only arise from the potential domino effects created by the insolvency of an individual institution, but also stem, increasingly, from the sector's growing common exposures. This means that supervisors should monitor not only individual firms but also the behavior of the sector as a whole and the interconnections with the rest of the financial system. Enhanced system-wide reporting and disclosure requirements for new and/or less liquid investment products and for duration gaps based on internationally agreed definitions would help supervisors identify greater risk-taking by insurers. Moreover, the IAIS (2013c) work on macroprudential policy measures to strengthen the resilience of the insurance sector should be advanced quickly. One such measure could be countercyclical capital buffers, which—provided they are properly designed—are built up during upswings of the financial cycle and run down during periods of financial market stress. Limits on the use minimum guaranteed interest rates on new life insurance contracts (possibly combined with limits on certain underwriting activities) can also be envisaged. Regular macroprudential stress tests of the sector as a whole would also help identify the sector's resilience to potential vulnerabilities.

<sup>43</sup>This policy recommendation is also elaborated in Monkiewicz and Małecko (2014).

**Figure 3.16. Compliance with Insurance Core Principles (Percent)**



Sources: IMF, Financial Sector Assessment Programs (FSAP); and IMF staff calculations. Note: Based on FSAP core insurance principles' assessments (33 advanced economies and 20 emerging market economies over the period 2003–15). Insurance core principle compliance is ranked in descending order based on advanced economies. Observed is for fully or largely observed. Unobserved is for partly to fully non-observed. AE = advanced economy; Cap. = solvency; Cond. = supervisory effectiveness (conduct); EM = emerging market economy; Enforce. = enforcement; IAIS = International Association of Insurance Supervisors; Invest. = investments; Liab. = liabilities; MaPru. = macroprudential; M&A = merger and acquisition; PCA = prompt corrective action; Risk Mgt. = risk management.

#### Market-consistent valuation

Full market-consistent valuation increases transparency, and thus helps enhance policyholder protection and provides incentives to address duration mismatches. It is superior to cost-based valuation using book values in reflecting the true economic value of the balance sheet and encouraging greater asset-liability matching. However, this valuation approach tends to make regulatory capital requirements more procyclical, as asset values and capital surpluses change in fairly

lock-step fashion.<sup>44,45</sup> The procyclical implications can be mitigated if insurers hold high-grade bonds whose durations are perfectly matched to their liabilities. Such matching would minimize the cyclical impact of credit and illiquidity premiums of assets on the discounting of long-term liabilities (since liabilities are also discounted at market rates).<sup>46</sup>

Wherever adopted, market-consistent valuation will need to be paired with macroprudential measures that help limit system-wide risks from procyclicality. An example of that accommodation is the European Union's Solvency II regime, which requires market-consistent valuations of both assets and liabilities but includes a "volatility adjustment" that effectively reduces liability values during periods of rising credit spreads in the fixed-income market. To make such countercyclical measures most effective, institutions would need to build capital in the upswing of the financial cycle. In addition, to minimize regulatory arbitrage, authorities should build a consistent international framework for such measures.

#### *Attention to smaller and weaker firms*

Existing international standards focus on larger and stronger firms, but the empirical findings suggest additional policy responses should also target smaller and weaker firms. Weaker firms—those with lower capital ratios, or larger shares of assets with minimum guaranteed returns—and especially smaller companies, seem to be taking relatively more risks. Although the chapter finds that the insurance sector's systemic risk contribution is increasing, international standards are targeted at larger institutions and thus may not apply to the weaker and smaller firms. Insurance supervisors should fill the gap by enhancing both micro- and macroprudential supervision of weaker and smaller firms. Where a large proportion of the insurance sector consists of weaker

and smaller firms, policymakers should consider implementing higher industry-wide capital standards.

#### *Regulatory arbitrage*

Regulatory inconsistencies may trigger significant regulatory arbitrage that boosts systemic risks. Even variations that reflect different business models and risk profiles<sup>47</sup> may trigger it, especially among large insurance groups. For example, in the absence of national U.S. regulatory standards, regulatory arbitrage has been observed via "captive" reinsurance whereby large U.S. insurers established captive reinsurers within the group and transferred significant risks to outside legal entities subject to lower capital requirements (IMF 2015; Kojien and Yogo 2013). Some European internationally active insurance groups reportedly also conduct similar transactions. Proper implementation of group capital requirements may help reduce such arbitrage. The chapter's analysis also shows that weaker insurers seem to adopt more active search-for-yield strategies, which is another form of (ratings-based) regulatory arbitrage. If left unaddressed, such behavior could impair balance sheets if market conditions were to abruptly turn negative.

### **Conclusions and Policy Implications**

The contribution of the insurance sector—particularly of life insurers—to systemic risk has increased, although not yet to the level of the banking sector. Life insurers' contribution to the aggregate capital shortfall and value at risk of the financial sector has returned to historically high levels and may remain elevated if interest rates continue to be low for long (April 2016 *World Economic Outlook*). Moreover, together with banks, insurers are important transmitters of volatility spillovers across financial sectors and across regions, and they have become more central to the financial systems of North America and advanced Asia.

Life insurers have raised their exposures to aggregate risk, partly as a result of maturity mismatches. Although in the six countries studied in more detail in this chapter, the life insurance sector does not seem to have increased its exposure to assets generally considered "riskier"; life insurers individually seem to have become more sensitive to common shocks and to interest rate

<sup>44</sup>Chapter 3 of the October 2008 GFSR found that the methodological weaknesses of the market-consistent valuation method known as fair value accounting (FVA) may introduce unintended volatility and procyclicality at banks. The study noted that capital buffers, forward-looking reserving, and more refined disclosures can help mitigate FVA procyclicality, and that FVA remains the preferred accounting framework for financial institutions.

<sup>45</sup>The IMF's recent U.S. Financial System Stability Assessment compares two approaches (IMF 2015). It finds a significant effect on the U.S. life insurance sector under a fully market-consistent valuation system, while the effect of cost-based standards appears more benign.

<sup>46</sup>In practice, in recognition of the generally stable nature of insurance liabilities, many jurisdictions allow some adjustments to market-consistent valuation if cash inflows from the assets are expected to meet the projected insurance liability cash outflows.

<sup>47</sup>For example, U.K. and U.S. life insurers have large shares of variable annuities and unit-linked insurance policies, which transfer some or all of the profits and losses on underlying investment portfolios to policyholders. In contrast, in Germany and Japan, life insurers tend to provide guarantees to policyholders.

changes. This is not a completely inevitable outcome. It reflects in part a deliberate choice not to adjust assets or liabilities to a changed environment. The effect of making different choices (likely driven, in part, by regulation) is exemplified by the decline in key systemic risk metrics of nonlife insurers and banks in recent years.

Combating the risks of higher common exposures requires strengthening the macroprudential perspective in regulation and supervision. System-wide risk analysis and enhancements of prudential requirements must be built up to complement the microprudential efforts. In light of the chapter's findings regarding systemic risks, work should be accelerated on macroprudential policy measures and their potential effectiveness in the insurance sector. One such measure could be the adoption of countercyclical capital buffers. Regular macroprudential stress testing of the sector is needed to help identify emerging risks. The approaches used here to measure systemic risk contributions in the insurance sector may prove especially useful in supervisory examinations to highlight insurance trends and identify firms that deserve further scrutiny.

Smaller and weaker firms require more supervisory attention. Their profitability remains under pressure, and they seem to have become more susceptible to a search for yield in the current low-interest-rate environment. Assessing their contribution to systemic risk will require detailed analysis of their investments by type and riskiness, since the failure of one or more midsize insurers could trigger an industry-wide loss of confidence (October 2015 GFSR).

The trends described in the chapter call for increased vigilance over the insurance sector and should encourage further global regulatory reforms. National accounting standards need better alignment with each other to permit international comparisons of capital adequacy to be made. The aim of covering all financial activities within insurance groups should eventually contribute to improve the consistency with the capital regimes of other sectors. Most fundamentally, an international capital standard for insurance companies is needed to counteract their increased contribution to systemic risk and protect against cross-sectoral and regional spillovers. Finally, data gaps (for example, on liability structures) need to be addressed to allow for more complete risk assessments.

### Box 3.1. Insurance Models

Insurance firms have a dual character that is reflected on their balance sheets. They provide protection, an activity that creates liabilities, and they invest, which creates assets.

As protection providers, insurers maintain reserves (their main liabilities) that cover claims and future benefits and provide margins for any unexpected events such as longevity and mortality risks. To supplement the protection obtained from their reserves, insurers may pay out part of the premiums they receive to reinsurers, which cover the insurers for major risks, particularly for property and casualty policies (Box 3.3).

As investment managers, insurers maintain large portfolios, which traditionally are invested primarily in bonds, as well as in equities and loans (Figure 3.1.1). Increasingly, however, insurance companies are acquiring assets from so-called nontraditional non-insurance activities. The following discussion examines the financial structure of life insurance and life annuity plans in more detail.

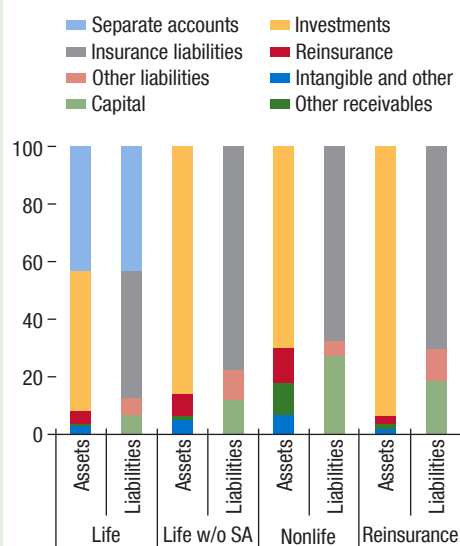
Life insurance is sold in two basic forms: term and whole life. Term life provides coverage for a fixed period, with a level premium guaranteed for its duration; it may be renewable with a premium that may increase with each renewal. If the insured person dies during the term, a death benefit is paid to the policy's beneficiary.<sup>1</sup> Whole life has two components: a defined benefit paid to the beneficiary when the insured person dies, plus an investment component that accumulates a cash value.

Life annuities come in two basic formats: immediate and deferred. Upon making a lump-sum advance payment, the holder of an immediate annuity begins receiving periodic payments that last until the annuitant's death. Deferred annuities delay the start of periodic payments, and the starting principal may be paid for via periodic premiums leading up to the start date. Both immediate and deferred types can have variable accumulation and withdrawal features based on underlying unitized funds and various guaranteed minimum benefits or rates of return. The insurer, which is obliged to continue making payments even after the assets arising from an annuity's premiums are exhausted, sets withdrawal rates at the outset.

This box was prepared by John Kiff and Nico Valckx.

<sup>1</sup>Another form is endowment insurance: term life insurance with a survival benefit paid at the end of the term.

**Figure 3.1.1. Typical Insurance Balance Sheet Structures (Percent)**



Sources: A.M. Best, Global Statement File; Haver Analytics; and IMF staff calculations.

Note: Life w/o SA = life without separate accounts.

Life insurance and annuities have opposite risk profiles. Life insurance policies expose insurers to mortality risk (policyholders die sooner than expected) whereas annuities expose them to longevity risk (policyholders live longer). Therefore, life policies and annuities are in principle natural hedges of each other. However, they are not perfect hedges, in part because life insurance policyholders are usually younger than annuitants. All life products expose insurers to investment risk—the risk that asset portfolios do not perform as well as assumed in pricing and reserving calculations.<sup>2</sup>

<sup>2</sup>For more detail on life annuity risk management, see Chapter 3 in Geneva Association, 2013, *Variable Annuities—An Analysis of Financial Stability*, March; for more on modeling and managing the risk of unit-linked policy guarantees, see Hardy (2003). Nonlife insurance policies are structured like term life policies. Because of the more idiosyncratic nature of nonlife risks, risk management entails investing premiums in high-quality liquid assets and reinsuring tail risks. In addition, nonlife insurers are increasingly turning to alternative risk capital markets.



### Box 3.2. Designation of Global Systemically Important Insurers

The International Association of Insurance Supervisors (IAIS) has created a framework and assessment methodology for identifying firms as global systemically important insurers (GSII). This policy work stems from the fact that insurers contribute to systemic risk, and the distress or disorderly failure of systemic firms threatens financial stability and economic activity. Systemic insurers with a global presence pose such risks on an international scale (IAIS 2012a).

The IAIS assesses global systemic importance along five dimensions. The dimensions are weighted, and each has one or more indicators by which it is measured (Figure 3.2.1). The five categories are size, global activity, interconnectedness, nontraditional non-insurance activities, and substitutability. Using this methodology, the Financial Stability Board, in consultation with IAIS, designated nine primary insurers as GSII and updates this list annually.<sup>1</sup>

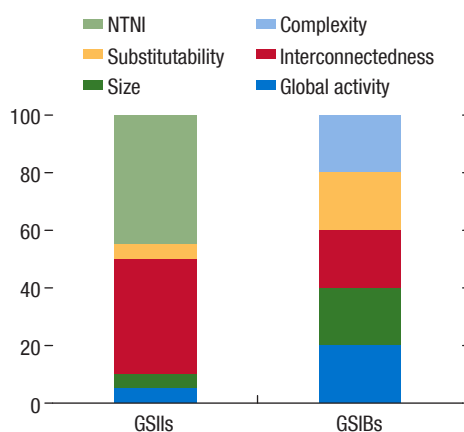
The IAIS has developed policy measures applicable to GSII. These measures include higher loss-absorbency requirements, enhanced group-wide supervision, and national group-wide resolution planning and resolution frameworks. As of 2019, GSII will be expected to hold regulatory capital that is not less than the sum of the requirements for basic capital and higher loss absorbency; the requirements will apply to all group activities, including those of non-insurance subsidiaries.

The framework is comparable to that of the Basel Committee on Banking Supervision (2011) for designating global systemically important banks (GSIB).

This box was prepared by Nico Valckx.

<sup>1</sup>For 2015, these entities were Aegon (the Netherlands), Allianz (Germany), American International Group (United States), Aviva (United Kingdom), Axa (France), MetLife (United States), Ping An Insurance Company of China, Prudential Financial (United States), and Prudential plc (United Kingdom).

**Figure 3.2.1. Systemic Risk Category Weights for Insurers and Banks (Percent)**



Sources: Basel Committee on Banking Supervision 2011; International Association of Insurance Supervisors 2013a; and IMF staff calculations.

Note: GSIBs = global systemically important banks; GSII = global systemically important insurers; NTNI = nontraditional non-insurers.

The specific indicators and weights for the categories differ across the two frameworks, and the GSIB assessment adds a sixth category, complexity (measured with over-the-counter derivatives activity, level 3 assets and the size of the trading book, and the amount of assets available for sale). The GSIB categories all carry equal weights, whereas GSII risk weights vary: low for size, global activity, and substitutability, and high for interconnectedness and nontraditional non-insurance activities.

**Box 3.3. Reinsurance, Retrocession, and Financial Stability**

Reinsurance is insurance for insurers. Retrocession is reinsurance for reinsurers. Both provide coverage for (re)insurers that protects them against the cost of payouts for low-probability, high-severity events (tail risks). Reinsurance gives insurers capital relief and expanded underwriting capacity as well as potential opportunities for regulatory arbitrage.<sup>1</sup>

The reinsurance market is small and concentrated. It consists of a relatively few specialist companies plus some primary insurers that sell reinsurance (“assumed reinsurance”). Eight countries account for about 90 percent of reinsurance premiums and the 10 largest

reinsurers account for more than 60 percent of the premiums (Group of Thirty 2006). The rate of use of reinsurance varies widely across countries (Figure 3.3.1).

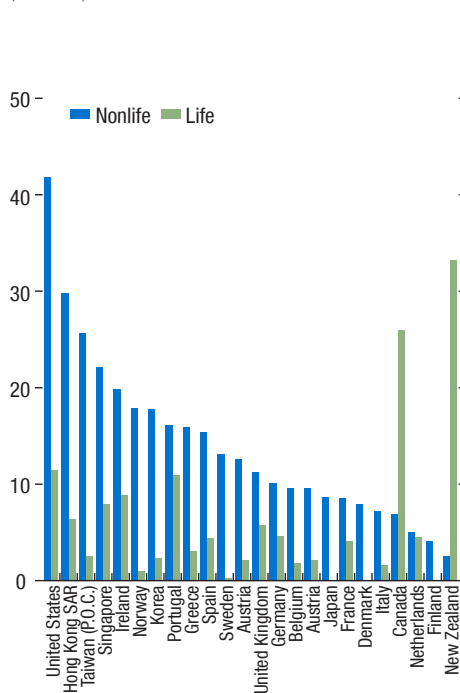
Reinsurers are currently facing pressure from excess capacity, lower demand under a low-loss environment, and competition from alternative sources of capital (European Insurance and Occupational Pensions Authority 2015). Alternative sources of risk capital include catastrophe (CAT) bonds, mortality bonds, and collateralized reinsurance.<sup>2</sup> Alternative risk capital currently comprises about 12 percent of total reinsurance

This box was prepared by John Kiff and Nico Valckx.

<sup>1</sup>Until 2007, there was an active U.S. life insurance securitization market, aimed at arbitraging Regulation XXX and AXXX reserve requirements. Securitization of the so-called redundant reserves required monoline insurance to achieve AAA ratings. However, the postcrisis financial challenges of monoline insurers have virtually closed this market. This regulatory arbitrage is now being achieved with the help of bank letters of credit (Kojien and Yogo 2013).

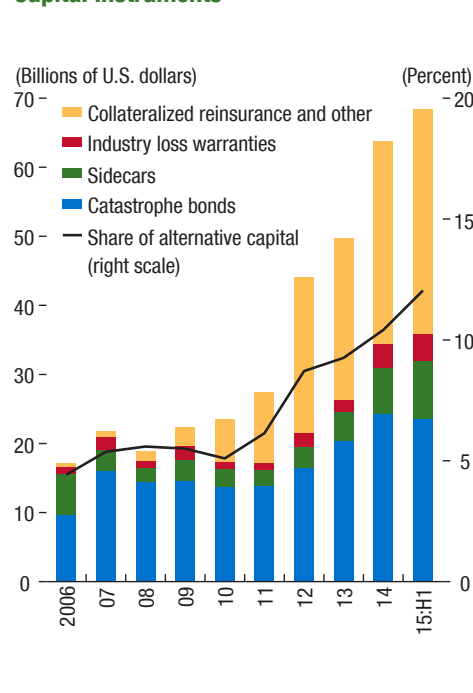
<sup>2</sup>CAT risk is also being transferred via finite-life limited purpose reinsurance vehicles such as “sidecars” and “industry loss warranties,” which are derivative contracts triggered by previously agreed upon levels of industry losses estimated by a third party. Life insurers and defined benefit pension plan sponsors are using insurance risk transfer markets to hedge longevity risk. Longevity swaps provide defined benefit pension plan sponsors with ways of managing longevity risk that go beyond closing or freezing plans; and they provide life insurers with a partial offset to their life insurance mortality risk.

**Figure 3.3.1. Insurers’ Use of Reinsurance (Percent)**



Sources: A.M. Best, Global Statement File; and IMF staff calculations.  
 Note: Reinsurance utilization is defined as reinsurance ceded as a percent of gross premiums written.

**Figure 3.3.2. Alternative Insurance Risk Capital Instruments**



Sources: A.M. Best, Global Statement File; Aon Securities 2015; McKinsey 2013; and IMF staff calculations.

**Box 3.3. (continued)**

capital (Figure 3.3.2). Sophisticated investors are drawn to CAT-linked products as high-yielding uncorrelated assets. CAT products typically provide fully collateralized protection against peak exposures for which traditional reinsurance is unavailable or too expensive.

However, alternative sources of risk capital may pose financial stability concerns. Like the reinsurance market, alternative risk capital markets tend to be highly concentrated. In addition, cash flows on these instruments are often linked to standardized indices, leaving insurers with basis risk. And although most products provide fully collateralized coverage, collateral release terms and conditions may not align with the particulars of insured events (Aon Benfield 2015).<sup>3</sup>

<sup>3</sup>CAT products with indemnity triggers (based on actual losses) provide perfect coverage. In 2015, 62.6 percent of bonds issued were indemnity based (Artemis 2016).

Views about the systemic riskiness of reinsurers and insurance risk transfer markets are mixed. On the one hand, reinsurance liabilities are not redeemable on demand, and claims payments can be spread over many years. Moreover, reinsurer failure and resolution is usually an orderly and lengthy process (Kessler 2013), and alternative risk capital markets can disperse potential losses to diverse ranges of investors. On the other hand, reinsurance creates interconnections within the insurance sector, so that the failure of a major reinsurer might trigger defaults among primary insurers (Park and Xie 2014). Broader potential spillovers depend on the scale and complexity of reinsurers' nontraditional non-insurance activities and, potentially, the change in systemic risk of primary insurers. An additional issue, the possibility of "retrocession spirals," whereby reinsurers inadvertently reinsure their own risk (IAIS 2012b), has become less important in recent years as regulation and supervision have strengthened, including through risk retention.

### Box 3.4. Insurance in China

The insurance industry in China has been growing rapidly. During the five years to 2015, total assets doubled to more than ¥12 trillion (\$1.9 trillion), and premium income also doubled, to more than ¥2 trillion (\$0.3 trillion). Even so, the low level of annual premiums—¥1,479 (\$240) per capita and 3.2 percent of GDP—indicates that growth potential is still strong.<sup>1</sup>

The Chinese insurance market is very concentrated. Of the 75 insurers in 2015, the top five account for more than 40 percent of total assets. One Chinese insurer is currently designated as a global systemically important insurer. Life insurance firms account for more than 80 percent of total insurance industry assets and 60 percent of total industry income from premiums.

In recent years, Chinese insurers have been investing in riskier assets (Figure 3.4.1). During the past two years, insurers invested significantly less in term deposits and bonds (which dropped from 71 percent to 54 percent of aggregate portfolios), and significantly

more in equity and other investments (rising from 29 percent to 46 percent).<sup>2</sup>

The growth in risky assets was more pronounced among smaller, unlisted insurers. On average, the country's five listed insurers increased their risky asset ratio to 28 percent from 17 percent during the past two years, whereas the rise at smaller insurers was to 55 percent from 20 percent.

A key reason for the rapid growth of risky assets is the prevalence of universal life and unit-linked products. Premiums for these products have grown 49 percent annually since 2013. Universal life products offer guaranteed interest rates of 2.5–3.5 percent, with relatively low early withdrawal charges (or even without penalties after one year). This trend is especially strong among smaller and unlisted insurers.

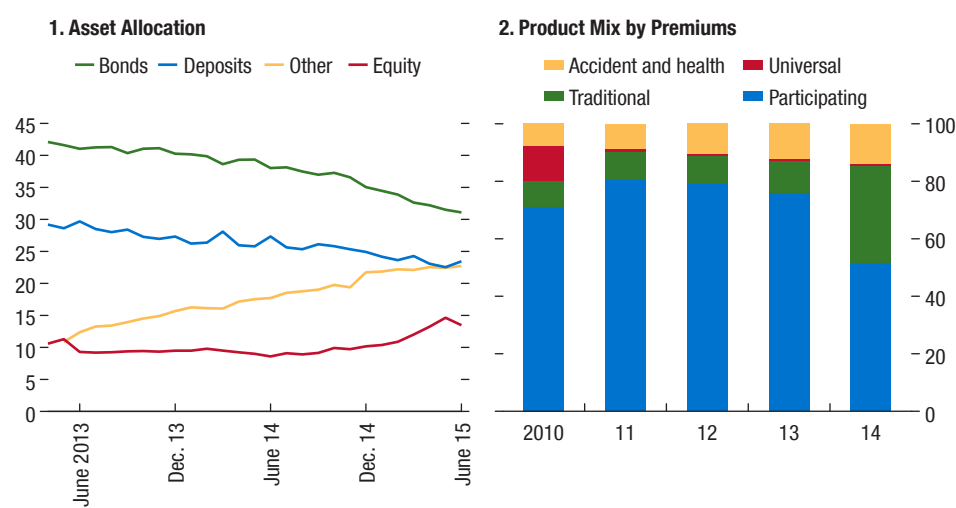
Insurers have strong incentives to concentrate their equity holdings. Insurance regulations stipulate that equity stakes exceeding 20 percent be treated as affiliates, which incur significantly lower capital charges (between 10 percent and 15 percent instead of 31 percent). As a result, the top five equity positions in some insurance firms account for about 30–40 percent of total equity allocations, a concentration that poses significant counterparty risk and thus becomes a financial stability concern.

This box was prepared by Kai Yan.

<sup>1</sup>The State Council has set a goal of achieving a penetration rate for aggregate premiums of 5 percent of GDP and premium density of ¥3,500 per capita by 2020.

<sup>2</sup>Other investments are mostly credit instruments, such as trust loans, infrastructure loans, and wealth management products.

**Figure 3.4.1. Asset Allocations and Product Types for Insurers in China (Percent)**



Sources: People's Bank of China; and IMF staff calculations.

### Box 3.5. Inward and Outward Spillovers and Centrality of European Insurers

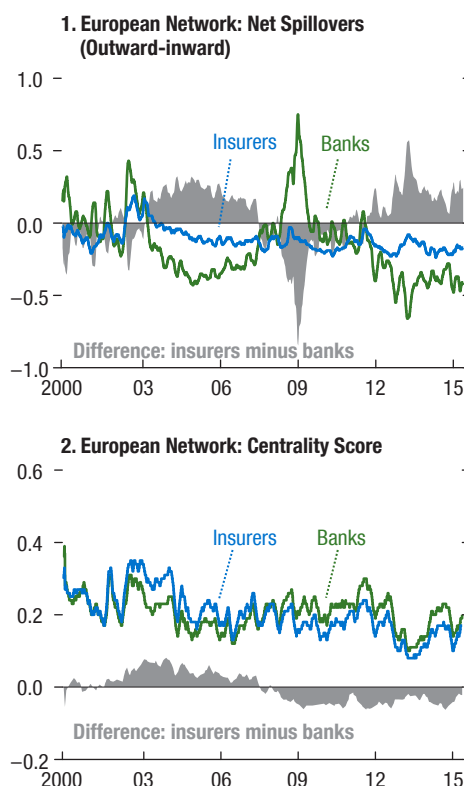
This box uses a conditional of value-at-risk (CoVaR) network approach to quantify systemic risk. The method measures tail dependence and its propagation within a financial network based on the association between very large joint negative equity price changes. This approach permits specification of the degree of outward spillovers (to other firms), inward spillovers (from other firms), and the degree of influence of a firm in the network (the eigenvalue centrality score). As such, the approach is technically closer in spirit to the domino view of systemic risk (for more details, see Ito and Jobst [forthcoming]).

European insurers have been the destination, rather than the source, of spillovers, but the trend suggests that this direction is changing. Banks were the main source of connectedness until the end of the global financial crisis, whereas insurers' net spillover risk has remained largely unchanged since 2008 (Figure 3.5.1, panel 1). In addition, the aggregate results disguise some important time-varying, cross-country differences. The net spillover risks of insurers in Belgium, Denmark, and Spain are generally higher and positive, whereas those of insurers in Finland and Germany are consistently negative. During the financial crisis, spillover risks increased the most for insurers in Belgium and the United Kingdom (and to a lesser extent in the Netherlands), whereas the opposite was true for their peers in Austria, Finland, and France.

With regard to influence on the network (the eigenvalue centrality score), insurers are somewhat less important than banks. Before 2008, the centrality score of European insurers was higher than that of banks (Figure 3.5.1, panel 2). However, the financial crisis led to a decrease in the scores of European insurers and an increase for banks. More recently, the gap between the systemic importance of European banks and insurers has decreased. Moreover, additional analysis suggests that the propagation of negative shocks from insurance companies tends to be smaller and shorter-lived than comparable shocks from banks.

This box was prepared by Andy Jobst.

**Figure 3.5.1. Spillover Effects and Interconnectedness of European Banks and Insurers**



Source: IMF staff calculations based on Ito and Jobst (forthcoming).  
 Note: Net spillovers defines a network-based measure of “absorption capacity” as the difference between the “to-degree connectedness” and the “from-degree connectedness” conditional on a daily measure of 95 percent CoVaR between two firms. A positive value indicates a higher average probability of being a source of spillover. Estimation uses daily equity log returns between January 1, 2000, and July 20, 2015, are of 114 European Union firms, of which 30 are insurance companies.

## Annex 3.1. Regulatory Standards for Valuations in the Insurance Sector

### Annex Table 3.1.1. Regulatory Standards for Valuations in the Insurance Sector

|                  |                | Valuation Basis   |   |
|------------------|----------------|---|---|
|                  |                | Market-Based and/or Consistent Assets and Liabilities   | Historical Cost/Book Value  |
| Risk Sensitivity | Risk-Based     | European Union ( <i>Solvency II</i> )<br>Australia<br>Belgium ( <i>pre-Solvency II</i> )*<br>Bermuda<br>Canada<br>Denmark ( <i>pre-Solvency II</i> )<br>Japan*<br>Korea<br>Mexico<br>Netherlands ( <i>pre-Solvency II</i> )<br>Norway ( <i>pre-Solvency II</i> )*<br>Switzerland<br>United Kingdom ( <i>pre-Solvency II</i> ) | People's Republic of China (C-ROSS)<br>United States  |
|                  | Non-Risk-Based | Germany ( <i>pre-Solvency II</i> )  | Brazil<br>People's Republic of China Solvency I (pre-2016)<br>European Union Solvency I (pre-2016)<br>France ( <i>pre-Solvency II</i> )<br>India<br>Italy ( <i>pre-Solvency II</i> )<br>Ireland ( <i>pre-Solvency II</i> )<br>Luxembourg ( <i>pre-Solvency II</i> )<br>Spain ( <i>pre-Solvency II</i> )<br>South Africa<br>Sweden ( <i>pre-Solvency II</i> ) <sup>1</sup> |

Sources: IMF staff compilation based on supervisory; and other sources.

Note: This table provides a general comparison of risk measurement and valuation standards. The actual degree of “stringency” of a given solvency regime depends on the confluence of valuation standards, the definition of capital, the level of solvency thresholds, and the implementation of supervisory practices (\*: only assets).

<sup>1</sup>Sweden's Financial Supervisory Authority has used stress tests to make the solvency assessment more risk-sensitive.

### Annex Table 3.2.1 Determinants of Life Insurers' Asset Allocation to Higher-Risk Assets

|                             | United States        | Canada               | Netherlands          | Germany              | Korea              |      |
|-----------------------------|----------------------|----------------------|----------------------|----------------------|--------------------|------|
| Capital/Solvency Ratio × LT | 0.019**<br>(0.008)   | 0.009**<br>(0.003)   | 0.211*<br>(0.113)    |                      |                    |      |
| Capital/Solvency Ratio      | -0.088**<br>(0.036)  | -0.049***<br>(0.013) | -0.541***<br>(0.187) | -0.285***<br>(0.079) |                    |      |
| Annuities × LT              | -0.032***<br>(0.011) | -0.198***<br>(0.063) |                      |                      |                    |      |
| Annuities                   | 0.073*<br>(0.044)    | 1.021***<br>(0.234)  |                      |                      |                    |      |
| log (Total Assets) × LT     | 0.002**<br>(0.001)   | 0.010***<br>(0.003)  |                      |                      |                    |      |
| log (Total Assets)          | -0.010**<br>(0.005)  | -0.01<br>(0.018)     |                      | -0.084***<br>(0.031) | -0.048<br>(0.045)  |      |
| Large                       |                      |                      |                      |                      | -0.047+<br>(0.030) |      |
| Guaranteed Rate             |                      |                      |                      | 0.098**<br>(0.043)   |                    |      |
| Number of Observations      | 3,120                | 256                  | 245                  | 283                  | 227                |      |
| Firm Fixed Effects          | Yes                  | Yes                  | Yes                  | Yes                  | Yes                | No   |
| Year Fixed Effects          | Yes                  | Yes                  | Yes                  | Yes                  | Yes                | No   |
| R <sup>2</sup>              | 0.86                 | 0.80                 | 0.16                 | 0.14                 | 0.13               | 0.13 |

Source: IMF staff calculations.

Note: \*\*\*, \*\*, \*, and + represent statistical significance at 1 percent, 5 percent, 10 percent, and 15 percent levels, respectively. Numbers in parentheses indicate standard errors.



## Annex 3.2. Data and Methodology

### Data

Firm-level data for insurers are from A.M. Best, Global Financial Statement File, which provides standardized income and balance sheet information for a large set of firms and countries. In addition, more granular portfolio data are used to analyze life insurers' investments in the United States (Schedule D, provided by the NAIC), Canada (Office of the Superintendent of Financial Institutions), the Netherlands (De Nederlandsche Bank), Germany (Assekurata), Norway (Finanstilsynet), and Korea (Korean Life Insurance Association). Insurers' equity prices and other financial series are taken from Bloomberg, L.P.; Datastream Thomson Reuters; and J.P. Morgan. Insurers' probabilities of default and default correlations are obtained from Risk Management Institute (2015) at the National University of Singapore.

### Time Series Analysis of Investments

The analysis examines how changes in long-term interest rates and firm factors affect the investment decisions of life insurers. The main regression model is given by

$$\text{RiskyShare}_{it} = \beta_1 X_{it-1} \cdot LT_t + \beta_2 X_{it-1} + \beta_3 \text{Controls}_{it-1} + \alpha_i + \gamma_t + \varepsilon_{it},$$

in which  $\text{RiskyShare}_{it}$  is the share of higher-risk assets for insurer  $i$  in year  $t$  (for Korea, the dependent variable is the 2009–13 change in the share of higher-risk assets), and  $LT_t$  is the interest rate of the long-term (10-year) government bond. Firm variables  $X$  include regulatory capital surplus normalized by total assets (for U.S. life insurers), solvency ratio (for Canadian, Dutch, and German life insurers), ratio of annuities to total liabilities, average guaranteed interest rate of insurance policies, and whether the firm is among the upper half ranked by total assets.  $\text{Controls}$  include (logged) total assets, leverage, and the ratio of net premiums written to total liabilities. Standard errors are clustered at the group level where applicable.

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