

## SYSTEMIC RISK IN THE INSURANCE SECTOR: A REVIEW AND DIRECTIONS FOR FUTURE RESEARCH

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### ABSTRACT

This article reviews the extant research on systemic risk in the insurance sector and outlines new areas of research in this field. We summarize and classify 48 theoretical and empirical research papers from both academia and practitioner organizations. The survey reveals that traditional insurance activity in the life, nonlife, and reinsurance sectors neither contributes to systemic risk nor increases insurers' vulnerability to impairments of the financial system. However, nontraditional activities (e.g., credit default swap underwriting) might increase vulnerability, and life insurers might be more vulnerable than nonlife insurers due to higher leverage. Whether nontraditional activities also contribute to systemic risk is not entirely clear; however, the activities with the potential to contribute to systemic risk include underwriting financial derivatives and providing financial guarantees. This article is not only likely of interest to academics but also highly relevant for the industry, regulators, and policymakers.

### INTRODUCTION

In the wake of the financial crisis and the collapse of Lehman Brothers and AIG, systemic risk has been widely discussed in the financial services sector. A number of research papers on the subject have been published, and regulators and industry think tanks have issued reports. Recently, the Financial Stability Board (FSB) published a list of nine global systemically important insurers and it intends to implement several special policy measures for these institutions by January 2019.<sup>1</sup>

A more detailed review of existing work on this topic and an examination of what remains to be investigated is worthwhile for at least two reasons. First, researchers document that certain business activities might contribute to systemic risk in the insurance sector (see, e.g., Acharya et al., 2011; Besar et al., 2011, for securities lending). A structured review can identify those activities and the situations in which the activities may be cause for alarm. Second, the literature reports mixed results regarding systemic risk,

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<sup>1</sup> See FSB (2013a). The FSB is an international organization that was established by the G-20 in April 2009. Its purpose is to monitor the finance industry and to make recommendations for addressing systemic risk.

for example, in the case of credit default swaps (CDSs),<sup>2</sup> which calls for a structured review of what has been studied to date and what remains to be done to settle this issue.

This article makes three contributions to the ongoing discussion. First, we discuss how systemic risk can be understood conceptually and how it can (or cannot) be measured. Second, based on this framework, we review the literature on systemic risk in the insurance sector. Third, we highlight areas in need of further research. The survey is intended to enhance our understanding of systemic risk in the insurance sector and to motivate additional research in this field. The literature indicates that policymakers and regulators need to closely analyze systemic risk, especially with respect to nontraditional insurance activities.

The remainder of the article is organized as follows. We begin by discussing the definition and classification of systemic risk and systemic risk measures. Subsequently, we review the extant insurance literature on systemic risk and summarize the main results for different lines and activities of insurance companies. Then, we investigate whether banking regulation should be extended to insurance companies. We close the article with a conclusion and a discussion of future research directions.

### **CLASSIFICATION OF SYSTEMIC RISK**

The financial system can be thought of as a network with two types of nodes (financial institutions and nonfinancial actors that have business relationships with financial institutions) and edges (business activities).<sup>3</sup> To identify the origins of a possible impairment and the contributors to systemic risk, one can focus on the nodes, the edges, or both. Furthermore, it is important not only to identify which parts of the financial system can originate impairment and contribute to systemic risk but also to discover which parts are most vulnerable to impairment.

In the remainder of the article, we use the term “contribution to systemic risk” for an institution or business activity that increases systemic risk. We use “vulnerability” when describing those parts of the financial system (institution or business activity) that are most vulnerable to impairment.<sup>4</sup>

#### **Systemic Risk Definitions**

There is no generally agreed-upon definition of “systemic risk” other than that it involves uncertainty about the occurrence of a specific event. We reviewed 26 definitions of systemic risk and identified three important elements:

<sup>2</sup> See Trichet (2005), Baluch et al. (2011), Klein (2013), Grace (2011), Baranoff (2012), Chen et al. (2013), and Cummins and Weiss (2013), in addition to the industry study by the Geneva Association (2010a) versus Radice (2010); Wallison reported by Harrington (2009, 2013).

<sup>3</sup> See, for example, Anand et al. (2013).

<sup>4</sup> Our classification is similar to the “contribution approach” and “participation approach” defined by Tarashev et al. (2010) and used by Drehmann and Tarashev (2011) and Jobst (2012). We do not use that terminology here because, for our purposes, it is too narrow. Both approaches consider only institutions and bankruptcies and ignore, for example, institutions that are in distress but not insolvent, in addition to business activities. Our approach is also employed by others, for example, Klein (2013) and Schwarcz and Schwarcz (2014).

1. **Risk of an event:** For each risk, there must be an associated event that can occur. The associated event is the dysfunction of financial services, default of financial institutions, or a shock to the economy.<sup>5</sup>
2. **Impact of the event:** Most definitions specify the consequences if the event occurs, which are typically that the real economy is negatively affected.
3. **Causation of the event:** Some definitions require the risk to have a certain causation before it is labeled systemic. These causations can be general in nature and/or specific<sup>6</sup> and are mostly related to the financial services sector.

The variety of definitions makes obvious the enormous difficulty involved in differentiating among cause, impact, and events when discussing systemic risk.<sup>7</sup> Thus, it is not surprising that to date, no agreement on the definition of systemic risk has been reached.<sup>8</sup> However, most of the definitions considered in this article relate to the 2008 financial crisis;<sup>9</sup> thus, it might be useful to examine the events of 2008 as a means of differentiating systemic risk from other risks:

1. **Event:** Certain financial services became unavailable (e.g., interbank lending) or had virtually no market (e.g., credit).
2. **Impact of the event:** As a consequence, there was a substantial negative effect on the economy.
3. **Causation of the event:** In 2008, an external shock (falling prices in the U.S. subprime mortgage market) impaired several financial institutions. Due to contagion and interdependence, other financial institutions and services also became impaired.

An appropriate definition should encompass all risks that can lead to the reoccurrence of the 2008 crisis and exclude all others. Studies often ignore this last point. An exception is the concept of systemic risk proposed by De Bandt and Hartmann (2000), who distinguish between risks of shocks based on their second-round effects (the focus is not on institutions affected by the shock but on the consequences of these institutions' being

<sup>5</sup> The first two factors involve financial services; the latter factor involves the general economy. We use "financial instability" as a synonym for "dysfunction of financial services." It must be kept in mind that neither financial "stability" nor "instability" have clear-cut definitions. See, for example, Allen and Wood (2006), the European Central Bank (2013), and the Federal Reserve Bank of Cleveland (2013).

<sup>6</sup> Klein (2013) writes that idiosyncratic events (e.g., the failure of a single entity or cluster of entities) or general conditions in financial intermediaries might cause systemic risk. The general conditions are related to the linkages between financial institutions, which can lead to a cascading effect of bankruptcies, especially in the case of excessive risk taking.

<sup>7</sup> For example, it is not clear whether the shock to the real economy is the event or the consequence of the event. Similarly, it is far from clear whether the default of institutions is the event or the causation of an event.

<sup>8</sup> See, for example, Liedtke (2010) and Dwyer (2009) for a critical discussion of several definitions of systemic risk.

<sup>9</sup> See, for example, Bach and Nguyen (2012), Billio et al. (2012), and Rodríguez-Moreno and Peña (2013).

impaired due to the shock). In these authors' view, the risk is systemic only when most institutions or markets would be affected indirectly and fail. In addition, Harrington (2009) distinguishes systemic risk from the risk of common shocks. According to him, the risk of only an event that involves "interdependency-transmitted contagion" should be labeled systemic. In general, we argue that a definition of systemic risk should be judged against the following criteria:

1. **Risk of an event:** The definition should address the dysfunction of financial services. Mandating that the event must involve the simultaneous default of institutions or contagion effects would result in too narrow a definition of systemic risk because such events can conceivably occur without the financial services sector becoming dysfunctional.
2. **Impact of the event:** The definition should include that the event must cause a substantial negative impact on the real economy. The phrase "substantial negative impact on the real economy" is important because, without this level of specificity, the definition could cover insignificant events. The term "substantial" should be understood in terms of severity. Furthermore, the negative impact must be a definite consequence of the occurring event. Otherwise, as Liedtke (2010) notes, the risks of wars, floods, and diseases would also be systemic risks, making the definition too broad to be useful.
3. **Causation of the event:** Similarly, unless causation of the risk is included, the definition will again be too broad. For example, without imposing some limits on "causation," the risk of the regulator issuing a regulation that impairs financial services and, consequently, affects the real economy could be labeled a systemic risk. In essence, the definition stipulates that systemic risk emerges within the financial system. However, the limits on causation must also not be too narrow. In general, there are two ways in which impairments can occur and both should be considered<sup>10</sup>—a *system-wide shock* or a *limited shock with subsequent contagion*.

A system-wide shock is an external shock that has a direct negative impact on most or all financial services companies; as a consequence, these institutions can no longer offer their full range of services. As De Bandt and Hartmann (2000) note, new information can also be a shock of this type. For example, suppose that before the financial crisis, the financial industry were to have suddenly realized that investing in mortgage-backed securities bears a high concentration risk (exposure to the same mortgages via several securities) and therefore offers only limited diversification. Immediately, a wide range of financial institutions would have been impaired and had to address a much higher risk exposure. As a consequence, institutions would have had to hold more risk-bearing capital, and the financing of risky projects in the real economy would have been more difficult or even no longer possible.

A limited shock with subsequent contagion occurs when one or a few market participants cannot meet their obligations for internal reasons or due to an external shock. This shock spreads in a chain reaction across the entire financial system. Contagion can take different forms:

<sup>10</sup> Note that a number of definitions consider only a limited shock with subsequent contagion (see, e.g., Csiszar, 2002; Adrian and Brunnermeier, 2016; Billio et al., 2010, 2012).

- bankruptcies of institutions, which trigger insolvencies of other companies due to unfulfilled commitments;
- contracts conditional on credit ratings, which can be canceled in case of a downgrading;
- a decrease in asset prices caused by sales by a few institutions that force other market participants to also sell assets;
- investor uncertainty, eventually resulting in aligned behavior, due to the distress of one company combined with nontransparency regarding whether other companies are experiencing the same problem;<sup>11</sup>
- information, eventually resulting in aligned behavior, concerning the distress of one company from which markets conclude that other companies face similar problems; and
- irrationality.<sup>12</sup>

In this article, as a working definition of systemic risk, we use that established by the FSB (2009) and the International Association of Insurance Supervisors (IAIS, 2009). Systemic risk is defined as “a risk of disruption to financial services that is (1) caused by an impairment of all or parts of the financial system and (2) has the potential to have serious negative consequences for the real economy.” This definition’s occurring event meets our requirements. Additionally, the definition covers spillover effects to the real economy and causal relationships. Moreover, only risks that emerge due to issues within the financial system are included.

### Systemic Risk Measures

There is no common definition of systemic risk; thus, there is no standard for systemic risk measures, and the literature cannot agree on one specific measure.<sup>13</sup> Broadly, there are two strands of literature according to Bisias et al. (2012), one strand that addresses macroprudential and another that addresses microprudential systemic risk measures. Macroprudential measures attempt to assess systemic risk at the level of the entire economy; microprudential measures are used to discover individual institutions that contribute the most to systemic risk or are especially vulnerable to an impairment of the financial system. The studies that we reviewed for this article focus on microprudential measures. The most common measures are shown in Table 1.

BANKBETA,  $\Delta\text{CoVaR}$ , lower tail dependence (LTD), and Granger causality networks focus on the interconnectedness of institutions in normal times (interdependence) and in times of crisis (contagion). They are based on the assumption that the institutions that are highly interconnected contribute the most to systemic risk. Naturally, the studies endorsing these measures use a definition of systemic risk that focuses on contagion effects.<sup>14</sup>

<sup>11</sup> See Harrington (2009) and Cummins et al. (2012).

<sup>12</sup> See Harrington (2009, 2013) and Park and Xie (2014).

<sup>13</sup> Bisias et al. (2012) provide a broad overview and explanation of currently discussed systemic risk measures.

<sup>14</sup> See Chen et al. (2013, 2014), Adrian and Brunnermeier (2016), and Billio et al. (2012). Summaries of these authors’ understanding of systemic risk are presented in Table A1 in Supporting Information.

**TABLE 1**  
Systemic Risk Measures Applied to the Insurance Sector

Systemic Risk Measure	Description	Focus	Reference
BANKBETA	Measures linkages between stock returns and the portfolio returns of the banking sector.	Interconnectedness between institutions	Chen et al. (2013)
$\Delta\text{CoVaR}$	Measures the impact of a certain institution's distress on the value at risk of the financial system.	Interconnectedness between institutions (contagion)	Adrian and Brunnermeier (2016)
DIP (distressed insurance premium)	Measures the price of insurance against financial distress based on asset return calculations and default probabilities of individual institutions.	Market price of insurance against the institution's default	Huang et al. (2009)
LRMES	Measures the long-run marginal expected shortfall of a company's return in the event of a financial crisis.	Shortfall in times of crisis	Engle et al. (2015)
LTD (lower tail dependence)	Measures the probability that an observation of stock returns' joint distribution will lie in the distribution's lower tail.	Interconnectedness between institutions (contagion)	Weiß et al. (2014)
Granger causality networks	Measures Granger causality between the stock market returns of institutions.	Interconnectedness between institutions	Billio et al. (2012)
MES (marginal expected shortfall)	Measures the stock return of a company when the entire equity market is in a downturn.	Shortfall in times of crisis	Acharya, Pederson, et al. (2012)
SRISK	Measures the capital that a company needs if there is a crisis.	Shortfall in times of crisis	Acharya, Engle, et al. (2012)

LRMES, MES, and SRISK (and, to a certain extent, Distressed Insurance Premium [DIP]) measure the impact of a crisis on an institution and do not capture contagion effects. Therefore, work focusing on LRMES, MES, or SRISK does not regard the interrelations between institutions as crucial for systemic risk.<sup>15</sup> Some differences in the literature result from the definition of systemic risk used and the measure employed to measure it, as we show in the following section. Generally, however, the first group of measures assesses contribution to systemic risk, whereas the second group assesses the vulnerability of an institution (see Chen et al., 2013; Cummins and Weiss, 2013; Bernal et al., 2014; Weiß and Mühlhnickel, 2014).

Nevertheless, even if the characteristics of the systemic risk measures are kept in mind, there is still ample room for improvements. To a certain extent, all systemic risk measures rely on comovements of stock market returns. Using this information as a measure of “interconnectedness” is very intuitive. However, whether systemic risk can be measured with this information in its entirety is not clear. For example, from a theoretical perspective, no measure is able to distinguish between financial and nonfinancial firms, which is crucial to our working definition because the impairment has to originate within the financial system. Furthermore, it is not clear that comovements in stock prices or variables based on this information are a sufficient approximation of a chain reaction—the pattern that the bankruptcy of one institution automatically leads to bankruptcies of other institutions. Empirical findings support this critical view. Benoit et al. (2013) argue that  $\Delta\text{CoVaR}$ , MES, and SRISK have no advantages over traditional market risk measures. For a U.S. sample of 2,000 financial institutions, they show that identifying systemically important institutions by  $\Delta\text{CoVaR}$  leads to the same results as using value at risk. Similarly, MES can be substituted for by market beta and SRISK by leverage in normal times or liabilities in times of crisis. The authors conclude “that these measures fall short in capturing the multifaceted nature of systemic risk” (Benoit et al., 2013). Another, more practical, shortcoming of these systemic risk measures is that they provide information about only the relative contribution to the systemic risk/vulnerability of an institution; absolute risk remains unknown. In boom times, even the most significant systemically relevant institution might not be a problem, whereas in times of crisis, even events at an institution that is number 28 in line could be cause for concern.

### SYSTEMIC RISK IN THE INSURANCE SECTOR

We discuss the different business activities of insurance companies and examine how certain activities might contribute to systemic risk. Furthermore, we evaluate which business activities and which types of insurers are vulnerable to an impairment of the financial system. Our assessment of systemic risk in the insurance industry is based on the studies listed in Table 2. These were selected from five sources: peer-reviewed journal articles, working papers, reports by international government organizations or regulators, books or chapters in books, and industry reports.

It is important to consider the source of a study when interpreting its results. For example, industry reports typically adopt an industry perspective, whereas peer-reviewed journal articles are typically more neutral as they are typically written by independent academics and undergo independent review before publication. We place the most weight on the

<sup>15</sup> See, for example, Acharya et al. (2011).



**TABLE 2**

Reviewed Studies on Systemic Risk in Insurance Classified by Source

Type of Source	Study
Peer-reviewed journal articles	Trichet (2005), Harrington (2009), Baluch et al. (2011), Van Lelyveld et al. (2011), Besar et al. (2011), Bach and Nguyen (2012), Billio et al. (2012), Baranoff (2012), Chen et al. (2013, 2014), Harrington (2013), Kessler (2014), Bernal et al. (2014), Weiß and Mühlnickel (2014), Cummins and Weiss (2014), Berry-Stölzle et al. (2014), Park and Xie (2014), Bierth et al. (2015), Engle et al. (2015), Mühlnickel and Weiß (2015)
Working papers	Radice (2010), Cummins and Weiss (2013), Grace (2011), Cummins et al. (2012), Neale et al. (2012), Jobst (2012), Weiß et al. (2013), Grace et al. (2013), Chen et al. (2013), Baranoff et al. (2013), Berdin and Sottocornola (2015)
Books/chapters in books	Acharya et al. (2011), Klein (2013), Acharya and Richardson (2014), Schwarcz and Schwarcz (2014)
Reports by international government organizations/regulators	Zufferey (2000), FSB (2009), IAIS (2009, 2010, 2011, 2012a, 2012b)
Industry reports	Baur et al. (2003), Geneva Association (2010a, 2010b, 2011, 2012), Keller (Geneva Association) (2011)

Notes: The informed reader might note that we place only limited focus on a highly critical work on the insurance industry by Schwarcz and Schwarcz (2014). We believe that this work is not very helpful in our context because the definition of systemic risk is too broad and any negative event qualifies for systemic risk. In addition, we do not consider a work by Subramanian and Wang (2015) because their understanding of systemic risk is simply that there is an aggregate shock to the economy.

findings from the peer-reviewed journal articles but believe it is important to also present the results of industry studies.<sup>16</sup> Where our results are based on work coming from an industry perspective, we explicitly note this fact so that this report is as unbiased and neutral as possible. To ensure that all relevant studies are included, we used a search strategy based on Biener and Eling (2012). Details of the search strategy are presented in Supporting Information.

Table 3 provides an overview of insurance activities and their systemic risk potential. We classify insurance activities as related to either underwriting or funding and investing processes. This view can be justified by the actuarial distinction between insurance and financial risks. The classical ruin process as described, for example, by Kaas et al.

<sup>16</sup> Naturally, the authors of peer-reviewed journal articles might also adopt an industry perspective, for example, Kessler (2014), who is the CEO of the insurance company SCOR.



**TABLE 3**  
Evaluation of Systemic Risk of Traditional and Nontraditional Insurance Activities Classified According to Business Processes

Process	Business Activity	Systemic Risk Contribution	Company's Vulnerability	Rationale and Source
Under-writing	Traditional	<b>Very low</b> (all studies agree that there is no systemic risk contribution)	<b>Very low</b> (there is no study arguing that nonmarket risks are influenced by an impairment of the financial system)	<ul style="list-style-type: none"><li>• Interconnectedness (counterparty credit risk/ cross-holdings) is low among the life, nonlife sector, and banks; between reinsurance companies and primary insurers, the relationship is hierarchical (e.g., Zufferey, 2000; Baur et al., 2003; Trichet, 2005; Baluch et al., 2011; LAIS, 2011, 2012b; Cummins and Weiss 2013; Grace et al., 2013; Kessler, 2014; Chen et al., 2015)</li><li>• A reinsurance retrocession spiral affects the insurance sector but not the rest of the economy (e.g., Geneva Association, 2010a; Cummins and Weiss, 2013, 2014)</li><li>• Claims are contingent on loss events and therefore an "insurance run" is not possible (e.g., Radice, 2010; Baluch et al., 2011; Cummins and Weiss, 2014; Geneva Association, 2012; Kessler, 2014); the opposite opinion is held by Acharya and Richardson, (2014)</li><li>• Cash outflow if loss events occur is slow (e.g., Cummins and Weiss, 2014; Jobst, 2012; Kessler, 2014)</li></ul>
	Life <ul style="list-style-type: none"><li>• Life insurance</li><li>• Annuities</li></ul> Nonlife <ul style="list-style-type: none"><li>• Health insurance</li><li>• Property and casualty insurance</li><li>• Liability insurance</li><li>• Legal insurance</li></ul> Reinsurance			

(Continued)

**TABLE 3**  
Continued

Process	Business Activity	Systemic Risk Contribution	Company's Vulnerability	Rationale and Source
				<ul style="list-style-type: none"><li>• Entry barriers are low, and classical insurance activities are substitutable, provided that insurability is given, e.g., via alternative risk transfer and self-insurance, or its absence would not substantially affect the real economy (e.g., Baur et al., 2003; Geneva Association, 2010b; Cummins and Weiss, 2013, 2014; IAIS, 2012a)</li><li>• Primary insurers diversify their exposure to reinsurance (e.g., Baur et al., 2003; Geneva Association, 2010a; Baluch et al., 2011; Besar et al., 2011); however, there are contrary views (e.g., Park and Xie, 2014; IAIS, 2012b)</li><li>• Studies show that bankruptcies of reinsurers would not lead to market failure (e.g., van Lelyveld et al., 2011; Park and Xie, 2014)</li><li>• Insurance is a necessary function for the economy (Bach and Nguyen, 2012), but individual insurance companies are substitutable (e.g., IAIS, 2011; Jobst, 2012)</li></ul>

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**TABLE 3**  
Continued

Process	Business Activity		Systemic Risk Contribution	Company's Vulnerability	Rationale and Source
	Nontra- ditional	Life	Life: Very Low (no evidence of contribution)	High (except for credit insurance, studies agree that these activities increase vulnerability)	<ul style="list-style-type: none"><li>• Life products with guarantees are specifically vulnerable to systemic risk (Geneva Association, 2011)</li><li>• Systemic risk measures give some indication that annuities with options and guarantees can be associated with increased withdrawals in times of crisis and therefore might increase vulnerability (Cummins and Weiss, 2013)</li><li>• Credit insurance has no direct liquidity impact and has very limited volume (e.g., Baur et al., 2003; Geneva Association, 2010a)</li><li>• Financial guarantees impose market risk on insurance companies and can have a direct liquidity impact; thus, they increase vulnerability to financial crisis (e.g., Geneva Association, 2010a; IAIS, 2010; Cummins and Weiss, 2013, 2014; Chen et al., 2013)</li><li>• CDSs/CDOs have direct liquidity impact and make the selling party vulnerable to a systemic crisis</li></ul>
		<ul style="list-style-type: none"><li>• Annuities with guarantees/variable annuities</li><li>• Group annuities</li><li>• Separate accounts</li></ul> Nonlife	Nonlife Medium (most studies agree that there is a systemic risk contribution)		
		<ul style="list-style-type: none"><li>• Credit insurance</li><li>• Financial guarantees</li><li>• CDSs/CDOs</li></ul>			

(Continued)

**TABLE 3**  
Continued

Process	Business Activity	Systemic Risk Contribution	Company's Vulnerability	Rationale and Source
Funding & Investing	Traditional	Life, nonlife, reinsurance		
		<ul style="list-style-type: none"><li>• Premiums funding</li><li>• Asset liability management and hedging</li><li>• Liquidity management</li></ul>		
		<b>Very low</b> (all studies agree that there is no systemic risk contribution)	<b>Medium</b> (studies agree that except for catastrophe bonds, these activities are vulnerable; however, the risks are very manageable)	<ul style="list-style-type: none"><li>• Majority view: contribution to systemic risk because the CDS buyer faces counterparty risk if the CDS seller defaults (e.g., Trichet, 2005; Geneva Association, 2010a; Baluch et al., 2011; Klein, 2013; Grace, 2011; Baranoff, 2012; Chen et al., 2013; Cummins and Weiss, 2013)</li><li>• Minority view: no contribution to systemic risk because if the CDS seller defaults, then the CDS buyer does not face a direct liquidity impact (e.g., Radice, 2010; Wallison reported by Harrington, 2009; cf. Harrington, 2013)</li><li>• Premiums are paid up front for contingent claims; no risk caused by maturity mismatches (e.g., Trichet, 2005; Cummins and Weiss, 2014; Kessler, 2014)</li><li>• Contingent claims prohibit a fire sale of assets in case of an insolvency (e.g., Cummins and Weiss, 2013; Kessler, 2014)</li><li>• In contrast to banks, insolvencies of insurers are lengthy and orderly processes (e.g., IAIS, 2009, 2010; Geneva Association, 2012)</li><li>• Relatively high equity levels in nonlife and reinsurance; life insurers are more vulnerable to a crisis due to higher leverage (e.g., Harrington, 2009; Chen et al., 2013)</li></ul>

(Continued)

**TABLE 3**  
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Process	Business Activity	Systemic Risk Contribution	Company's Vulnerability	Rationale and Source
	<ul style="list-style-type: none"><li>Insurance-linked securities (catastrophe bonds)</li></ul>			<ul style="list-style-type: none"><li>In many markets, high lapse fees for life products with saving components make immediate cash outflows unlikely (e.g., Radice, 2010; Geneva Association, 2010b; Kessler, 2014); additionally, life insurers would have enough liquidity without the need to sell assets (Baranoff et al., 2013)</li><li>Even during the financial crisis, external funding was available for life insurers (Berry-Stölzle et al., 2014)</li><li>Limited fungibility of liquidity within insurance groups could lead to increased vulnerability in times of crisis (e.g., Radice, 2010; Baranoff, 2012)</li><li>Compared to the market for financial derivatives, the market volume of alternative risk transfer products is small, the insurer remains liable, and the insurer keeps a certain amount of the risk on its balance sheet (IAIS, 2011, 2012b); in particular, cat bonds help the underwriting issuer diversify and decrease its underwriting risk to catastrophes (e.g., Weiß et al., 2013; Kessler, 2014)</li></ul>

(Continued)

**TABLE 3**  
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Process	Business Activity		Systemic Risk Contribution	Company's Vulnerability	Rationale and Source
Nontraditional	Life		<b>Unclear</b> (whether there is a systemic risk contribution is unclear)	<b>High</b> (studies agree that these activities increase vulnerability)	• Short-term funding can lead to fire sales if liquidity dries up, especially in the case of securities lending and credit rating utilization (e.g., Geneva Association, 2010a, 2010b; Acharya et al., 2011; Besar et al., 2011; Jobst, 2012; Schwarcz and Schwarcz, 2014); however, it is also argued that securities lending does not contribute to systemic risk because counterparties receive collateral (Baranoff, 2012)
	• Embedded value securitization				
	• Short-term funding				
	Life, nonlife, reinsurance				
	• Securities lending				• There is interest rate risk for investors if securitized products contain (1) guarantees and/or (2) the discount factor is inadequate (IAIS, 2010, 2012b)
	Nonlife, reinsurance				• The performance (stock market returns) of financial institutions is becoming increasingly interconnected (e.g., Acharya et al., 2011; Baluch et al., 2011; Cummins et al., 2012; Billio et al., 2012; Schwarcz and Schwarcz, 2014; Weiß and Mühlnickel, 2014; Bierth et al., 2015); however, banks still have a stronger impact on insurers than vice versa (e.g., Grace, 2011; Engle et al., 2015; Chen et al., 2014); this interrelation is mainly driven by nontraditional insurance activities (e.g., Neale et al., 2012; Cummins and Weiss, 2013)

(Continued)

**TABLE 3**  
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Process	Business Activity	Systemic Risk Contribution	Company's Vulnerability	Rationale and Source
				<ul style="list-style-type: none"><li>• Exploitation of nonregulated subsidies and information asymmetries (e.g., Zufferey, 2000; Harrington, 2009; IAIS, 2010; Acharya et al., 2011; Baranoff, 2012)</li><li>• It is not clear whether the prices of alternative risk transfer products are uncorrelated with the financial market in times of crisis (IAIS, 2012b; Schwarcz and Schwarcz, 2014)</li><li>• Industry-loss warranties are not linked to an individual loss event but cover the downturn of an entire industry, which can lead to an increased basis risk and credit risk because there is no collateral (IAIS, 2012b)</li></ul>



(2008) considers this distinction and focuses only on insurance risks.<sup>17</sup> Furthermore, it is used by regulatory bodies (see, e.g., IAIS, 2011) and by industry organizations (see, e.g., Geneva Association, 2010a).<sup>18</sup>

Specifically, we define as underwriting related all activity that has as its purpose the transfer of a risk to the insurer from a third party in exchange for a fee. Therefore, we understand not only the transfer of life and nonlife risks as underwriting but also reinsurance and all types of alternative risk transfer products.<sup>19</sup> We define funding and investing processes as all activities with the purpose of increasing investment income and ensuring that liabilities are met. We include not only investment of premium income and asset liability management (see, e.g., Rejda and MacNamara, 2014, chaps. 6 and 7; Zweifel and Eisen, 2012, chap. 1.4), but also profit-enhancing activities as described by the Geneva Association (2010a, chap. 3.4.1).<sup>20</sup> Furthermore, we differentiate business activities according to their degree of innovation, thus classifying them as either traditional or nontraditional insurance business, as is common in the literature (see, e.g., Baluch et al., 2011; Kessler, 2014; Cummins and Weiss, 2014 and Berdin and Sottocornola, 2015, instead use the terms core and noncore activities). This classification is not always clear-cut but, in general, we consider an activity to be traditional when its accompanying risks are mostly (1) idiosyncratic, (2) not correlated with one another, and (3) not influenced by economic business cycles (see IAIS, 2012b).<sup>21</sup> Using this classification system, we identify papers that discuss a particular business model and evaluate that business model's contribution to systemic risk and its vulnerability to impairments of the financial system.

A list and summary of all studies reviewed for this analysis can be found in Table A2 in Supporting Information. In that table, we distinguish between academic work published in scientific journals or as a working paper and more applied work by industry associations and regulators.

We have already noted some limitations of systemic risk measures. In the discussion of the literature, recall that none of the quantitative measures captures systemic risk in its

<sup>17</sup> Dhaene et al. (2002a, 2002b) provide an overview of the research on modeling portfolios of risks that are not mutually independent. As an application, the combination of insurance and financial risks in an insurance context is noted.

<sup>18</sup> Note that the classification of insurance activities in Table 3 is not meant to be a final assessment but instead a framework for evaluating the systemic risk of insurance. Therefore, the classification of a certain activity could be arguable; for example, compare IAIS (2013).

<sup>19</sup> Compare with Rejda and McNamara (2014, chap. 6), who distinguish between underwriting and reinsurance. Using their framework, we consider all risk transfer activities to be underwriting within life insurance, health insurance, and property and liability insurance, in addition to reinsurance.

<sup>20</sup> According to our definition, the noninsurance activity of CDS underwriting, as noted by the IAIS (2011), belongs to the underwriting processes, whereas capital market business, banking, and third-party asset management are funding and investing processes.

<sup>21</sup> For example, many market participants (especially in German-speaking countries) view life insurance contracts with embedded guarantees as their traditional business model. According to our classification, however, guaranteed annuities are nontraditional because they are influenced by the economic business cycle. In this context, we also discuss modern variable annuities with different types of guarantees.

entirety; thus, all studies are limited to a specific content. Another general shortcoming of all reviewed empirical studies is that the considered time horizons are very short. For example, no empirical study addresses the period of the Great Depression in the United States during the late 1920s and early 1930s, which is understandable, given the data availability issues. However, to make assessments about infrequent events such as systemic crises, one needs to look across centuries, not just decades.<sup>22</sup>

### Systemic Risk in Traditional Insurance Underwriting

Traditional insurance activities include underwriting life, health, property, accident, liability, and legal risks in the life and nonlife sectors, in addition to the transfer of risk via reinsurance.

The literature qualitatively assessing the systemic risk of business activities agrees that the systemic risk contribution of traditional nonlife insurance (property, accident, liability, legal, and, in some jurisdictions, health) is very low.<sup>23</sup> The reasons are low interconnectedness within the field and that claims are bound to specific loss events that in most cases, are independent of the business cycle. The major argument is that claims settlement can take several years. Thus, these activities contribute very little, if anything, to systemic risk and do not increase the company's vulnerability to impairments of the financial system. This conclusion and line of reasoning is found in peer-reviewed journals and in reports by regulators and industry.

Two further strands of the literature using quantitative methods support this conclusion. The first strand is represented, for example, by Billio et al. (2012), Chen et al. (2014), and Rauch et al. (2015).<sup>24</sup> All studies empirically show that the stock market returns of life and nonlife insurers and banks have become more correlated in recent years. Billio et al. (2012) use monthly return data from the 25 largest U.S. hedge funds, brokers, and banks, in addition to insurers, and test pairwise for Granger causality. In essence, Chen et al. (2014) do the same for 11 insurers and 22 banks in the United States; however, their analysis is not based on stock market returns but on the DIP measure. Finally, Rauch et al. (2015) employ a factor model based on systematic, sector-specific, and idiosyncratic risk to measure the interconnectedness among the stock market returns of different financial sectors. They use data for all publicly available financial services companies provided by SNL Financial. All studies find that banks and insurers are interdependent but that shocks in the banking industry affect insurers much more than vice versa.

The second strand of literature calculates systemic risk measures directly for insurers. For example, Mühlnickel and Weiß (2015) apply LTD as a systemic risk measure in an attempt to discover whether insurance mergers increase the contribution to the systemic risk of an insurer. The authors find only slightly significant results for the North American banking sector, indicating that insurance mergers might affect the systemic risk contribution of banks. Generally, however, they find no evidence for an increased systemic risk contribution due to merger and acquisition (M&A) activities in the insurance sector.

<sup>22</sup> In essence, we share the opinion of Taylor (2012).

<sup>23</sup> See, for example, Trichet (2005) and Cummins and Weiss (2014) (peer-reviewed journal articles), IAIS (2011) (regulator report), and the Geneva Association (2010a) (industry association report).

<sup>24</sup> See also Adams et al. (2014) for another paper analyzing spillover effects with results similar to those in the papers noted above.

Furthermore, Cummins and Weiss (2013) and Mühlnickel and Weiß (2015) show that based on SRISK and MES, insurers' stock prices are severely negatively affected in times of crisis. These findings do not actually contradict the results noted above because they focus on insurance companies, not on specific business activities. Indeed, both studies conclude that the results are due to nontraditional insurance activities. Bierth et al. (2015) also support this view by calculating  $\Delta\text{CoVaR}$ , MES, and SRISK for 253 life and nonlife insurers worldwide and comparing the results with previous studies of banks. They conclude that insurers contribute much less to systemic risk than do banks. Finally, Bernal et al. (2014) calculate  $\Delta\text{CoVaR}$  not for specific companies but for the insurance, banking, and other financial services sector in the United States and the Eurozone. They find that in the Eurozone, the other financial services sector contributes the most to systemic risk and that in the United States, the insurance sector contributes the most to this risk.<sup>25</sup> In general, as noted in the Section Classification of Systemic Risk, we believe that studies based on systemic risk measures should be interpreted very cautiously. It remains unclear whether systemic risk measures are able to properly assess the systemic risk of companies or entire sectors.

The Geneva Association (2010b) and Klein (2012), in addition to Cummins and Weiss (2013, 2014), argue that there is also no systemic risk from life insurance or annuities. Their main argument is that this line of business does not have a strong impact on other financial market participants or on the economy in general in the case of bankruptcy. Moreover, in most countries, customers are protected by guarantees.<sup>26</sup> This argument is convincing in view of the fact that there is no known case of a bankruptcy of a single life insurance company triggering a contagion effect and other insolvencies. The risks that led to insolvency in these cases were of an idiosyncratic nature (e.g., management failures). Radice (2010) supports this argument by noting that even the insolvency of very large life insurers might not contribute to systemic risk. Even if guarantees are not sufficient, policyholders do not suffer a total loss; instead, their claims will be reduced, as was the case with Equitable Life. Finally, as argued by the Geneva Association (2010a, 2010b), life insurance should not contribute to systemic risk for reasons having to do with time. The windup of an insurer is an orderly process and does not lead to an immediate default on liabilities, the fire sale of assets, or increased cash outflow. Indeed, this process can take up to several years, as described by Kessler (2014). In principle, this view is shared by the IAIS (2012a), which assesses global systemically important insurers and places only minor weight on traditional life and nonlife underwriting activities.<sup>27</sup>

Baluch et al. (2011) and Cummins and Weiss (2014) are more critical of reinsurers and note that the reinsurance market is highly concentrated. There is high interconnectedness among reinsurers and between reinsurers and insurance companies. They argue that there is a danger of a retrocession spiral. Premiums are ceded not only between primary

<sup>25</sup> In addition, Drakos and Kouretas (2015) calculate  $\Delta\text{CoVaR}$  measures for the banking, insurance, and other financial services sectors for the United Kingdom between 2000 and 2012. Their results support the view that banks contribute the most to systemic risk. See also Berdin and Sottocornola (2015).

<sup>26</sup> See Geneva Association (2012), Harrington (2013), and Oxera (2007).

<sup>27</sup> Another aspect that we do not discuss in detail is the controversial discussion on U.S. life insurers' ceding parts of their liabilities to less regulated off-balance-sheet entities (the so-called "shadow reinsurers"). See Kojen and Yogo (2014) and Harrington (2014).

insurers and reinsurers, but also within the reinsurance industry; thus, the bankruptcy of one reinsurer could trigger the bankruptcies of others. Similarly, the rating downgrade of a reinsurance company could trigger a chain reaction due to reinsurance contracts, which can typically be canceled in such circumstances. This argument is presented by Park and Xie (2014), who show that up- and downgrades of reinsurers' ratings also affect primary insurers' ratings. However, scenario analyses by Park and Xie (2014) and Van Lelyveld et al. (2011) show that even the failure of several large reinsurers would result in only a few primary insurer insolvencies, and therefore, reinsurers do not appear to contribute to systemic risk. Furthermore, Kessler (2014) also argues that reinsurance does not contribute to systemic risk because primary insurers diversify their counterparty risk to reinsurers. In addition, he states that retrocession spirals are unlikely due to a hierarchical market structure between reinsurers and primary insurers. This reasoning accords with that of the IAIS (2012b) and the conclusions of a study by Swiss Re (see Baur et al., 2003). Most recently, in an empirical analysis of the microstructure of the U.S. reinsurance market, Chen et al. (2015) show that the market is indeed hierarchical. In addition, Cummins and Weiss (2013) argue that reinsurance does not contribute to systemic risk because reinsurers "are not sufficiently interconnected with noninsurance institutions."<sup>28</sup>

In this context, the question arises of whether the unavailability of insurance coverage is a systemic risk in the sense that the real economy is affected. There is consensus on the answer to this question in academic studies, regulator reports, and industry association reports, and it is as follows.<sup>29</sup> Provided that the risk is quantifiable, insurance companies and their products are substitutable by other market participants and products, for example, by catastrophe (cat) bonds, due to low market entry barriers. Additionally, insurance coverage can be created within a certain industry in the form of a self-insurance cooperative.<sup>30</sup> Furthermore, provided that an insurance business is profitable, there will be new market entries if there is demand and a shortage of supply.

In our opinion, the issue of the substitutability of an individual insurance company should not be confused with the situation in which the entire insurance context changes. For example, after September 11, 2001, it was nearly impossible to obtain insurance coverage against terrorism. This situation was not due to an impairment of the financial system but because the risk of terror attacks became unquantifiable. Therefore, there is no contribution to systemic risk because a link to the financial system is necessary for systemic risk.

<sup>28</sup> In addition, for the Chinese market, Yang and Manikowski (2015) attempt to evaluate the effect of reinsurance on the likelihood of insolvency for ceding insurers. However, they have yet to obtain results. Masayasu (2016) performs a network analysis for the 118 largest nonlife reinsurers and confirms the results of the studies mentioned above.

<sup>29</sup> See, for example, Cummins and Weiss (2014) (peer-reviewed journal article), Radice (2010) (working paper), the IAIS (2012a) (regulator report), and the Geneva Association (2010b) (industry association report).

<sup>30</sup> An example of such a cooperative is the absence of industry liability insurance in 1984/1985 in the United States. Insurers had to excessively increase their provisions for potential claims due to asbestos hazards and stopped writing new business. In response, industrial companies founded an insurance cooperative for these risks. For further details, see Radice (2010).

Another argument for why traditional underwriting risks are not likely to increase the vulnerability of insurers is market discipline. As we discuss in greater detail below, the literature shows that market discipline is strong in the insurance industry and that policyholders prefer to conduct business with financially healthy insurers (see, e.g., Epermanis and Harrington, 2006). Therefore, insurance companies are careful not to underwrite risks that endanger their financial stability, which in turn makes them more resilient in times of crisis. In addition, the commercial clients of insurance companies recognize that insurance companies can fail, and therefore, commercial clients diversify their insurance portfolio. If an insurer fails, the impact on firms in other industries is relatively small because these firms work with multiple insurers. Therefore, any failure of an insurance company has only a marginal impact on other industries and the overall economy.

### Systemic Risk in Nontraditional Insurance Underwriting Activities

As nontraditional insurance underwriting activities in the life segment, we consider only annuities for which the insurer bears the investment risk and guarantees a certain payout. In the nonlife sector, we classify credit insurance, financial guarantees, and financial derivatives underwriting as nontraditional activities.

The IAIS (2011), Grace (2011), Klein (2013), and Cummins and Weiss (2014) note that some aspects of guaranteed annuities could increase the issuing company's vulnerability in times of crisis. The literature agrees that in the case of life insurance products with an investment component or a guaranteed annuity, a sudden cancellation of many contracts and a subsequent cash outflow is theoretically possible. The likelihood of such an event, however, is disputed. Radice (2010) and a study by an industry association (see Geneva Association, 2011) argue that policyholders normally have to pay high cancellation fees, making cancellation unattractive.

However, consider the bankruptcy of the Belgian insurance company Ethias in 2008. When the company became financially distressed, many of its life insurance products were canceled. Nevertheless, the Geneva Association (2010b) argues that the insurance products were in fact savings accounts—cash could be withdrawn and the contracts canceled at any time without any fee or discount. In contrast to the Geneva Association, Acharya and Richardson (2014) believe that such contracts are not the exception but are becoming increasingly popular. In addition, Cummins and Weiss (2013) provide further evidence that casts some doubt on the conventional wisdom that cancellations of policies are unlikely. They employ the SRISK systemic risk measure and discover that it is related to separate account assets and group annuity premiums. Their interpretation is that separate accounts can be associated with increased withdrawals in times of crisis because these accounts are especially used to provide annuities with options and guarantees. Furthermore, large companies are likely to cancel group annuities in times of crisis. Therefore, in line with the discussion of systemic risk measures noted above, it could be argued that life insurance products containing annuities with options or guarantees can increase the vulnerability of an insurer.

Another critical factor is the rate of return on guaranteed annuities, as Radice (2010) notes. If the promised return can be generated only in a bullish market, insurers will suffer financial distress when interest rates plunge and they are not sufficiently hedged. To date, this has occurred for only a few insurance companies because the practice of

guaranteeing a rate of return on an annuity generally takes several business cycles into account. Even if insurers fail to deliver the guaranteed return, the impact on the economic system is minor. In two cases, those of the Japanese insurance company Nissan Mutual Life and Equitable Life in the United Kingdom, declining interest rates and unhedged, guaranteed annuities caused substantial financial distress for the companies. However, neither case triggered a systemic crisis.

In the nonlife segment, the area of credit protection can be divided into three categories: credit insurance, credit guarantees, and derivatives (especially CDSs). In the case of credit insurance, two industry studies—Baur et al. (2003) and the Geneva Association (2010a)—argue that in contrast to CDS underwriting, substantial reserves must be held on the balance sheet for loss events and that a cash outflow occurs only in the event of loss when loans can no longer be fully repaid, not in the case of a downgrading. In addition, there is only weak interconnectedness between credit insurance and the rest of the financial sector. Thus, the authors conclude that credit insurance's contribution to both systemic risk and vulnerability is low.

Drake and Neale (2011) present a comprehensive study of the financial guarantee business, which underwrites public and private debt and structured finance products. The interconnectedness between this type of business and the financial system is strong due to the exposure of large banks to guaranteed derivatives. In addition, the products react very quickly to market downturns because the securities are valued mark-to-market and losses (or collateral demands) can spread quickly through the financial services industry. Indeed, the Geneva Association (2010a) argues that this business activity significantly increases the issuing insurer's vulnerability to economic downturns. Some products contain implicitly guaranteed interest rates, and rating downgrades of the underwriting entity can trigger immediate collateral calls and contract cancellations. This argument finds support in an empirical study by Chen et al. (2013), who calculate BANKBETA and MES for a broad range of U.S. insurers underwriting CDSs.<sup>31</sup> They find that according to both measures, systemic risk levels for financial guarantee insurers exceed those of property-casualty insurers. Therefore, conditional on the appropriateness of these particular systemic risk measures, the findings support the view that financial guarantees increase the contribution to systemic risk and the vulnerability of institutions.

The most common credit derivative is the CDS.<sup>32</sup> In its plain vanilla form, the company selling the swap receives money continuously throughout the duration of the contract and promises to pay out money in the event that the entity mentioned in the contract

<sup>31</sup> Both measures, as described in "Systemic Risk Measures," consider only the interconnectedness between institutions. Further aspects of systemic risk are neglected. For example, financial and nonfinancial institutions cannot be distinguished; one shock that could severely impair the entire financial industry is not considered, and whether interconnectedness automatically implies the risk of a chain reaction of bankruptcies is not clear.

<sup>32</sup> There is a controversy over whether CDSs qualify as insurance or, instead, are another type of capital market product. See, for example, National Association of Insurance Commissioners (2000), Schwartz (2007), and Acharya et al. (2011). In the context of this article, the question is of minor relevance. What matters is that the insurance sector in total underwrites more CDSs than it buys for hedging (see Barrett and Ewan, 2006); furthermore, in no paper have CDSs been considered a form of traditional insurance.



goes bankrupt. To buy a CDS relating to a certain entity, one need not have a claim against the entity itself. The purchaser of a CDS, however, is exposed to the risk that the counterparty cannot meet its obligation in the event that the entity mentioned in the contract goes bankrupt. Therefore, it is common for the CDS seller to provide collateral based on that risk of bankruptcy (see Kress, 2011). Consequently, CDS underwriting businesses are exposed to liquidity risk. They have an increased cash outflow as soon as there is an economic downturn and the risk of credit defaults increases.<sup>33</sup>

We found no disagreement on the part of academics, regulators, or the industry that CDS underwriting, at the very least, increases vulnerability to impairments of the financial system. Regarding the contribution to systemic risk, a few studies argue that CDS underwriting has no effect. Wallison (associated with the American Enterprise Institute, a think tank), as reported by Harrington (2009), argues that CDS holding companies are well diversified, and consequently, the insolvency of a CDS underwriting business would have only limited effect. For example, with regard to AIG, he argues that “[i]f Goldman, AIG’s largest counterparty, would not have suffered significant losses, there is no reason to believe that anyone else would have suffered systemically significant losses either.” Furthermore, Radice (2010) does not think that defaulting CDS would have a substantial impact on counterparties. In a qualitative scenario analysis, he also argues that one can easily mitigate the systemic risk contribution of CDSs by diversifying the counterparties.

By contrast, Heyde and Neyer (2010) build a banking model with and without CDSs and compare the results of each with regard to financial stability. They define financial stability as the shock-absorbing ability of the system, that is, the likelihood that a bank goes bankrupt and triggers a chain reaction. They find that CDSs have a destabilizing effect on the financial system: market participants are not sufficiently diversified, and the risk transfers encourage CDS-buying banks to invest more in high profit but illiquid and risky assets. This assessment accords with the majority of academic papers and reports by regulators and industry. They all agree that the failure of a CDS-underwriting entity would trigger a chain reaction that could impair the entire financial system.<sup>34</sup> This assessment is based on the size of the CDS business, its interconnectedness with the entire financial sector, the short time it takes for an impairment caused by a CDS default to evolve, and the nontransparency of the CDS business.<sup>35</sup>

### Systemic Risk in Traditional Insurance Funding and Investing Activities

Traditional funding and investing activities of insurance companies include collecting up-front premiums for underwriting risks and asset and liability management, in addi-

<sup>33</sup> CDSs can be designed such that there are immediate, realizable losses and not only margin calls. For example, Swiss Re had to realize 1.2 billion CHF in 2007 due to underwriting CDSs protecting mortgage-backed securities from rating downgrades (see Swiss Re, 2008).

<sup>34</sup> Regarding the AIG bailout, Bernanke is reported by Brady (2009) in *The Washington Post* to have said: “[The] AIG situation is obviously a very uncomfortable one ... [but a collapse] ... would be devastating to the stability of the world financial system.” See also Acharya et al. (2011).

<sup>35</sup> See, for example, Baluch et al. (2011) and Cummins and Weiss (2014) (peer-reviewed journal articles), the IAIS (2011) (regulator report), and the Geneva Association (2010a) (industry association report).



tion to liquidity management. In addition, insurance-linked securities (ILS), specifically cat bonds, are considered traditional.

There is consensus in the literature that the business model based on collecting upfront premiums for bearing risks that can lead to contingent claims is very stable and ensures sufficient liquidity. Therefore, an “insurance run” is not possible in the nonlife sector, and a fire sale of assets that could have a systemic impact is unlikely.<sup>36</sup> Furthermore, regulators might anticipate the risk of fire sales and automatically relax capital requirements during a crisis (indeed, precisely such a procedure is expected to be included in the forthcoming Solvency II regulation).<sup>37</sup> The opposite situation, that is, long-term liabilities and short-term assets, increases insurers’ exposure to interest rate risk and their vulnerability. However, the Geneva Association (2010a) claims that insurance companies use “assets and derivatives to replicate insurers’ liability profiles and match their expected claims.” Cummins and Weiss (2014), who analyze the balance sheets of U.S. nonlife and life insurers, support this industry view that there should be no maturity mismatch and conclude that “asset and liability maturities are both long term for insurers.”

Insurer funding and asset liability management enjoy a certain degree of stability due to the generally high equity coverage in nonlife and reinsurance, as reported by Harrington (2009) and Cummins and Weiss (2013). Regarding life insurers, however, Harrington (2013), Cummins and Weiss (2014), Grace (2011), and Baranoff et al. (2011) argue that the equity basis of life insurers is relatively low. These companies’ assets might not be sufficiently diversified (many insurers hold only government bonds), and some companies are substantially invested in mortgage-backed securities. Furthermore, it could be argued that the business model of life insurers in general is more vulnerable to impairments of the financial system than that of nonlife insurers due to contract duration. Life insurance is a long-tail business and involves contracts that span decades. By contrast, nonlife insurance is short-tail, and contracts tend to be short term. Therefore, if loss frequency is low, life insurers have to invest more capital over a longer period of time and are therefore more affected by adverse capital market movements. This indication of life insurers’ vulnerability to impairments of the financial system is supported by Chen et al. (2013), who calculate the SRISK and MES systemic risk measures via a copula approach and discover that life insurers are much more affected by economic downturns than are nonlife insurers.

However, a few studies express some doubt that life insurers are vulnerable to impairments of the financial system. Even if an insurance run did materialize, Baranoff et al. (2013) show that the likelihood of a fire sale is low because life insurers maintain a level of liquidity adequate to cope with stressful situations. Simulations based on historical lapse rates reveal that life insurers need not sell assets before maturity to fulfill their obligations. Even in a worst-case scenario in which 10 times the normal number of policies are canceled, the volume of assets that need to be sold before maturity makes up only a small fraction of the bond market. Berry-Stölzle et al. (2014) support this line of reason-

<sup>36</sup> See the Geneva Association (2010b) (industry association report), Eling and Schmeiser (2010) (peer-reviewed journal article), Lehmann and Hofmann (2010) (peer-reviewed journal article), and the IAIS (2011) (regulator report).

<sup>37</sup> See Article 106 in Directive 2009/138/EC of the European Parliament and European Council (2009).

ing and show that during the subprime crisis, life insurers' access to external capital was not endangered and TARP funds for life insurers were unnecessary. Using regression analyses, they show that for the period between 1999 and 2010, the reasons for issuing new capital—compensating for operational losses or funding growth opportunities—were the same during the subprime crisis as during normal times. In addition, capital issuance can be predicted by the same factors during normal times and times of crisis. No evidence of a shortage of capital for insurers during times of crisis could be found.

There is one aspect of liquidity management that could increase vulnerability in an extremely adverse market environment: the fungibility of liquidity in globally operating insurance conglomerates. As Radice (2010) argues, in the event of a crisis, local regulators could prohibit the transfer of capital from local subsidiaries to a holding company outside of the local jurisdiction. This type of ring-fencing could be attractive for regulators, if the local subsidiary holds sufficient capital to remain solvent and to ensure that local policyholders are protected.<sup>38</sup> As a downside, this regulatory action would come at the expense of the holding company and other subsidiaries in other jurisdictions. In the worst case, this pattern could lead to the insolvency of the holding company or one of its other subsidiaries, even if the group as a whole continues to be solvent. Drake and Neale (2011) argue in the opposite direction and stress that the guarantees given among different judicial entities within an insurance group could lead to another AIG case: healthy subsidiaries under the oversight of insurance regulators have to pay for the poor decisions of noninsurance, nonregulated entities.<sup>39</sup> Nevertheless, bear in mind that capital transfers out of insurance companies are normally restricted if the transfer endangers the financial stability or solvency of the insurer.

Similar to the IAIS (2013), we regard ILS as a traditional insurance funding and investing activity, provided that the underwritten risks are (1) idiosyncratic, (2) not correlated with one another, and (3) not influenced by economic business cycles. The most common ILS are cat bonds. In essence, these products use the financial markets to further diversify the underwriting risk of events such as pandemics or hurricanes among a wider group of investors. A study by Cummins and Weiss (2009) shows that returns on cat bonds are not correlated with returns on bonds or stocks during normal times and only slightly so in times of crisis. They conclude that cat bonds are valuable for diversification even during a crisis. A recent study by Weiß et al. (2013) supports this view. The authors relate the issuing of cat bonds to systemic risk measures and find that cat bonds have no statistical impact on SRISK or  $\Delta\text{CoVaR}$ . Finally, Kessler (2014), the IAIS (2011, 2012b), and Schwarcz and Schwarcz (2014) note that the volume of cat bonds is remains relatively

<sup>38</sup> Typically, regulators fence off a subsidiary when that subsidiary is in financial distress and not many assets remain. However, Radice (2010) notes that ring-fencing might also occur as a precautionary act, even if many assets remain. This type of ring-fencing might have a negative impact on the financial situation of an insurance group.

<sup>39</sup> See also the Geneva Association (2012), which discusses precisely such a scenario in chapter 3.4.4. An insurance group is assumed with subsidiaries addressing insurance activities and subsidiaries addressing noninsurance activities such as CDS underwriting. What impact the failure of the noninsurance-related entity would have on the insurance holding company is discussed. The study agrees with Drake and Neale (2011) that there is a risk that the holding company could be substantially impaired by the failing subsidiary if guarantees between the entities are given.

low and thus cannot be counted as either a contribution to systemic risk or a vulnerability to impairments of the financial system.

Another factor that should prevent contribution to systemic risk by insurers is the high level of market discipline in insurance and reinsurance. Harrington (2004, 2013) argues that policyholders are risk sensitive and prefer to address financially sound insurers. Furthermore, agents, brokers, and advisors, as well as rating agencies, monitor insurance companies. Therefore, insurance companies limit their risk taking and are careful to maintain a financially healthy position.<sup>40</sup>

#### Systemic Risk in Nontraditional Insurance Funding and Investing Activities

We regard the securitization of embedded value securitization, securities lending, and credit rating utilization, as well as short-term funding via issuing commercial papers, as nontraditional funding and investing activities. These activities can be undertaken by life, nonlife, and reinsurance companies.

Insurance companies pay commissions to agents and brokers for new policies sold. These commission payments are typically up front because they are often paid out immediately after the sales process but involve the entire life span of the policy. Therefore, under certain circumstances, these payments are not fully expensed immediately but deferred over the duration of the policy and are recognized as an intangible asset on the balance sheet.<sup>41</sup> The securitization of these intangible assets is called embedded value securitization and increases the liquidity of the insurer. According to the IAIS (2012b), this activity exposes the investor who buys these intangible assets to substantial interest rate risk via implied guarantees, insurance risks, and market risk. However, embedded value securities do not contribute to systemic risk because (1) their outstanding volume is marginal compared to other asset-backed securities and (2) the risks seem to be similar to those of directly buying the stock of the insurance company.

As noted above, it is typically not necessary for insurance companies to engage in a fire sale of assets before maturity to overcome liquidity problems. The Geneva Association (2010a) argues that there can be an exception if short-term financing is used to fund additional investments. Two profit-enhancing methods, if used excessively, can increase the systemic risk contribution of insurers and make them more vulnerable to impairments of the financial system:

1. "Securities lending," which is when long-term investors such as insurance companies lend their long-term securities to other market participants for short-selling, and therefore receive a fee and collateral. For the collateral, the insurance company has to pay interest, which is normally low and generated by investing the collateral in safe and short-term assets. In its plain vanilla form, this activity is not a problem from a systemic risk perspective. However, the vulnerability of an

<sup>40</sup> Epermanis and Harrington (2006) provide empirical evidence for this reasoning. For U.S. property-casualty insurers, the authors show that premium income is decreasing if the insurer's rating is downgraded. More recently, Eling and Schmit (2012) provide evidence of market discipline in the insurance sector for Germany.

<sup>41</sup> See, for example, the Financial Accounting Standard Board (2010).

insurer increases if the collateral is invested instead in risky or long-term assets to generate additional profits. The fact that the investor typically has the right to return the borrowed securities on short notice is especially problematic. It might also increase the insurance company's liquidity risk, if the collateral is invested in illiquid assets, and might lead to a situation in which a fire sale of assets becomes necessary to meet obligations.

2. "Credit rating utilization" is essentially a form of increasing leverage. It involves borrowing money, provided that the credit rating is not endangered. Again, the additional capital is invested in safe and short-term assets. If the capital is instead invested in long-term assets, then the liquidity risk and, subsequently, the vulnerability of the insurer might increase. In times of crisis, it can be expected that the rating of an insurer is under pressure and assets have to be sold to maintain the investment grade.

Acharya et al. (2011) note that securities lending *per se* need not be a risky activity, provided that the collateral is invested in safe assets with a shorter duration than the securities that are borrowed by other institutions. By contrast, AIG engaged in very aggressive securities lending, which was one reason that the company needed financial support. Harrington (2009) makes a similar assessment of the AIG failure, but Baranoff (2012) explains why the securities lending program on its own did not and most likely in general will not contribute to systemic risk: market practice normally requires 120 percent of the value of the security as cash collateral from the borrower. However, as the lender, AIG also ultimately had to post collateral; thus, the borrower took no risk. In the event of an AIG-like bankruptcy, the borrower could simply sell the borrowed securities and keep the additional collateral. Generally, the right to liquidate the securities in the event of the lender's default limits the counterparty risk and strongly reduces the systemic risk contribution of this business activity. In the case of AIG, the company itself eventually chose to reduce this business activity and instead turned to the Federal Reserve Bank of New York for funding.

Finally, the Geneva Association (2010a) illuminates another practice that can contribute to systemic risk and increases vulnerability to impairments of the financial system: relying extensively on short-term funding via issuing commercial paper could lead to the necessity of selling assets before maturity. Bear in mind, however, that this practice is highly unusual for standard insurance companies. Effectively, this issue illustrates why one should not focus on the company level but instead on the level of business activities. There are systemic risk-contributing practices in which insurance companies can engage, but that does not mean that a substantial part of the insurance sector is doing so.

In the reinsurance sector, industry-loss warranties (ILW) can be viewed as nontraditional insurance activities. These warranties are not linked to an individual loss event but instead cover the downturn of an entire industry. According to the IAIS (2012b) and Acharya and Richardson (2014), these products can pose increased basis and credit risk because there is no collateral requirement. With the exception of the case of cat bonds, there are not enough studies on which to base a solid assessment of alternative risk transfer products (ILS and ILW). In addition to ILW, other ILS related to life insurance could be strongly connected to interest rate and credit risk.

Thus, in principle, all nontraditional funding and investing activities have the potential to increase insurer vulnerability to impairments of the financial system. Whether and, if so, to what extent these activities contribute to systemic risk is not entirely clear.

### REGULATION OF SYSTEMIC RISK IN INSURANCE AND BANKING

One major question that remains is whether regulatory requirements designed to mitigate systemic risk should be the same for the banking and insurance sectors. In essence, there are two lines of thought on this question:

1. *One size fits all.* One possibility is to treat insurers exactly the same as banks and to require higher equity levels from insurers that are deemed systemically important. This logic is partially followed by the FSB, which states that “[h]igher loss-absorption capacity, more intensive supervision and resolution planning requirements will apply to all these institutions [globally systemically important institutions]” (FSB, 2013b).
2. *No systemic risk, no additional regulation.* As discussed above, many papers find that insurers contribute much less to systemic risk and are much less vulnerable to impairment than banks (e.g., Kessler, 2014, in the case of reinsurers). Therefore, no additional regulation is required. In addition, market discipline is strong in the insurance sector. Provided that there is a realistic risk that an insurer might go bankrupt, market participants will closely monitor insurance companies. According to this line of thought, well-intended regulatory initiatives can easily have an adverse outcome, for example, if regulation becomes more intense but undermines market discipline. Harrington (2004, 2009, 2013) is skeptical of additional regulation for systemically important institutions. He argues that a designation as systemically important could be interpreted as a bailout guarantee, which would reduce market discipline.

We believe that both perspectives are valuable, provided that they are applied to activities rather than to institutions. We argue in favor of the following principle: same business, same risks, and same regulation. There is no indication that improved regulation of AIG’s property–casualty division would have resulted in a less severe financial crisis. Simultaneously, higher capital requirements would have been a good idea for AIG’s financial services division and for many banks. In addition, studies calculating systemic risk measures show that results differ if the measures are derived for specific companies (e.g., Bierth et al., 2015) or entire industries (e.g., Bernal et al., 2014; Drakos and Kouretas, 2015). It seems that specific activities performed by certain institutions dominate the perception of entire sectors. Therefore, we approve of the fact that an activities-based view has entered the policy debate.<sup>42</sup> It is important, however, to focus not only on capital requirements, but also on transparency and the structure of large financial groups. Market discipline can have a beneficial impact only if the business

<sup>42</sup> The IAIS (2014) plans to differentiate between traditional and nontraditional activities in their formula for basic capital requirements.

activities performed by institutions are public knowledge.<sup>43</sup> In the current discussion, the fact that it was not only high leverage, but also the opacity of an institution's risk exposure, that was a problem during the crisis is sometimes overlooked. Furthermore, it would be beneficial if separate business activities were performed in separate business units that could go bankrupt individually. In this manner, market discipline would be more effective in monitoring even specific activities. Dubious activities could fail (and their respective business units go bankrupt) without affecting traditional activities. The implication, for example, would be that a customer could trust (or mistrust) an insurer even if some activities were regarded as (not) sustainable. As a conclusion, we see no necessity to introduce additional systemic risk-oriented regulations of traditional insurance activities because they do not contribute to systemic risk.

### CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

In this article, we discuss and review the extant literature on systemic risk, a topic of high interest for academics and practitioners in recent years. Systemic risk can occur when there is a limited shock that spreads via contagion or interdependence to other financial institutions or upon the occurrence of a system-wide shock that impacts the entire financial system simultaneously.

There is agreement in the literature that insurance companies and their activities contribute less to systemic risk and are less vulnerable to impairments of the financial system than are banks. Traditional underwriting and funding and investing activities in the life, nonlife, and reinsurance business contribute very little to systemic risk and do not increase insurer vulnerability to impairments of the financial system. However, certain nontraditional insurance activities appear to be relevant to systemic risk. The literature agrees that some underwriting activities in the nonlife segment (financial guarantees and CDSs) increase insurers' vulnerability to impairments of the financial system. A majority of academic studies, working papers, regulator reports, and industry studies claim that these activities also contribute to systemic risk; only a minority argues that these products make a very limited contribution to systemic risk.

According to the literature, in principle, traditional funding and investing activities (including cat bonds) neither contribute to systemic risk nor increase the vulnerability of an institution in times of crisis. With regard to nontraditional funding and investing activities, securities lending, short-term funding, and ILW can especially increase vulnerability to impairments of the financial system. However, to date, no consensus has been reached on whether and, if so, to what extent these activities contribute to systemic risk. Furthermore, to date, there is very little work on alternative risk transfer products.

Studies adopting a qualitative approach to the issue and studies that calculate systemic risk measures conclude that life insurance companies are more vulnerable to impairments of the financial system than are nonlife insurers. Our review of 35 academic and 13 industry papers reveals that in general, both groups agree with regard to systemic risk.

<sup>43</sup> See, for example, an empirical work by Ellul et al. (2014), who illustrate our point in the case of accounting rules. Mark-to-market in contrast to historical cost accounting might increase the risk of a fire sale during a crisis, but it leads to more prudent behavior by insurers in advance.



A final contribution of this article is that we systematically searched the extant literature for open research questions on the topic of systemic risk and discovered that there is ample room for future research. In our opinion, the currently most important research strands can be sorted into three types: (1) the definition of systemic risk, (2) systemic risk measures, and (3) the regulation of systemic risk in the financial services industry.

In the literature, there is still no common understanding of systemic risk (for an overview, see Table A1 in Supporting Information). In this article, we argue that the starting point should be the financial crisis, and we provide a framework for how to think about a definition of systemic risk. Our argument is that the entire systemic risk discussion is based on the goal of preventing such a crisis from ever occurring again. Therefore, it would be helpful if the scientific community could agree on a definition of the risks that led to this disaster. Accomplishing this first step would be of benefit for the next step of designing an appropriate systemic risk measure.

Currently, as shown in “Systemic Risk Measures,” too many issues regarding these measures remain open. For example, in which cases is the application of a systemic risk measure appropriate? Is it sufficient to rely on stock price information to measure interconnectedness? Does interconnectedness actually capture systemic risk in its entirety? Is a macroprudential systemic risk measure, a measure that would indicate, for example, when the overall systemic risk level in the financial system is high, necessary? How can the quality of systemic risk measures be assessed? In our opinion, the vast number of measures and the fact that a certain measure is sometimes used for measuring systemic risk contribution and sometimes for measuring vulnerability indicates that more research in this area is needed.

With regard to regulation, the major research question that remains to be answered is how regulation can be designed to mitigate systemic risk. This issue is currently under discussion, and to date, no consensus has been reached. Additionally, a question that is not thoroughly considered in the literature is whether new regulation (e.g., Solvency II) might contribute to systemic risk, as is sometimes discussed in academia and practice (see, e.g., Eling et al., 2008). In particular, the International Monetary Fund (2007) argues that regulatory convergence can decrease the variety of applied risk models and discourage contrarian behavior in times of crisis. Consequently, regulatory regimes might destabilize the financial system.

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### **SUPPORTING INFORMATION**

Additional Supporting Information may be found in the online version of this article at the publisher's website:

**Table A1:** Definitions of systemic risk in the literature and from the perspective of industry organizations and regulatory bodies.

**Table A2:** Papers on systemic risk in insurance.