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

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Abstract: This paper reviews the extant research on systemic risk in the insurance sector and outlines new areas of research in this field. We summarize and classify 43 theoretical and empirical research papers from both academia and practitioner organizations. The survey reveals that traditional insurance activity in the life, non-life, and reinsurance sectors neither contributes to systemic risk, nor increases insurers' vulnerability to impairments of the financial system. However, non-traditional activities (e.g., CDS underwriting) might increase vulnerability and life insurers might be more vulnerable than non-life insurers due to higher leverage. Whether non-traditional 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, providing financial guarantees, and short-term funding. This paper is of interest not only to academics, but is also highly relevant for the industry, regulators, and policymakers.

Keywords: Systemic Risk; Insurance; Solvency II; Financial Crisis

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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 reports have been issued by regulators and industry think-tanks. Recently, the Financial Stability Board (FSB) published a list of nine global systemically important insurers and intends to implement several special policy measures for these institutions by January 2019.¹

A more detailed review of the work already done on this topic and a look at 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. A structured review can identify those activities and the situations under which they may be cause for alarm. Second, the literature shows mixed results regarding systemic risk, for example, in the case of reinsurance, which calls for a structured review of what has been studied to date and what remains to be done to settle this issue.

This paper 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 more research. The survey is intended to enhance understanding of systemic risk in the insurance sector and also motivate more research in this field. The literature indicates that policymakers and regulators need to closely analyse systemic risk, especially with respect to non-traditional insurance activities.

The remainder of the paper is organised as follows. We start by discussing the definition and classification of systemic risk as well as 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. After that we investigate whether banking

¹ 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 make to recommendations for addressing systemic risk.

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 kinds of nodes (financial institutions and non-financial actors having business relations with financial institutions) and edges (business activities).² To identify the origins of a possible impairment and the contributors to systemic risk, one can focus on the nodes, the edges, or both.

Regulators focus on the nodes and try to identify those institutions most likely to cause an impairment of the financial system. As a regulatory response to the financial crisis, the FSB initially suggested three criteria for evaluating whether a financial institution is systemically relevant: *size*, *interconnectedness*, and *substitutability*.³ According to the FSB/IAIS, these criteria should be used to identify companies, not business activities, which can impair the financial system.⁴

Another branch of the literature focuses on the edges of the network, or the business activities of institutions, in attempting to identify possible origins of financial system impairment (see Geneva Association, 2010a). We follow this strand of literature, arguing that it is the more appropriate approach for regulatory purposes and for understanding systemic risk of the financial industry.

From a regulatory perspective, business activities should be considered because otherwise regulatory arbitrage—the migration of risky business activities from highly regulated institutions to less regulated ones—is likely. Market distortions can occur because distressed systemically important financial institutions (SIFIs) are likely to be bailed out and therefore have a competitive advantage over non-SIFIs (see, e.g., Keller, 2011; Kessler, 2013).

² See, e.g., Anand et al. (2013).

³ Subsequently, the FSB (2009) and IAIS (2013a) added *global activity* and *non-traditional insurance* to this list.

⁴ Recently, nine insurance companies and 28 banks were identified as systemically important financial institutions (SIFIs); see FSB (2012, 2013a).

When it comes to understanding systemic risk, the activity-based view also has advantages because, in most cases, it is not the whole institution that contributes to systemic risk, but only certain of its activities.⁵ Furthermore, applying the systemic risk criteria to institutions can be misleading. For example, the *size* of an insurance company does not necessarily increase systemic risk if the company has a well-diversified underwriting portfolio. In fact, the insurance company business model is based on the underwriting and pooling of uncorrelated idiosyncratic risks. As long as the size of a certain business line is not the result of risk concentration, but instead a manifestation of the law of large numbers, there should be no increased potential for systemic risk (see, e.g., IAIS, 2011, 2012a; Kessler, 2013).

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. If the financial system is thought of as a network, it is plausible that both nodes (institutions) and edges (business activities) can be vulnerable.

In the remainder of the paper, 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 that are most vulnerable to impairment.⁶

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.⁷ We reviewed 26 definitions of systemic risk and identified three important elements:

⁵ For example, the AIG financial services division was not regulated by the framework applicable to insurers despite its very risky business model. Only the much less riskier parts of AIG were subject to insurance regulation, and thus the company’s severe systemic risk was not visible. See Harrington (2009), Brady (2009), and Acharya et al. (2011).

⁶ 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, as well as business activities. Our approach is also employed by others, for example, Klein (2013).

⁷ Note that according to risk theory, the term ‘risk’ is misleading since it implies that the probability of the occurrence of an event is measurable and exactly known. In contrast, ‘uncertainty’ implies that the

- **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.⁸
- **Impact of the event:** Most definitions specify the consequences if the event occurs, which is usually that the real economy is negatively affected.
- **Causation of the event:** Some definitions require the risk to have a certain causation before it is labelled systemic. These causations can be general in nature and/or specific⁹ and are mostly related to the financial services sector.

The variety of definitions makes obvious the enormous difficulty involved in differentiating between cause, impact, and events when discussing systemic risk.¹⁰ Thus, it is not surprising that, to date, no agreement on *the* definition of systemic risk has been reached.¹¹ However, most of the definitions considered in this paper refer to the 2008 financial crisis,¹² and it thus might be useful to look at the events of 2008 as a means of differentiating systemic risk from other risks.

- **Event:** Certain financial services became unavailable (e.g., inter-bank lending) or had virtually no market (e.g., credit).
- **Impact of the event:** As a consequence, there was a substantial negative effect on the economy.

probability of the occurrence of an event is not measurable and not exactly known. Most scholars base their definition of uncertainty and risk on Knight (1921). See, e.g., Tversky and Kahneman (1992), Camerer and Weber (1992), and Zweifel and Eisen (2012). In the following, for the sake of simplicity, we use the term ‘risk’ as it is used in the systemic risk literature.

⁸ The first two aspects refer to financial services; the latter event 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, e.g., Allen and Wood (2006), European Central Bank (2013), and Federal Reserve Bank of Cleveland (2013).

⁹ Klein (2011) 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.

¹⁰ 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 default of institutions is the event or the causation of an event.

¹¹ See, e.g., Liedtke (2010) and Dwyer (2009) for a critical discussion of several definitions of systemic risk.

¹² See, e.g., Bach and Nguyen (2012), Billio et al. (2012), and Rodríguez-Moreno and Peña (2013).

- **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 became impaired as well.

An appropriate definition should encompass all risks that can lead to the reoccurrence of the 2008 crisis and exclude all others. It is this last point that is usually ignored in many studies. An exception is the concept of systemic risk proposed by De Bandt and Hartmann (2000), which distinguishes 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 impaired due to the shock). In these authors' view, only when most institutions or markets would be affected indirectly and fail is the risk systemic. In addition, Harrington (2009) distinguishes systemic risk from the risk of common shocks. According to him, only the risk of an event that involves 'interdependency-transmitted contagion' should be labelled systemic. In general, we argue that a systemic risk definition should be judged against the following criteria:

- **Risk of an event:** The definition should address the dysfunction of financial services. Mandating that the event must involve simultaneous default of institutions or contagion effects would result in too narrow a definition of systemic risk, since such events can conceivably occur without the financial services sector becoming dysfunctional.
- **Impact of the event:** The definition should include that the event has to cause a substantial negative impact on the real economy. The term 'substantial negative impact on the real economy' is important since 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) points out, the risks of wars, floods, and diseases would also be systemic risks, making the definition too broad to be useful.

- **Causation of the event:** Likewise, unless causation of the risk is included, the definition will again be too broad. For example, without putting some limits on ‘causation’, the risk that the regulator will issue a regulation that impairs financial services with the consequence that the real economy is affected could be labelled a systemic risk. However, the limits on causation must not be too narrow either. For example, some definitions only consider as systemic the risk of a certain event caused by the impairment of a few institutions that starts a chain reaction (e.g., Csiszar, 2002; Adrian and Brunnermeier, 2011; Billio et al., 2010, 2012). However, these definitions fail to consider the situation where one shock affects the entire financial services industry. Basically, it is important that the definition makes clear that systemic risk emerges within the financial system. For a more detailed discussion of system-wide shock versus contagion, see ‘Types of Impairments’ in the Appendix.

Systemic Risk Measures

There is no common definition of systemic risk, so there is no standard for systemic risk measures and the literature cannot agree on one specific measure.¹³ Broadly, there are two strands of literature, one dealing with macro- and the other with microprudential systemic risk measures. Macroprudential measures attempt to assess systemic risk at the level of the whole economy; microprudential measures are used to discover individual institutions that contribute most to systemic risk or are especially vulnerable to an impairment of the financial system. The studies we reviewed for this paper focus on microprudential measures. The most common measures are shown in Table 1.

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

Systemic Risk Measure	Description	Focus	Reference
BANKBETA	Measures linkages between stock returns and the portfolio returns of the banking sector.	Interconnection between institutions (interdependence)	Chen et al. (2013)
Δ CoVaR	Measures the impact of a certain institution's distress on the value at risk of the financial system.	Interconnection between institutions (contagion)	Adrian and Brunnermeier (2011)
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. (2014)
LTD (lower tail dependence)	Measures the probability that an observation of stock returns' joint distribution will lie in the distribution's lower tail.	Interconnection between institutions (contagion)	Wei et al. (2012)
Granger-causality networks	Measures Granger-causality between the stock market returns of institutions.	Interconnection between institutions (interdependence)	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 et al. (2012b)
SRISK	Measures the capital a company needs if there is a crisis.	Shortfall in times of crisis	Acharya et al. (2012a)

Table 1: Systemic risk measures applied to the insurance sector

BANKBETA, Δ CoVaR, LTD, and Granger-causality networks focus on the interconnection of institutions in normal times (interdependence) as well as in times of crisis (contagion). They are based on the assumption that the institutions that are highly interconnected contribute most to systemic risk. Naturally, the studies endorsing these measures use a definition of systemic risk that focuses on contagion effects.¹⁴ LRMES, MES, and SRISK (and, to a certain extent, 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 consider interrelations between institutions as crucial for systemic risk.¹⁵ Some differences in the literature are due to the definition of systemic risk used and the measure employed to measure it, as we show in the following section. Generally, though, the first group of measures assesses contribution to systemic risk, whereas the second one assesses the vulnerability of an institution (see Chen et al., 2013; Cummins and Weiss, 2013; Wei and Mhlnickel, 2014).

Nevertheless, even if the characteristics of the systemic risk measures are kept in mind there is still plenty of room for improvements. The most fundamental criticism is presented by Benoit et al. (2013). They argue that Δ CoVaR, MES, and SRISK have no advantages over

¹⁴ See Chen et al. (2013), Adrian and Brunnermeier (2011), and Billio et al. (2012). Summaries of these authors' understanding of systemic risk are set out in Table A1 in the Appendix.

¹⁵ See, e.g., Acharya et al. (2011).

traditional market risk measures. For a U.S. sample of 2,000 financial institutions they show that identifying systemically important institutions by ΔCoVaR 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 only provide information about the *relative* contribution to 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 which is no. 28 in line could be cause for concern.

Systemic Risk in the Insurance Sector

One of the first institutions hit by the financial crisis was AIG. Several bailout programs were instituted to prevent its insolvency. AIG received the first rescue funds in September 2008 and by July 2009, US\$135 billion had been spent on the company.¹⁶ Against this background, it is reasonable to ask whether and, if so, to what extent insurers and their business activities contribute to systemic risk.¹⁷

We thus discuss the different business activities of insurance companies and look at how certain activities contribute to systemic risk. Furthermore, we evaluate which business activities and which kinds 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 organisations 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 take an industry perspective, whereas peer-reviewed journal articles are usually more neutral, seeing as they typically are written by independent academics and undergo independent review before publication. We put most weight on the findings from the peer-reviewed journal articles, but think it is important to also present the results of industry studies.¹⁸ Where our results are based on work coming from an industry perspective, we explicitly mention this fact so that this report is as unbiased and neutral as possible. To make sure that all relevant studies are included, we used a search strategy based on Biener and Eling (2012).

¹⁶ See Harrington (2009).

¹⁷ Harrington (2009) and Baranoff (2012) show that the AIG bailout is not a good case for studying the systemic risk contribution of a standard insurer, since traditional insurance activities were not responsible for the crisis. In this paper we identify more generally which business activities do or do not contribute to systemic risk and increase vulnerability to impairments of the financial system.

¹⁸ Of course, authors of peer-reviewed journal articles also might take an industry perspective, e.g., Kessler (2013), who is CEO of the insurance company SCOR.

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), Kessler (2013), Chen et al. (2013a), Weiß and Mühlnickel (2014), Cummins and Weiss (2014), Engle et al. (2014), Berry-Stölzle et al. (2014), Park and Xie (2014)
Working papers	Radice (2010), Cummins and Weiss (2013), Grace (2011), Harrington (2011), Cummins et al. (2012), Neale et al. (2012), Jobst (2012), Weiß et al. (2013), Weiß and Mühlnickel (2013), Grace et al. (2013), Chen et al. (2013, 2013b), Baranoff et al. (2013)
Books/chapter in books	Acharya et al. (2011), Klein (2013)
Reports by international government organisations/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)

Table 2: Reviewed studies on systemic risk in insurance classified by source

Table 3 provides an overview of insurance activities and their systemic risk potential. The structure of the table is similar to that employed by the IAIS in classifying insurance activities (see IAIS, 2011) and by the Geneva Association (2010a).¹⁹ In our view, insurance activities are either related to underwriting or funding and investing processes. We define as underwriting related all activity that has as its purpose in 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 non-life risks as underwriting, but also reinsurance and all kinds of alternative risk transfer products.²⁰ We define funding and investing processes as all activities with the purpose of increasing investment income and ensuring that liabilities are met. This includes not only investment of premium income and asset liability management (see, e.g., Rejda and MacNamara, 2014, chapters 6 and 7; Zweifel and Eisen, 2012, chapter 1.4), but also profit-enhancing activities as described by the Geneva Association (2010a, chapter 3.4.1).²¹ Furthermore, we differentiate business activities according to their degree of innovation, thus classifying them as either traditional or non-traditional insurance business. This classification is not always clear cut but, in general, we consider an activity to be traditional when its accompanying risks are mostly (a) idiosyncratic, (b) not correlated with each other, and (c)

¹⁹ It is important to note that the classification of insurance activities in Table 3 is not meant to be a final assessment, but more a framework for evaluating the systemic risk of insurance. Therefore, the classification of a certain activity could be arguable; for example, compare IAIS (2013b).

²⁰ Compare with Rejda and McNamara (2014, chapter 6), who distinguish between underwriting and reinsurance. Using their framework, we consider all risk transfer activities as underwriting within life insurance, health insurance, and property and liability insurance, as well as reinsurance.

²¹ The non-insurance activity of CDS underwriting, as mentioned by IAIS (2011), belongs, according to our definition, to the underwriting processes, whereas capital market business, banking, and third-party asset management are funding and investing processes.

not influenced by economic business cycles (see IAIS, 2012b).²² 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 the Appendix. 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.²³

We already mentioned some limitations of systemic risk measures and why the results of studies using these measures are contentious. Before discussing the literature in detail, it seems worthwhile to point out another general shortcoming of all empirical studies we reviewed: the considered time horizons are very short. For example, no empirical study takes the time of the Great Depression in the United States during the late 1920s and early 1930s into account. This is understandable, given data availability issues, but in order to make assessments about infrequent events like systemic crises, one needs to look across centuries, not just decades.²⁴

²² 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 non-traditional since they are influenced by the economic business cycle. In this context, we also discuss modern variable annuities with different types of guarantees.

²³ In Table A2 we also categorise the papers according to the methodology employed. Most papers are qualitative discussion papers (27 papers), but some take a quantitative approach (16 papers). For the quantitative papers, we explain the underlying methodology in more detail, i.e., the use of event studies, systemic risk measurement calculation, or regression analysis.

²⁴ Basically, we share the opinion of Taylor (2012).

Pro- cess	Business Activity		Systemic Risk Contribution	Company's Vulnerability	Rationale & Source
Underwriting	Tra- ditional	Life <ul style="list-style-type: none"> Life insurance Annuities Non-Life <ul style="list-style-type: none"> Health insurance Property & casualty insurance Liability insurance Legal insurance Reinsurance 	Very low (all studies agree there is no systemic risk contribution)	Very low (there is no study arguing that non-market risks are influenced by an impairment of the financial system)	<ul style="list-style-type: none"> Between life, non-life sector, and banks, interconnectedness (counterparty credit risk/cross-holdings) is low; between reinsurance companies and primary insurers, the relation is hierarchical (e.g., Zufferey, 2000; Baur et al., 2003; Trichet, 2005; Baluch et al., 2011; IAIS, 2011, 2012b; Cummins and Weiss 2013; Grace et al., 2013; Kessler, 2013) 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) 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, 2013) Cash outflow if loss events occur is slow (e.g., Cummins and Weiss, 2014; Jobst, 2012; Kessler, 2013) Entry barriers are low and classical insurance activities are substitutable as long as 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) 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, p. 10; IAIS, 2012b) Studies show that bankruptcies of reinsurers would not lead to market failure (e.g., van Lelyveld et al., 2011; Park and Xie, 2014) Insurance is a necessary function for the economy (Bach and Nguyen, 2012), but individual insurance companies are substitutable (e.g., IAIS, 2011; Jobst, 2012)
	Non-Tra- ditional	Life <ul style="list-style-type: none"> Annuities with guarantees/variable annuities Group annuities Separate accounts Non-Life <ul style="list-style-type: none"> Credit insurance Financial guarantees CDSs/CDOs 	Medium (most studies agree there is a systemic risk contribution)	High (except for credit insurance, studies agree that these activities increase vulnerability)	<ul style="list-style-type: none"> Life products with guarantees might exacerbate a crisis if assets have to be sold during a downturn (Geneva Association, 2011) Systemic risk measures give some indication that group annuities and separate accounts might create systemic risk (Cummins and Weiss, 2013) Credit insurance has no direct liquidity impact and has very limited volume (e.g., Baur et al., 2003; Geneva Association, 2010a) Financial guarantees impose market risk on insurance companies and can have a direct liquidity impact; they thus increase vulnerability to financial crisis (e.g., Geneva Association, 2010a; IAIS, 2010; Cummins and Weiss, 2013, 2014; Chen et al., 2013) CDSs/CDOs have direct liquidity impact and make the selling party vulnerable to systemic crisis <ul style="list-style-type: none"> Majority view: contribution to systemic risk because CDS buyer faces counterparty risk if 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) Minority view: no contribution to systemic risk because if CDS seller defaults, CDS buyer does not face direct liquidity impact (e.g., Radice, 2010; Wallison reported by Harrington, 2009; cf. Harrington, 2011)
Funding & Investing	Tra- ditional	Life, Non-Life, Reinsurance <ul style="list-style-type: none"> Premiums funding Asset liability management & hedging Liquidity management Insurance-linked securities (catastrophe bonds) 	Very low (all studies agree there is no systemic risk contribution)	Medium (studies agree, that except for catastrophe bonds, these activities are vulnerable; however, the risks are very manageable)	<ul style="list-style-type: none"> Premiums are paid upfront for contingent claims; no risk caused by maturity mismatches (e.g., Trichet, 2005; Cummins and Weiss, 2014; Kessler, 2013) Contingent claims prohibit fire sale of assets in case of an insolvency (e.g., Cummins and Weiss, 2013; Kessler, 2013) In contrast to banks, insolvencies of insurers are lengthy and orderly processes (e.g., IAIS, 2009, 2010; Geneva Association, 2012) Relatively high equity levels in non-life and reinsurance; life insurers are more vulnerable to crisis due to higher leverage (e.g., Harrington, 2009; Chen et al., 2013b) 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, 2013); also, life insurers would have enough liquidity without the need to sell assets (Baranoff et al., 2013) Even during the financial crisis, external funding was available for life insurers (Berry-Stölzle et al., 2014) Limited fungibility of liquidity within insurance groups could lead to increased vulnerability in times of crisis (e.g., Radice, 2010; Baranoff, 2012) 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 to diversify and decrease its underwriting risk to catastrophes (e.g., Weiß et al., 2013; Kessler, 2013)
	Non-Tra- ditional	Life <ul style="list-style-type: none"> Securitization of embedded value in upfront paid commissions Short-term funding Non-Life, Reinsurance <ul style="list-style-type: none"> Securities lending Credit rating utilization Industry-loss warranties 	Medium (whether there is a systemic risk contribution is unclear)	High (studies agree that these activities increase vulnerability)	<ul style="list-style-type: none"> 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, 2010; Acharya et al., 2011; Besar et al., 2011; Jobst, 2012); however, it is also argued that securities lending does not contribute to systemic risk since counterparties receive collateral (Baranoff, 2012) There is an interest rate risk for investors if securitized products contain (a) guarantees and/or (b) the discount factor is inadequate (IAIS, 2010, 2012b) 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; Weiß and Mühlhnickel, 2014); however, banks still have a stronger impact on insurers than vice versa (e.g., Grace, 2011; Engle et al., 2014; Chen et al., 2013a); this interrelation is mainly driven by non-traditional insurance activities (e.g., Neale et al., 2012; Cummins and Weiss, 2013) Exploitation of non-regulated subsidies and information asymmetries (e.g., Zufferey, 2000; Harrington, 2009; IAIS, 2010; Acharya et al., 2011; Baranoff, 2012) Not clear whether prices of alternative risk transfer products are uncorrelated with the financial market in times of crisis (IAIS, 2012b) Industry-loss warranties are not linked to an individual loss event, but cover the downturn of a whole industry, which can lead to an increased basis risk and credit risk since there is no collateral (IAIS, 2012b)

Table 3: Evaluation of systemic risk of traditional and non-traditional insurance activities classified according to business processes

Systemic Risk in Traditional Insurance Underwriting

Traditional insurance activities include underwriting life, health, property, accident, liability, and legal risks in the life and non-life sectors, as well as the transfer of risk via reinsurance.

The literature qualitatively assessing the systemic risk of business activities agrees that the systemic risk contribution of traditional *non-life insurance* (property, accident, liability, legal, and, in some jurisdictions, health) is very low due to low interconnectedness within the field and the fact that claims are bound to specific loss events that are in most cases independent from the business cycle. The major argument is that claims settlement can take several years. Thus, these activities contribute very little, if any, 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 as well as in reports by regulators and the industry.²⁶

However, the results from two different strands of the literature cast some doubt on this conclusion. The first strand is represented by Billio et al. (2012) and Chen et al. (2013a). Both studies empirically show that the stock market returns of life as well as non-life insurers and banks have become more correlated in recent years. Billio et al. (2010) use monthly returns data from the 25 biggest U.S. hedge funds, brokers, and banks, as well as insurers, and test pairwise for Granger-causality. Basically, Chen et al. (2013b) 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 Distressed Insurance Premium (DIP) measure. Both studies find that banks and insurers are interdependent, but that shocks in the banking industry affect insurers much more than vice versa. Thus, banks seem to contribute to systemic risk but insurers do not.

The second strand of literature calculates systemic risk measures directly for insurers. For example, Weiß and Mühlnickel (2013) apply LTD (lower tail dependence) as a systemic risk

²⁶ See, e.g., Trichet (2005) and Cummins and Weiss (2014) (peer-reviewed journal articles), IAIS (2011) (regulator report), and Geneva Association (2010a) (industry association report).

measure in an attempt to discover whether insurance mergers increase the contribution to systemic risk of an insurer. The authors only find 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 increased systemic risk contribution due to M&A activities in the insurance sector. Furthermore, Cummins and Weiss (2013) and Weiß and Mühlnickel (2013) show that, based on SRISK and MES, insurers are vulnerable to impairments of the financial system. However, these findings do not really contradict the results mentioned above because they focus on insurance companies, not specific business activities. Indeed, both studies conclude that the increased vulnerability is due to non-traditional insurance activities.

The Geneva Association (2010b) and Klein (2012), as well as Cummins and Weiss (2013, 2014), argue that there is no systemic risk from *life insurance* or annuities, either. 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.²⁷ This is a convincing argument 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 pointing out 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 does 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. This view, in principle, is shared by the IAIS

²⁷ See Geneva Association (2012), Harrington (2011), and Oxera (2007).

(2012a), which assesses global systemically important insurers and puts only minor weight on traditional life and non-life underwriting activities.

Cummins and Weiss (2014) and Baluch et al. (2011) are more critical of *reinsurers* and mention that the reinsurance market is highly concentrated. There is high interconnection among reinsurers and between reinsurers and insurance companies. They argue that there is a danger of a retrocession spiral. Premiums are not only ceded between primary insurers and reinsurers, but also within the reinsurance industry and 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, typically, can be cancelled in such circumstances. This argument is presented by Park and Xie (2014), who show that up- and downgrades of reinsurers' ratings have an effect on primary insurers' ratings as well. 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 there is no contribution to systemic risk by reinsurers. Furthermore, Kessler (2013), too, argues that reinsurance does not contribute to systemic risk, since primary insurers diversify their counterparty risk to reinsurers. In addition, he states that retrocession spirals are unlikely due to a hierarchal market structure between reinsurers and primary insurers. This reasoning is in accordance with that of the IAIS (2012b) and the conclusions of a study by Swiss Re (see Baur et al., 2003). However, to our knowledge, there are no academic studies analysing such a hierarchical market structure. Cummins and Weiss (2013) argue that the failure of reinsurance companies could lead to problems within the insurance industry due to the connections between reinsurers and primary insurers, but they agree that reinsurance does not contribute to systemic risk since reinsurers 'are not sufficiently interconnected with non-insurance institutions'.

In this context, the question arises as to whether unavailability of insurance coverage is a systemic risk in the sense that the real economy is affected. The answer to this question is one on which academic studies, regulator reports, and industry association reports all agree and goes as follows.²⁸ As long as the risk is quantifiable, insurance companies and their products are substitutable by other market participants and products, for example, by catastrophe bonds, due to low market entry barriers. Also, insurance coverage can be created within a certain industry in the form of a self-insurance cooperative.²⁹ Furthermore, as long as 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 where the whole 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 since a link to the financial system is necessary for systemic risk.

Systemic Risk in Non-Traditional Insurance Underwriting Activities

As non-traditional 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 non-life sector, we classify credit insurance, financial guarantees, and financial derivatives underwriting as non-traditional activities.

Klein (2013), Cummins and Weiss (2014), IAIS (2011), and Grace (2011) point out that some aspects of guaranteed annuities could increase the issuing company's vulnerability in

²⁸ See, e.g., Cummins and Weiss (2014) (peer-reviewed journal article), Radice (2010) (working paper), IAIS (2012a) (regulator report), and Geneva Association (2010b) (industry association report).

²⁹ An example 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).

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 the 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 cancelled. Nevertheless, the Geneva Association (2010b) argues that the insurance products were in fact saving accounts—cash could be withdrawn and the contracts cancelled any time without any fee or discount. In addition, Cummins and Weiss (2013) provide further evidence throwing some doubt on the conventional wisdom that cancellations of policies are unlikely. They employed the systemic risk measure SRISK and discovered 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 since 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 as mentioned above, it could be argued that life insurance products containing annuities with options or guarantees can indeed increase the vulnerability of an insurer.

Another critical aspect is the rate of return on guaranteed annuities, as pointed out by Radice (2010). 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 happened only to a few insurance companies since 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, that of the Japanese insurance company Nissan Mutual Life and Equitable Life in Great Britain, declining interest rates and unhedged, guaranteed annuities caused substantial financial distress for the companies. However, neither case triggered a systemic crisis.

In the non-life segment, the area of *credit protection* can be divided into three categories: credit insurance, credit guarantees, and derivatives (especially credit default swaps (CDS)). In the case of credit insurance, two industry studies—Baur et al. (2003) and Geneva Association (2010a)—argue that in contrast to CDS underwriting, substantial reserves must be held on the balance sheet for loss events and 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 a weak interconnection 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 as well as structured finance products. The interconnection 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 since 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, as well as contract cancellations. This argument finds support in an empirical study by Chen et al. (2013), which calculates BANKBETA and MES for a broad range of U.S. insurers underwriting CDS. They find that according to both measures, systemic risk levels for financial guarantee insurers exceed those of property-casualty insurers. In

addition, they evaluate whether the measures can explain the stock market returns of insurers during the financial crisis. Their results show that the explanatory power of both measures in the case of financial guarantee insurers exceeds the one for property-casualty insurers. Therefore, conditional on the appropriateness of these particular systemic risk measures, it can be assumed that financial guarantees increase the contribution to systemic risk as well as the vulnerability of institutions.

The most common credit derivative is the credit default swap.³⁰ 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 the entity mentioned in the contract goes bankrupt. To buy a CDS relating to a certain entity, one need not have a claim against the entity itself.³¹ The purchaser of a CDS, however, is exposed to the risk that the counterparty cannot meet its obligation in the event 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.³²

We found no disagreement by academics, regulators, or from the industry that CDS underwriting, at the very least, increases vulnerability to impairments of the financial system. When it comes to 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

³⁰ There is controversy over whether CDS qualify as insurance or are, instead, another type of capital market product. See, e.g., NAIC (2000), Schwartz (2007), and Acharya et al. (2011). In the context of this paper, the question is of minor relevance. What matters is that the insurance sector in total underwrites more CDS than it buys for hedging (see Barrett and Ewan, 2006) and in no paper have CDS been considered a form of traditional insurance.

³¹ Short selling and/or buying uncovered CDS on sovereign debt was forbidden temporarily during the peak of the financial crisis in order to prevent speculation on sovereign debt in many countries. Since then, regulation of the CDS business has become stricter, especially with regard to sovereign debt; see, e.g., regulation of the European Parliament and European Council (2012).

³² CDS can be designed so that there are immediate, realizable losses and not only margin calls. For example, Swiss Re had to realize 1.2 bn CHF in 2007 due to underwriting CDS protecting MBS from rating downgrades (see Swiss Re, 2008).

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 defaulting CDS would have a huge impact on counterparties. In a qualitative scenario analysis, he, too, argues that the systemic risk contribution of CDS can be easily mitigated by diversifying the counterparties.

In contrast, Heyde and Neyer (2010) build a banking model with and without CDS and compared 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 effect. They find that CDS 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 is in line with the majority of academic papers and reports by regulators and the industry agree that the failure of a CDS underwriting entity would trigger a chain reaction that could impair the entire financial system.³³ This assessment is based on the size of the CDS business, its interconnectedness with the whole financial sector, the short time it takes for an impairment caused by a CDS default to evolve, and the non-transparency of the CDS business.³⁴

The U.S. Financial Stability Oversight Council (see FSOC, 2012) provides a different perspective on CDS. It argues that institutions can be systemically relevant also, by being

³³ Regarding the AIG bailout, Bernanke is reported by Brady (2009) in *The Washington Post* to have said: ‘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).

³⁴ See, e.g., Baluch et al. (2011) and Cummins and Weiss (2014) (peer-reviewed journal articles), IAIS (2011) (regulator report), and Geneva Association (2010a) (industry association report).

reference entities if the notional volume is in excess of \$30 billion. Unfortunately, we found no study that further elaborates this point with regard to insurance companies.

Systemic Risk in Traditional Insurance Funding and Investing Activities

Traditional funding and investing activities of insurance companies include collecting upfront premiums for underwriting risks and asset and liability management, as well as liquidity management. In addition, insurance-linked securities, specifically, catastrophe bonds, are considered traditional.

In the literature, there is agreement that the business model based on collecting upfront premiums for bearing risks that can lead to contingent claims is a very stable one and ensures sufficient liquidity. Therefore, an ‘insurance run’ is not possible in the non-life sector and a fire sale of assets that could have a systemic impact is unlikely.³⁵ Furthermore, regulators might anticipate the risk of fire sales and automatically relax capital requirements during a crisis (indeed, just such a procedure is expected to be included in the forthcoming Solvency II regulation).³⁶ The opposite situation, that is, long-term liabilities and short-term assets, increases insurers’ exposure to interest rate risk and their vulnerability as well. However, the Geneva Association (2010a) claims that insurance companies use ‘assets and derivatives to replicate insurers’ liability profiles and match their expected claims’. This industry view that there should be no maturity mismatch is supported by Cummins and Weiss (2014), who analyse the balance sheets of U.S. non-life and life insurers 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 non-life and reinsurance, as reported by Harrington (2009) and Cummins and Weiss (2013). When it comes to life insurers, however, Harrington

³⁵ See Geneva Association (2010b) (industry association report), Eling and Schmeiser (2010) (peer-reviewed journal article), Lehmann and Hofmann (2010) (peer-reviewed journal article), and IAIS (2011) (regulator report).

³⁶ See Article 106 in the Directive 2009/138/EC of the European Parliament and European Council (2009).

(2011), 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 only hold 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 impairment of the financial systems than that of non-life insurers because of contract duration. Life insurance is long-tail business and involves contracts spanning decades. In contrast, non-life 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. (2013b), who calculate the systemic risk measures SRISK and MES via a copula approach and discover that life insurers are much more affected by economic downturns than are non-life 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 small since life insurers maintain a level of liquidity adequate to deal with stressful situations. Simulations based on historical lapse rates show that life insurers need not sell assets before maturity in order fulfil their obligations. Even in a worst-case scenario in which 10 times the normal number of policies is cancelled, the volume of assets that needs to be sold before maturity makes up only a small fraction of the bond market. This line of reasoning is supported by Berry-Stölzle et al. (2014), who show that during the subprime crisis, life insurers' access to external capital was not endangered and TARP funds for life insurers were unnecessary. By using regression analyses, they show that the reasons for issuing new capital—compensating for operational losses or funding growth opportunities—were the same during the subprime crisis as during the normal period

between 1999 and 2010. 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: fungibility of liquidity in globally operating insurance conglomerates. As Radice (2010) argues, in the event of a crisis, ring-fencing of subsidies by local regulators in an effort to protect local policyholders could lead to an 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), however, stress that guarantees made within different judicial entities in 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 non-insurance, non-regulated entities.³⁷

Like the IAIS (2013b), we regard *insurance-linked securities* (ILS) as a traditional insurance funding and investing activity as long as the underwritten risks are (a) idiosyncratic, (b) not correlated with each other, and (c) not influenced by economic business cycles. The most common ILS are catastrophe bonds and the literature agrees that they are not systemically relevant. Basically, these products use the financial markets to further diversify the underwriting risk of events like pandemics or hurricanes among a wider group of investors. A study by Cummins and Weiss (2009) shows that returns on catastrophe 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 crisis. This view is supported in a recent study by Weiß et al. (2013). The authors relate the issuing of cat bonds to systemic risk measures and find that cat bonds have no statistical impact on SRISK or ΔCoVaR . Finally, Kessler (2013) and IAIS (2011, 2012b) point out that

³⁷ See also the scenario mentioned by the Geneva Association (2012).

the volume of cat bonds is currently still relatively 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, 2011) argues that policyholders are risk sensitive and prefer to deal with 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.³⁸ Nevertheless, one should not be overconfident that market discipline works in all cases. For example, as Drake and Neale (2011) argue, it was possible for financial guarantee insurers to hide substantial risk exposures in special purpose vehicles outside of the balance sheet.

Systemic Risk in Non-Traditional Insurance Funding and Investing Activities

We consider the securitization of upfront commission payments, securities lending, and credit rating utilization, as well as short-term funding via issuing commercial papers, as non-traditional funding and investing activities. These activities can be undertaken by life, non-life, and reinsurance companies.

According to the IAIS (2012b), securitization of upfront commission payments exposes the investor to substantial interest rate risk via implied guarantees, insurance risks, and market risk. However, these business activities do not contribute to systemic risk—at least not yet—since their outstanding volume is marginal compared to other asset-backed securities.

As mentioned above, it is usually 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 to this if short-term financing is used as the primary form of funding. Two profit-enhancing methods, if used excessively, can increase the

³⁸ Empirical evidence for this reasoning is provided by Epermanis and Harrington (2006). They show for U.S. property-casualty insurers 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.

systemic risk contribution of insurers as well as make them more vulnerable to impairments of the financial system:

- ‘Securities lending’, which is when the insurance company lends its long-term securities to other market participants and therefore receives collateral. The received money is typically invested in short-term assets.
- ‘Credit rating utilization’, which involves borrowing money as long as the credit rating is not endangered. Again, the additional capital is invested in short-term assets.

Both methods increase the insurance company’s liquidity risk and can lead to a situation in which a fire sale of assets becomes necessary in order to meet obligations. When the financial market is already in distress, these particular activities can aggravate the situation, especially if many insurers engage in them. Acharya et al. (2011) point out that securities lending per se need not be a risky activity as long as the collateral is invested in safe assets with a shorter duration than the securities that are borrowed by other institutions. In contrast, AIG engaged in very aggressive securities lending and this was one reason why 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 probably in general will not contribute to systemic risk: market practice normally requires 120% of the value of the security as cash collateral from the borrower. However, AIG as the lender in the end had to post collateral, too, and so the borrower took no risk. In the event of an AIG bankruptcy, the borrower could have just sold the borrowed securities and 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 turned instead to the Federal Reserve Bank of New York for funding.

Finally, the Geneva Association (2010a) sheds light on another practice that can contribute to systemic risk and increase vulnerability to impairments of the financial system: relying extensively on short-term funding via issuing commercial papers could lead to the necessity of selling assets before maturity. One should keep in mind, though, that this is a highly unusual practice for standard insurance companies. Effectively, this issue illustrates why one should not focus on the company level, but 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 non-traditional insurance activities. These warranties are not linked to an individual loss event, but cover the downturn of an entire industry. According to IAIS (2012b), these products can pose an increased basis and credit risk since there is no collateral requirement. With the exception of the case of catastrophe 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 insurance-linked securities related to life insurance could be strongly connected to interest rate and credit risk as well.

Thus, in principle, all non-traditional 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 remaining question is whether regulatory requirements designed to mitigate systemic risk should be the same for banking and insurance sectors. Basically, there are three lines of thought on this question.

First, *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 to be 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).

Second, *no systemic risk, no additional regulation*. If one argues that insurance does not contribute to systemic risk, then, of course, there should not be any additional regulation. No paper so far argues such an extreme view, but it would be the natural conclusion of the papers finding no systemic risk contribution from non-traditional insurance activities.

Third, *market discipline is the key*. As discussed above, market discipline is strong in the insurance sector and policyholders, brokers, and agents, as well as other intermediaries, monitor insurance companies. According to this line of thought, well- intended regulatory initiatives can easily have a bad outcome, for example, if regulation becomes more intense, but undermines market discipline. Harrington (2004, 2011) is sceptical 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 all perspectives are valuable as long as they are applied to activities rather than to institutions. We argue in favour of the principle: *same business, same risks, same regulation*. There is no indication that an improved regulation of AIG's property-casualty division would have resulted in a less severe financial crisis. At the same time, higher capital requirements would have been a good idea for AIG's financial services division as well as for many banks. Therefore, we approve that an activities-based view has entered the policy debate.³⁹ It is important, though, to focus not only on capital requirements but also on transparency. Market discipline can have a beneficial impact only if it is publicly known which business activities are conducted by institutions. In the current discussion, it is sometimes overlooked that it was not only high leverage that was a problem during the crisis, but also the opacity of an institution's risk exposure. Finally, we see no necessity to introduce

³⁹ The IAIS (2014) plans to differentiate between traditional and non-traditional activities in their formula for basic capital requirements.

additional systemic-risk-oriented regulation of traditional insurance activities, since they do not contribute to systemic risk.

Conclusions and Directions for Future Research

In this paper we discuss, and review the extant literature on, systemic risk, a topic of high interest for academics and practitioners in the last few 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 at once.

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, non-life, and reinsurance business contribute very little to systemic risk and do not increase insurer vulnerability to impairments of the financial system. However, certain non-traditional insurance activities do appear to be relevant to systemic risk. The literature agrees that some underwriting activities in the life segment (annuities with guarantees) and in the non-life segment (financial guarantees and CDS) 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 catastrophe bonds) neither contribute to systemic risk nor increase the vulnerability of an institution in times of crisis. With regard to non-traditional funding and investing activities, it is securities lending, short-term funding, and industry-loss warranties that can especially increase vulnerability to impairments of the financial system. However, no consensus has yet been reached as to whether and, if so, to what extent these activities

contribute to systemic risk. Furthermore, there is to date very little work on alternative risk transfer products.

Studies taking 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 non-life insurers. Our review of 30 academic and 13 industry papers reveals that, in general, both groups agree when it comes to systemic risk.

A final contribution of this paper is that we systematically searched the extant literature for open research questions on the topic of systemic risk and, as Table 4 shows, discovered that there is a lot of room for future research. In Table 4, we also include some of our own suggestions for future research on this topic.

Main Issue	Paper	Open Research Questions
Regulation	Vaughan (2009)	<ul style="list-style-type: none"> What is the appropriate trade-off in insurance regulation between ‘checks and balances’ and unnecessary high costs?
	Acharya et al. (2011)	<ul style="list-style-type: none"> CDS are essentially insurance. Is some form of insurance regulation needed for such products?
	Wei and Mhlnickel (2013)	<ul style="list-style-type: none"> What is the impact of divestitures of large insurers on systemic risk in the insurance industry?
	Based on Al-Darwish et al. (2011), Ashby (2011), Keller (2011), and Haldane (2012)	<ul style="list-style-type: none"> How is systemic risk considered in insurance regulation? Do the current regulation frameworks mitigate or contribute to systemic risk? Is regulation arbitrage possible between the banking and the insurance sector? Will the probably higher future capital requirements in the banking and insurance sectors transfer risk to consumers or other market participants?
	Wei and Mhlnickel (2013) Further questions	<ul style="list-style-type: none"> Can differences in global insurance regulation affect an insurer’s systemic relevance? Does the identification of global systemically important insurers lead to an implied bailout guarantee and moral hazard? How can regulation be designed so that it is not procyclical? Banking versus insurance: which regulation leads to stricter capital requirements and does this open the door for regulatory arbitrage?
Traditional Business Activities	Park and Xie (2014)	<ul style="list-style-type: none"> How do insurance companies react when both insurers and reinsurers simultaneously experience a macroeconomic shock?
	Van Lelyveld et al. (2011)	<ul style="list-style-type: none"> What is the impact of a reinsurer’s insolvency on affiliated insurance companies? Could primary insurers be influenced by a reinsurer default in a way other than via credit risks (e.g., reputational risks)?
	Chen et al. (2013a)	<ul style="list-style-type: none"> What is the effect of reinsurer insolvencies if primary insurers are already impaired? Banks contribute to systemic risk. What are the mechanisms through which banking shocks are transmitted to the insurance industry?
	Baluch et al. (2011)	<ul style="list-style-type: none"> The banking and insurance sectors are interconnected, but how and to what extent?
	Further questions	<ul style="list-style-type: none"> How can contagion effects be measured? Are positive correlations in prices sufficient to imply contagion risks?
Non-Traditional Business Activities	Harrington (2009)	<ul style="list-style-type: none"> Did AIG’s CDS portfolios contribute to systemic risk due to contagion?
	Cummins and Weiss (2014)	<ul style="list-style-type: none"> More research is needed about ‘non-core activities of insurers’ and their systemic impact.
	IAIS (2012b)	<ul style="list-style-type: none"> Do non-traditional insurance activities related to the financial markets (e.g., CDS, industry-loss warranties) empirically amplify or contribute to systemic risk?
	Cummins and Weiss (2013)	<ul style="list-style-type: none"> Some studies show increased interconnectedness between banks and insurers. Also, some systemic risk measures are high for insurance companies. Are core or non-core activities causing these results or is it some other characteristic of the insurers?
	Further questions	<ul style="list-style-type: none"> Which of the current systemic risk measures are adequate to measure an insurer’s contribution to systemic risk? Which of the current systemic risk measures are adequate to measure an insurer’s vulnerability to impairments of the financial system? Do alternative risk transfer products contribute to systemic risk?

Table 4: Open research questions

Open research questions can be sorted into three types: (1) regulation, (2) traditional business activities, and (3) non-traditional business activities.

With regard to regulation, the major research question that remains to be answered is how regulation can be designed so that systemic risk is mitigated. This issue is currently under discussion and no consensus has yet been reached. Also, 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 IMF (2007) argues that regulatory convergence can decrease the variety of applied risk models and discourage contrarian behaviour in times of crisis. Consequently, regulatory regimes might destabilize the financial system. Furthermore, how to prevent regulation arbitrage is still an open question.

With respect to traditional insurance activities, studies find that the stock market prices of insurance companies and other companies in the financial services industry are correlated. Nevertheless, more research into the specifics of this interconnection is necessary. To date, it is mainly measured by Granger-causality tests, linear correlation, and principal components analysis. Furthermore, even if, in general, there is agreement in the literature that the potential for systemic risk is very low in traditional insurance activities, indirect contagion effects, such as reputational risks, have not yet been analysed. Also, all studies on reinsurance risk find that traditional reinsurance activities neither contribute to systemic risk nor increase vulnerability, but all this work focuses on single facets of the reinsurance sector. A more comprehensive approach that takes into account several types of interconnection, as well as ‘second-round’ effects, would be useful.

With respect to non-traditional insurance activities, a controversial topic that has room for more research is the systemic risk contribution of derivatives and other innovative products from the field of alternative risk transfer, especially insurance-linked securities and industry-loss warranties. Furthermore, studies that link the results of systemic risk measures to characteristics of insurance companies would definitely profit from more discussion of these

measures and preconditions for their application. The link between the measures and the actual systemic risk definitions is not clear. In the literature, there is still no common understanding of systemic risk and, consequently, systemic risk measures often arrive at contradictory conclusions. In this paper we argue that the starting point should be the financial crisis and we provide a framework for how to think about a systemic risk definition. Our argument is that the whole 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. We believe that accomplishing this first step would be of enormous benefit in the next step of designing an appropriate systemic risk measure. Currently, as shown in the discussion above, too many issues regarding these measures remain. 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 an interconnection? Is a macro-prudential systemic risk measure necessary, one that would indicate, for example, when the *overall* systemic risk level in the financial system is high? 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.

Appendix

Reference	Definition
Acharya et al. (2011, p. 281)	‘Systemic risk can be conceived as the potential failure of a significant part of the financial sector—one large institution or many smaller ones—leading to reductions in the availability of credit and/or critical risk management products such as insurance, thereby adversely affecting the real economy’.
Adrian and Brunnermeier (2011, p. 1)	‘The spreading of distress gives rise to systemic risk—the risk that the intermediation capacity of the entire financial system is impaired, with potentially adverse consequences for the supply of credit to the real economy’. ... ‘reflect systemic risk—the risk that the stability of the financial system as a whole is threatened’.
Adrian and Brunnermeier (2011, p. 1), based on Brunnermeier et al. (2009)	‘A systemic risk measure should identify the risk on the system by individually systemic institutions, which are so interconnected and large that they can cause negative risk spillover effects on others, as well as by institutions which are systemic as part of a herd’.
Baur et al. (2003, p. 7)	‘Systemic risk is the danger that an event will trigger a loss of economic value and/or confidence in the financial system that has significant adverse effects on the real economy’.
Bach and Nguyen (2012, p. 131)	‘Hence, macroprudential regulation focuses on systemic risk—it refers to the risk of a malfunction of the financial system to an extent big enough to affect economic growth and welfare ...’
Baluch et al. (2011, p. 137)	‘However, the term “systemic risk” is somewhat ambiguous with regard to both its definition and derivation. A widely accepted definition of systemic risk is that of Csiszar who characterise it as “the risk that the failure of a participant to meet its contractual obligations may in turn cause other participants to default, with the chain reaction leading to broader financial difficulties”. However, this definition includes only the sort of “micro” systemic risk represented by a cumulative loss function caused by a domino effect ...’
Bernanke as reported by Boles (2009)	‘Systemic risks are developments that threaten the stability of the financial system as a whole and consequently the broader economy, not just that of one of two institutions’.
Billio et al. (2010, p. 1)	‘Systemic risk can be defined as the probability that a series of correlated defaults among financial institutions, occurring over a short time span, will trigger a withdrawal of liquidity and widespread loss of confidence in the financial system as a whole’.
Billio et al. (2012, p. 536)	‘By definition, systemic risk involves the financial system, a collection of interconnected institutions that have mutually beneficial business relationships through which illiquidity, insolvency, and losses can quickly propagate during periods of financial distress’.
Chen et al. (2013a, p. 1)	‘From a statistical perspective, systemic risk involves the co-movement of key financial variables measuring the health of stability of financial institutions and has also been described as the potential for multiple simultaneous defaults of major financial institutions’.
Chen et al. (2013b, p. 1)	‘Systemic risk can be defined as the risk that an event will generate a loss of economic value or confidence in a substantial segment of the financial system, which in turn could also affect the entire economy’.
Csiszar (2002, p. 2)	‘What is Systemic Risk? The risk that the failure of a participant to meet its contractual obligations may in turn cause other participants to default, with the chain reaction leading to broader financial difficulties’.
Committee on Capital Markets Regulation (CCMR) (2009, p. ES-3)	‘Systemic risk is the risk of collapse of an entire system or entire market, exacerbated by links and interdependencies, where the failure of a single entity or cluster of entities can cause a cascading failure. We recognize that there are at least five key externalities particular to financial markets that contribute to systemic risk. First, the spread of speculative information through the market can create the perception that economic difficulties impacting one financial institution will affect similarly situated firms. Second, customers of failed institutions may subsequently find themselves in a less friendly market when looking to re-direct their business. Third, there is considerable inter-connectedness between the financial institutions participating in modern financial markets, so that the failure of one firm can affect many others. Fourth, a negative spiral may be created by falling asset prices and resulting liquidity constrictions. Fifth, falling asset prices and liquidity crises could cause institutions to become reluctant to extend credit’.
Cummins and Weiss (2014, p. 2)	‘Systemic risk is the risk that an event will trigger a loss of economic value or confidence in a substantial segment of the financial system that is serious enough to have significant adverse effects on the real economy with a high probability’.
De Bandt and Hartmann (2000, p. 11)	‘Systemic risk (in the narrow and broad sense) can then be defined as the risk of experiencing systemic events in the strong sense’. See also page 10 for an understanding of the context.
Grace (2011, p. 2)	‘First, “Systemic risk refers to the ... breakdown in an entire system. ... This ... risk ... is evidenced by a high correlation and clustering of ... failures.” A second definition concerns contagion. One failure by an institution leads to a failure of another. This chain reaction requires linkages among firms, markets or sectors. Finally, a third definition focuses on an externality caused by a shock to one firm which creates uncertainty about other firms. For example, a firm suffers a loss and the market then becomes uncertain about the value of similar firms’.
Group of Ten (2001, p. 126)	‘Systemic financial risk is the risk that an event will trigger a loss of economic value or confidence in, and attendant increases in uncertainty about, a substantial portion of the financial system that is serious enough to quite probably have significant adverse effects on the real economy’.
Harrington (2009, p. 801)	‘There is no generally accepted definition of “systemic risk” or agreement on its importance and scope. While the term sometimes is used to encompass the risk of any large, macroeconomic shock, the term generally is used to connote situations with extensive interdependencies or “interconnectedness” among firms and an associated risk of contagion and significant economic spillovers’.
Harrington (2011, p. 4)	‘The term “systemic risk” generally is used broadly to encompass the risk of any large, macroeconomic shock and the risk arising from extensive interdependencies or “interconnectedness” among firms, with an attendant risk of contagion and significant economic spillovers. There is a distinction, however, between the risk of common shocks to the economy, such as widespread reductions in housing prices or large changes in interest rates or foreign exchange,

	which have the potential to directly harm large numbers of people and firms, and financial risk that arises from interconnectedness and contagion’.
Huang et al. (2009, p. 2036)	‘First, how to measure the systemic risk of a financial system, where systemic risk is defined as multiple simultaneous defaults of large financial institutions?’
IAIS (2009, p. 1)	‘The risk of disruption to the flow of financial services that is (i) caused by an impairment of all or parts of the financial system; and (ii) has the potential to have serious negative consequences for the real economy’.
Jobst (2012, p. 3)	‘Systemic risk refers to individual or collective financial arrangements—both institutional and market-based—that could either lead directly to system-wide distress in the financial sector and/or significantly amplify its consequences (with adverse effects on other sectors, in particular capital formation in the real economy). The potential emergence of systemic risk and its impact on financial stability is significantly influenced by institutions whose disorderly failure, because of their size, complexity and systemic interconnectedness, would cause significant disruption to the financial system and economic activity ...’
Kaufmann and Scott (2003, p. 372)	‘A search of the literature reveals three frequently used concepts. The first refers to a “big” shock or macroshock that produces nearly simultaneous, large, adverse effects on most or all of the domestic economy or system. Here, systemic “refers to an event having effects on the entire banking, financial, or economic system, rather than just one or a few institutions” ...’ ... ‘The other two definitions focus more on the microlevel and on the transmission of the shock and potential spillover from one unit to others’.
Klein (2011, p. 5)	‘Systemic risk could be defined as the risk that a market or financial system could experience severe instability, potentially catastrophic, caused by idiosyncratic events or conditions in financial intermediaries. It arises from the links between firms in a system or market where the failure of one or more firms can have cascading effects which could potentially bring down an entire system or market. This is a kind of market failure that can arise from excessive risk taking by financial institutions whose failure can lead to the failure of other firms in a market or system’.
Kress (2011, p. 57)	‘The aggregation of CDS counterparty risk throughout financial markets creates systemic risk, the possibility of contagion spreading from institution to institution’.
Rodriguez-Moreno and Peña (2013, p. 1)	‘Systemic risk appears when generalized malfunctioning in the financial system threatens economic growth and welfare. The causes of this malfunction are multiple and therefore a single measure of systemic risk may neither be appropriate nor desirable’.

Table A1: Definitions of systemic risk in the literature

Types of Impairments

There are two ways impairments can take place—a *system-wide shock* or a *limited shock with subsequent contagion*.

- A *system-wide shock* is one 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. Like De Bandt and Hartmann (2000), we also understand that new information can be a shock of this type. For example, suppose a certain regulatory requirement suddenly encourages financial institutions to sell a certain asset. As a consequence, most institutions start to sell this asset, the price of the asset decreases, and the institutions become distressed because the remaining assets of this type that they still hold have lost value. In this way, the institutions' aligned behaviour caused by the new information impairs the financial system.
- A *limited shock with subsequent contagion* occurs when one or a few market participants cannot meet their obligations, e.g., 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:
 - bankruptcies of institutions, which trigger insolvencies of other companies due to unfulfilled commitments,
 - contracts based on credit ratings,
 - decrease in asset prices caused by sales by a few institutions that force other market participants to sell assets as well,
 - investor uncertainty, eventually resulting in aligned behaviour, due to the distress of one company combined with non-transparency as to whether other companies are experiencing the same problem,⁴⁰

⁴⁰ See Harrington (2009) and Cummins et al. (2012).

- information, eventually resulting in aligned behaviour, about the distress of one company from which markets conclude that other companies face similar problems, and
- irrationality.⁴¹

Some definitions of contagion differentiate between the state of the economy at the time the contagion occurs (normal vs. extreme economic conditions) and between whether the shock is based on rational or irrational reasons (see Figure A1).⁴² In this paper, we define contagion as ‘a significant increase in linkages between financial institutions after a shock to one institution (or a group of institutions)’.⁴³ Therefore, we differentiate only between the conditions in which interdependence and contagion (including spillover effects) occurs (i.e., normal vs. extreme); we do not differentiate between how a shock is transmitted (rationally vs. irrationally).

Figure A1: Classification of different shock transmission mechanisms

⁴¹ See Harrington (2009, 2011) and Park and Xie (2014, p. 30).

⁴² For an overview of different perceptions of contagion, see Forbes (2012).

⁴³ This definition of contagion, interdependence, and spillover effects is based on Forbes and Rigobon (2002).

Part A: Academic Papers						
No.	Author	Year	Title/ Published in	Focus and Methodology	Research Question	Main Result
1	Jean-Claude Trichet	2005	Financial Stability and the Insurance Sector / The Geneva Papers on Risk and Insurance—Issues and Practice	<ul style="list-style-type: none"> Financial stability Life, non-life Qualitative discussion 	<ul style="list-style-type: none"> Which risks does the insurance industry pose to financial stability? 	<ul style="list-style-type: none"> Due to maturity transformation and fast transmission mechanisms, banks contribute to systemic risk Traditional insurance business is not vulnerable to ‘insurance runs’ and interconnectedness in comparison to banks is low, so traditional insurance does not contribute to systemic risk New business activities of insurers can lead to contagion affecting banks: <ul style="list-style-type: none"> Selling of credit risk transfer instruments (derivatives); banks are net buyers and insurers net sellers Bancassurance (banking groups engage in insurance); regulatory arbitrage might be possible Participation of insurers in financial markets; fire sales might trigger a downward spiral
2	Scott E. Harrington	2009	The Financial Crisis, Systemic Risk, and the Future of Insurance Regulation / Journal of Risk and Insurance	<ul style="list-style-type: none"> AIG case Life, non-life Qualitative discussion based on descriptive statistics 	<ul style="list-style-type: none"> Discussion of the AIG case Does insurance contribute to systemic risk? How should regulation be drafted? 	<ul style="list-style-type: none"> AIG became distressed because of its derivative writing business and securities lending program It is unclear if financial support was necessary; insurance subsidiaries would probably have avoided bankruptcy Traditional insurance products do not contribute to systemic risk Market transparency should be increased, but there should be no too-big-to-fail regulation for insurers
3	Marc P. Radice	2010 (June)	Systemische Risiken im Versicherungssektor? / Working Paper	<ul style="list-style-type: none"> Systemic risk Life, non-life Scenario analysis based on qualitative assessments of the insurance industry 	<ul style="list-style-type: none"> Can systemic risk be found within the insurance sector? 	<ul style="list-style-type: none"> Following scenarios do not identify contributions to systemic risk: <ul style="list-style-type: none"> Unavailability of insurance, Insurance run on life insurers, CDS payment default, Credit rating utilization (long-term investment, short-term funded) Following scenarios could be systemically risky: <ul style="list-style-type: none"> Asset contagion, Limited fungibility of available group liquidity, Distress of non-regulated/non-insurance business within an insurance group
4	Viral V. Acharya, John Biggs, Hanh Le, Matthew Richardson, Stephen Ryan	2011	Systemic Risk and the Regulation of Insurance Companies / Regulating Wall Street—The Dodd-Frank Act and the New Architecture of Global Finance	<ul style="list-style-type: none"> Regulation Life, non-life, reinsurance Qualitative discussion based on descriptive statistics and systemic risk measure calculation 	<ul style="list-style-type: none"> How to shape regulation and treat systemically risky institutions? 	<ul style="list-style-type: none"> MES is calculated for U.S. insurance companies at July 2007 Insurers with a traditional business model pose low systemic risk in contrast to companies engaged in non-traditional insurance products A federal regulator is proposed who manages ex ante and ex post the systemic risk of large insurers Institutions that are too interconnected to fail should pay a fee for the implicit guarantee of being bailed out in the case of crisis Insurance products relating to systemic risks (e.g., insolvency of AAA-CDOs or a nuclear attack) should be forbidden unless fully capitalized
5	Faisal Baluch, Stanley Mutenga, Chris Parsons	2011	Insurance, Systemic Risk and the Financial Crisis / The Geneva Papers on Risk and Insurance—Issues and Practice	<ul style="list-style-type: none"> Systemic risk Life, non-life, reinsurance Qualitative discussion based on descriptive statistics and correlation analysis 	<ul style="list-style-type: none"> What was the role of the insurance industry during the financial crisis? 	<ul style="list-style-type: none"> The impact of the financial crisis on the insurance industry was less severe than on the banking industry Companies with insurance and banking businesses suffered especially Systemic risk in insurance has grown in the last years, since insurers increased their participation in the capital markets and offered more banking services

6	Dwityapoetra Besar, Philip Booth, Ka K. Chan, Alastair K. L. Milne, J. Pickles	2011	Systemic Risk in Financial Services / British Actuarial Journal	<ul style="list-style-type: none"> • Systemic risk • Life, non-life, reinsurance • Qualitative discussion and four case studies based on qualitative assessments of financial crisis 	<ul style="list-style-type: none"> • What is systemic risk? • Where does systemic risk originate in the financial system? 	<ul style="list-style-type: none"> • Systemic risk can originate in four 'networks of interconnections' between financial institutions: <ul style="list-style-type: none"> - Payment systems, financial infrastructure, systems of clearing and settlement - Short-term funding markets - Common exposure of several institutions in collateral, securities, and derivatives market - Counterparty exposure • Insurers do not contribute to systemic risk, since insurers are only affected by the last issue and, in the case of life insurers and pension funds, by the third issue as well; however, in a much more limited way than banks
7	Iman van Lelyveld, Franka Liedorp, Manuel Kampman	2011	An Empirical Assessment of Reinsurance Risk / Journal of Financial Stability	<ul style="list-style-type: none"> • Contagion • Reinsurance • Scenario analysis based on a matrix showing the reinsurance linkages between insurers–insurers and insurers–reinsurers 	<ul style="list-style-type: none"> • Do linkages between reinsurers and insurers contribute to systemic risk via a threat of contagion? 	<ul style="list-style-type: none"> • 213 Dutch insurers and their reinsurance exposure are analysed as of 2005 • Scenario analysis shows that <ul style="list-style-type: none"> - Potential failure of any one reinsurer is not a systemic risk - Potential failure of reinsurers from a particular geographic region is not a systemic risk - Potential failure of the two largest reinsurers in the life and non-life segment is not a systemic risk • Even if many reinsurers went bankrupt, the market would not fail and only a few primary insurers would go bankrupt
8	Martin F. Grace	2011 (December)	The Insurance Industry and Systemic Risk: Evidence and Discussion / Working Paper	<ul style="list-style-type: none"> • Systemic risk • Life, non-life • Event study, empirical study (Granger-causality tests) 	<ul style="list-style-type: none"> • What are the systemic effects of insurance companies? • What kind of regulation is appropriate? 	<ul style="list-style-type: none"> • Insurers do not contribute to systemic risk, since duration of assets and liabilities are more closely matched than in the case of banks • Event studies show no indication that insurers contribute to systemic risk nor do Granger-causality tests (however, insurers are victims just like other market participants) • Stock market returns of banks can explain stock market returns of insurers, but not vice versa • No institution should be classified too big to fail, since this would lead to moral hazard • Financial guarantees should be minimized in any new regulation
9	Scott E. Harrington	2011 (December)	Insurance Regulation and the Dodd-Frank Act / Working Paper	<ul style="list-style-type: none"> • Regulation • Life, non-life, reinsurance • Qualitative discussion 	<ul style="list-style-type: none"> • Discussion of the Dodd-Frank Act and systemic risk • How should regulation be framed? 	<ul style="list-style-type: none"> • Regulation should take differences between insurers and banks into account, especially the facts that the insurance industry's contribution to systemic risk is lower and its market discipline higher in comparison with the banking industry • Stronger financial guarantees for insurers increase moral hazard • No insurer should be labelled systemically important, since this would create moral hazard • Federal Insurance Office should consider: modernisation of regulation, promoting market discipline, policyholder guarantees, capital requirements, and group supervision
10	J. David Cummins, Ran Wei, Xiaoying Xie	2012 (January)	Financial Sector Integration and Information Spillovers: Effects of Operational Risk Events on U.S. Banks and Insurers / Working Paper	<ul style="list-style-type: none"> • Contagion • Life, non-life • Event study and weighted least squares regressions for explaining the cumulative abnormal returns 	<ul style="list-style-type: none"> • Does the announcement of an operational loss event of a financial services company have an impact on other companies in the market? 	<ul style="list-style-type: none"> • 415 bank events and 158 insurance events between 1978 and 2010 are analysed • Operational loss announcements of banks and insurers have intra- and inter-industry wide negative effects • Contagion effects identified by the event studies seem to be information based; regressions show that investors can differentiate to what degree a particular institution is affected
11	Wolfgang Bach, Tristan Nguyen	2012	On the Systemic Relevance of the Insurance Industry: Is a Macro Prudential Insurance	<ul style="list-style-type: none"> • Regulation • Life, non-life, reinsurance • Qualitative discussion 	<ul style="list-style-type: none"> • Is a system-oriented regulation necessary? 	<ul style="list-style-type: none"> • Even though traditional insurance activities might not be systemically risky, macro-prudential regulation is necessary due to <ul style="list-style-type: none"> - Economic costs if insurance markets are impaired - High public interest in the availability of

			Regulation Necessary? / Journal of Applied Finance & Banking			large insurance capacity • Providing insurance is a systemic relevant function
12	Etti Baranoff	2012	An Analysis of the AIG Case: Understanding Systemic Risk and its Relation to Insurance / Journal of Insurance Regulation	<ul style="list-style-type: none"> • AIG case • Life, non-life • Qualitative discussion based on descriptive statistics 	<ul style="list-style-type: none"> • What were the internal and external factors for the distress of AIG? 	<ul style="list-style-type: none"> • Internal factors: (a) dependency on credit ratings based on insurance operations, (b) regulatory arbitrage, (c) poor financial models, (d) poor CDS contracts, (e) CDS growth, and (f) poor internal risk management and controls • External factors: (a) free markets philosophy, (b) 'everyone deserves to own a home' ideology, (c) trust in credit ratings, (d) poor banking regulation, (e) no derivatives regulation, and (f) growth of bundling securities with poor underwriting standards • CDS writing contributed to systemic risk • Securities lending did not contribute to systemic risk but exacerbated the situation • Insurance operations do not contribute to systemic risk
13	Monica Billio, Mila Getmansky, Andrew W. Lo, Loriana Pelizzon	2012	Econometric Measures of Connectedness and Systemic Risk in the Finance and Insurance Sectors / Journal of Financial Economics	<ul style="list-style-type: none"> • Contagion • Life, non-life, reinsurance • Empirical study (principal component analysis and Granger-causality tests) that measures the interconnectedness of stock market returns between financial institutions 	<ul style="list-style-type: none"> • Are banks, insurers, hedge funds, and brokers interconnected? • How to quantify systemic risk? 	<ul style="list-style-type: none"> • The 25 largest banks, insurers, hedge funds, and brokers in the world are analysed between 1996 and 2008 • Stock market returns of banks, insurers, hedge funds, and brokers have become highly interconnected over the last decade • Banks and insurers are especially prone to transmit shocks and therefore contribute to systemic risk • Interconnectedness as an indicator of systemic risk can be successfully measured by principal components analysis and Granger-causality tests
14	Faith R. Neale, Pamela Peterson Drake, Patrick Schorno, Elias Semaan	2012 (August)	Insurance and Interconnectedness in the Financial Services Industry / Working Paper	<ul style="list-style-type: none"> • Contagion • Life, non-life, reinsurance • Empirical study (principal components analysis and Granger-causality test) that measures the interconnectedness of stock market returns between financial institutions 	<ul style="list-style-type: none"> • Are insurance companies interconnected with the financial services industry? 	<ul style="list-style-type: none"> • U.S. financial institutions are analysed between 1994 and 2010 • Insurance companies became more interrelated with other financial services firms over time • Insurance companies have to be differentiated according to their line of business to understand the interconnectedness of the insurance sector • Companies involved in life insurance and financial guarantees are interconnected most with the financial services industry and it can be concluded that the interconnectedness between insurance and other institutions can be attributed to these lines
15	Andreas A. Jobst	2012 (December)	Systemic Risk in the Insurance Sector—A Review of General Issues and Some Findings on Large Insurers in Bermuda / Working Paper	<ul style="list-style-type: none"> • Regulation and systemic risk • Non-life, reinsurance • Qualitative discussion based on descriptive statistics 	<ul style="list-style-type: none"> • Are the current systemic risk indicators suggested by the IAIS/industry sufficient? • Do (re)insurers from Bermuda contribute to systemic risk? 	<ul style="list-style-type: none"> • Both indicator approaches proposed by the IAIS and the industry to identify systemically risky business activities as well as institutions have shortcomings; the state of the environment affecting the resilience of the insurance industry is neglected as well as the impact of transmission mechanisms • High liquidity buffers and low holdings of speculative derivatives indicate that the insurance industry of Bermuda neither contributes to systemic risk nor is vulnerable to impairments of the financial system
16	Fang Chen, Xuanjuan Chen, Zhenzhen Sun, Tong Yu, Ming Zhong	2013	Systemic Risk, Financial Crisis, and Credit Risk Insurance / The Financial Review	<ul style="list-style-type: none"> • Contagion • Life, non-life • Systemic risk measure calculation (MES, BANKBETA) and empirical study (panel regressions of credit insurers' 	<ul style="list-style-type: none"> • How were credit risk insurers affected by the financial crisis in comparison to life and non-life insurers? • Do credit risk insurers transmit shocks? 	<ul style="list-style-type: none"> • 20 insurers are identified that sell either CDS, offer financial guarantees, or both; 77 property-casualty insurers and 17 life insurers are used as comparisons; sample period is between 2006 and 2009 • During the financial crisis (2007–2009), performance (stock market return and return on assets) of credit risk insurers is substantially worse than the one of property-casualty or life insurers

				stock market return on systemic risk measures and other company characteristics/bond spreads on downgrading of guaranteeing insurer)		<ul style="list-style-type: none"> • MES can explain bad performance of credit risk insurers during the financial crisis • Rating downgrades of credit risk insurers lead to rating downgrades of insured bonds
17	Hua Chen, J. David Cummins, Krupa S. Viswanathan, Mary A. Weiss	2013	Systemic Risk and the Interconnectedness Between Banks and Insurers: An Econometric Analysis / Journal of Risk and Insurance	<ul style="list-style-type: none"> • Contagion • Life, non-life • Systemic risk measure calculation (DIP, use of Granger-causality tests to evaluate which institutions cause systemic risk) 	<ul style="list-style-type: none"> • Are insurers a source or a victim of systemic risk? 	<ul style="list-style-type: none"> • 33 U.S. financial institutions are analysed between 2002 and 2008 • In contrast to banks, insurers seem not to cause systemic risk, but are vulnerable to a banking crisis • After adjusting for heteroskedasticity, Granger-causality tests on risk measures based on CDS spreads show that banks have a much larger impact with a longer duration on insurers than vice versa • Results are confirmed by stress tests • Banks and insurers are strongly interconnected
18	Hua Chen, J. David Cummins, Krupa S. Viswanathan, Mary A. Weiss	2013 (February)	Systemic Risk Measures in the Insurance Industry: A Copula Approach / Working Paper	<ul style="list-style-type: none"> • Systemic risk measures • Life, non-life • Systemic risk measure calculation (ΔCoVaR, MES, and SRISK) 	<ul style="list-style-type: none"> • - 	<ul style="list-style-type: none"> • 40 U.S. insurers are analysed between 2002 and 2011 • Four systemic risk measures—ΔCoVaR, modified ΔCoVaR, MES, and SRISK—are estimated with the help of copula models • Insurers can be systemically risky because financial risk measures for insurers peak in times of financial crisis • Life-health insurers respond more significantly to negative financial market conditions than do property-casualty insurers
19	David Cummins, Mary A. Weiss	2013 (March)	Systemic Risk and Regulation of the U.S. Insurance Industry / Working Paper	<ul style="list-style-type: none"> • Systemic risk • Life, non-life, reinsurance • Qualitative discussion based on descriptive statistics, systemic risk measure calculation (SRISK, OLS regressions of systemic risk measure on company characteristics) 	<ul style="list-style-type: none"> • Does the U.S. insurance industry contribute to systemic risk or is it vulnerable to impairments of the financial system? • Which characteristics determine the vulnerability of an insurer to crisis? 	<ul style="list-style-type: none"> • U.S. insurers are analysed between 2001 and 2011 • Core property-casualty insurance and reinsurance activities do not contribute to systemic risk • Most core life insurance activities do not contribute to systemic risk—except separate accounts and group annuities • The following non-core insurance activities can contribute to systemic risk <ul style="list-style-type: none"> - Trading in derivatives - Asset lending and management - Financial guarantees • SRISK calculations and regressions on characteristics of insurers show that non-core insurance activities, size, MBS underwriting, and total reinsurance underwriting can explain vulnerability to crisis
20	Gregor N. F. Weiß, Janina Mühlhnickel	2013 (May)	Consolidation and Systemic Risk in the International Insurance Industry / Working Paper	<ul style="list-style-type: none"> • Systemic risk • Life, non-life • Systemic risk measure calculation (MES, LTD before and after M&A activity), empirical study (OLS regression of changes in systemic risk measure on company characteristics) 	<ul style="list-style-type: none"> • Do M&A activities increase systemic risk? • What determinants can explain changes in the level of systemic risk after M&A activities? 	<ul style="list-style-type: none"> • 409 international, domestic, and cross-border mergers are analysed between 1984 and 2010 • There are mixed results; if consolidation leads to higher systemic risk (measured by LTD), however, the vulnerability of insurers to impairments of the financial system increases (measured by MES) • Firm size, leverage, and diversification can explain changes in systemic risk measures
21	Martin F. Grace, Jannes Rauch, Sabine Wende	2013 (July)	Systemic Risk and Interconnectedness in the Financial Industry: Implications on Regulation of Financial Conglomerates /	<ul style="list-style-type: none"> • Systemic risk • Life, non-life • Event study 	<ul style="list-style-type: none"> • Can insurance-specific events contribute to systemic risk? 	<ul style="list-style-type: none"> • 12 insurance-specific events are analysed between 2001 and 2012, which include terror attacks, natural catastrophes, frauds, and financial bailouts • In comparison to the S&P 500, almost no significant abnormal returns for insurers and banks can be identified • There is only a low degree of interconnectedness between the different

			Working Paper			<p>financial sectors</p> <ul style="list-style-type: none"> • No evidence is found that insurance-specific events contribute to systemic risk
22	Etti Baranoff, Daniel Haefeli, Thomas Sager	2013 (August)	Surrenders in the Life Insurance Industry: A Systemic Risk of Runs? / Working Paper	<ul style="list-style-type: none"> • Systemic risk • Life • Qualitative discussion based on descriptive statistics, scenario analysis (potential cash outflows in the life insurance industry due to policy cancellations are compared with available liquidity) 	<ul style="list-style-type: none"> • Is a potential run on life insurers a systemic risk? 	<ul style="list-style-type: none"> • Between 2001 and 2011, U.S. life insurers were always able to survive cash outflows due to the cancellation of contracts without selling assets • Simulations based on the historical distribution of lapse rates show the same results • Only if lapse rates were 10 times higher, would assets have to be sold before maturity; however, in comparison to the whole bond market, the assets on sale would only be a small fraction
23	Gregor N. F. Weiß, Deneša Bostandzic, Felix Irresberger	2013 (August)	Catastrophe Bonds and Systemic Risk / Working Paper	<ul style="list-style-type: none"> • Systemic risk • Reinsurance • Systemic risk measure calculation (ΔCoVaR, MES, SRISK) before and after the issuing of cat bonds, empirical study (cross-sectional regression analysis of changes in the systemic risk measure on issuer characteristics) 	<ul style="list-style-type: none"> • Does the issuing of catastrophe bonds increase or decrease the systemic risk contribution of insurers? 	<ul style="list-style-type: none"> • 176 cat bonds and their issuers are analysed between 1996 and 2013 • The issuing of cat bonds neither increases nor decreases the systemic risk contribution of an insurer or its vulnerability to impairments of the financial system (results not significant) • Pre-issue leverage, higher firm valuation, and previous cat bond issues decrease changes in systemic risk (not significant) after issuing cat bonds
24	Robert W. Klein	2013	Insurance Market Regulation: Catastrophe Risk, Competition and Systemic Risk / Handbook of Insurance	<ul style="list-style-type: none"> • Regulation • Life, non-life, reinsurance • Qualitative discussion based on literature review 	<ul style="list-style-type: none"> • Overview of insurance regulation • How to respond to risks related to competition and catastrophes as well as systemic ones? 	<ul style="list-style-type: none"> • Core activities of insurance companies do not contribute to systemic risk • Life insurers are exposed to systemic risk due to their holdings of MBSs, privately placed bonds, minimum interest guarantees, and high leverage • CDSs (non-traditional activities) can contribute to systemic risk • In-/solvency and market conduct regulation desirable
25	Denis Kessler	2013 (forthcoming)	Why (Re)insurance is Not Systemic / Journal of Risk and Insurance	<ul style="list-style-type: none"> • Systemic risk • Reinsurance • Qualitative discussion 	<ul style="list-style-type: none"> • Does reinsurance contribute to systemic risk? 	<ul style="list-style-type: none"> • Reinsurance does not contribute to systemic risk <ul style="list-style-type: none"> - Insolvencies of reinsurers are lengthy and orderly processes - Claims settlements and cash outflows are conditional on loss events and pre-funded - Life insurance guarantee funds and lapse fees prevent 'insurance runs' in case of life insurance activities - Retrocession spirals are unlikely due to the hierarchical structure of the reinsurance market - Underwritten risks are diversified (uncorrelated)
26	Gregor N. F. Weiß, Janina Mühlhölzer	2014	Why Do Some Insurers Become Systemically Relevant? / Journal of Financial Stability	<ul style="list-style-type: none"> • Systemic risk • Life, non-life, reinsurance • Systemic risk measure calculation (ΔCoVaR, MES, SRISK), empirical study 	<ul style="list-style-type: none"> • Do insurers contribute to systemic risk? • Which factors determine the contribution of an insurer to systemic risk? 	<ul style="list-style-type: none"> • 89 publicly listed U.S. insurers are analysed with data from 2006 • Insurers can contribute to systemic risk and are vulnerable to impairments of the financial system • Size and other income are the only significant factors of the IAIS criteria in determining the systemic risk contribution of an insurer as well as its vulnerability to impairments of the

				(OLS and probit regressions of systemic risk measures and TARP funding on approximated IAIS indicators for systemic risk)		financial system
27	J. David Cummins, Mary A. Weiss	2014 (forth-coming)	Systemic Risk and the U.S. Insurance Sector / Journal of Risk and Insurance	<ul style="list-style-type: none"> • Systemic risk • Life, non-life, reinsurance • Qualitative discussion based on descriptive statistics 	<ul style="list-style-type: none"> • Does the U.S. insurance sector significantly contribute to systemic risk? 	<ul style="list-style-type: none"> • Traditional activities of insurers do not contribute to systemic risk, but derivatives trading and financial guarantees might • Life insurers are vulnerable due to leverage/MBSs to intra-sector crises • Both life and property-casualty insurers are vulnerable to reinsurance crisis • Insurance group supervision is needed to regulate non-core activities effectively
28	Robert Engle, Eric Jondeau, Michael Rockinger	2014 (forth-coming)	Systemic Risk in Europe / Review of Finance	<ul style="list-style-type: none"> • Systemic risk measures • Life, non-life, reinsurance • Systemic risk measure calculation (LRMES and SRISK) 	<ul style="list-style-type: none"> • Which European financial institutions are risky? 	<ul style="list-style-type: none"> • 196 European financial institutions are analysed for the period from 1990 to 2012 • Based on LRMES, an approximately 40% decline in world markets leads to an approximately negative return of 40% for European banking and insurance companies • Based on SRISK, the total amount of capital needed by the European financial system in times of crisis (capital shortfall) is calculated <ul style="list-style-type: none"> - 80% can be attributed to the banking sector - 18% can be attributed to the insurance sector
29	T. R. Berry-Stölzle, Gregory P. Nini, Sabine Wende	2014 (forth-coming)	External Financing in the Life Insurance Industry: Evidence from the Financial Crisis / Journal of Risk and Insurance	<ul style="list-style-type: none"> • Capitalization • Life • Empirical study (probit and fixed-effects regression models) to identify the determinants of equity issuing and its consequences 	<ul style="list-style-type: none"> • Can life insurers raise external capital in times of crisis? • What are causes and consequences of capital raising? 	<ul style="list-style-type: none"> • 6,960 U.S. insurers are considered between 1997 and 2010 • Capital is mostly raised if net income is negative or unfunded growth opportunities exist • Insurers had no difficulty in raising money during the crisis; there is no evidence that insurers had more difficulty in raising capital between 2007 and 2009 than at any other given period • Open TARP funds for insurers were unnecessary • Additional regulation for insurers is not needed since they could deal very well with the crisis
30	Sojung C. Park, Xiaoying Xie	2014 (forth-coming)	Reinsurance and Systemic Risk: The Impact of Reinsurer Downgrading on Property-Casualty Insurers / Journal of Risk and Insurance	<ul style="list-style-type: none"> • Contagion • Reinsurance • Empirical study (probit regressions) and scenario analysis about hypothetical equity levels of insurers if major reinsurers fail 	<ul style="list-style-type: none"> • Do reinsurer downgradings have an impact on insurers? 	<ul style="list-style-type: none"> • 516 rating up- and downgrades for U.S. insurers are analysed • Rating downgrades of reinsurers increase likelihood of rating downgrades of insurers, since companies are interconnected • No indication that reinsurers contribute to systemic risk • Scenario analysis shows that even if three leading reinsurers went bankrupt the market would not fail

Part B Industry Studies and Practitioner Papers

No.	Author	Year	Title/ Publication Type	Focus	Research Question	Main Result
1	Jean-Baptiste Zufferey (Experten-gruppe Finanzmarkt-aufsicht)	2000	Finanzmarkt-regulierung und -aufsicht in der Schweiz / Report	<ul style="list-style-type: none"> • Regulation • Life, non-life, reinsurance • Qualitative discussion 	<ul style="list-style-type: none"> • What are the challenges for the regulation of the financial sector in Switzerland? 	<ul style="list-style-type: none"> • In regard to insurance and systemic risk: <ul style="list-style-type: none"> - Regulation of insurers should take differences between banking and insurance into account, not differentiate according to the size of a company, and focus on the protection of policyholders - Contagion risks are low in insurance - The insurance sector is vulnerable to macroeconomic shocks - Underwriting of derivatives could lead to systemic risk if information asymmetries are exploited by the industry
2	Patrizia Baur, Rudolf Enz, Aurelia Zanetti (Swiss Re)	2003	Reinsurance—A Systemic Risk? / Report	<ul style="list-style-type: none"> • Systemic risk • Reinsurance • Qualitative discussion 	<ul style="list-style-type: none"> • Does reinsurance contribute to systemic risk? 	<ul style="list-style-type: none"> • Reinsurance does not contribute to systemic risk <ul style="list-style-type: none"> - Unavailability of reinsurance not sign of systemic risk but due to changes in the environment

						<ul style="list-style-type: none"> - Primary insurers diversify their reinsurance exposure - Retrocession spiral due to reinsurer bankruptcies would not reach critical volume - In the past, insurers failed mostly due to management problems and not due to reinsurance failures
3	Financial Stability Board (FSB)	2009	Guidance to Assess the Systemic Importance of Financial Institutions, Markets and Instruments: Initial Considerations / Policy Guidance	<ul style="list-style-type: none"> • Regulation • Life, non-life, reinsurance • Qualitative discussion 	<ul style="list-style-type: none"> • Policy guidance • Report to the G20 Finance Ministers 	<ul style="list-style-type: none"> • Indicators for systemic risk of organizations <ul style="list-style-type: none"> - Size - Lack of substitutability - Interconnectedness • Institutions and markets have to be considered • Indicators of financial vulnerability <ul style="list-style-type: none"> - Leverage - Liquidity risk - Maturity mismatches - Complexity of products and services
4	International Association of Insurance Supervisors (IAIS)	2009	Systemic Risk and the Insurance Sector / Report	<ul style="list-style-type: none"> • Systemic risk • Life, non-life, reinsurance • Qualitative discussion 	<ul style="list-style-type: none"> • Identification of further challenges of insurance regulators 	<ul style="list-style-type: none"> • Time as another aspect should be added to the FSB's assessment criteria of systemic risk • Insurers should be supervised on a group-wide basis, which should include non-regulated business activities • Different business model of insurers in contrast to banks has to be taken into account when framing regulation policies
5	Geneva Association	2010	Systemic Risk in Insurance—An Analysis of Insurance and Financial Stability / Report	<ul style="list-style-type: none"> • Systemic risk • Life, non-life, reinsurance • Qualitative discussion based on descriptive statistics 	<ul style="list-style-type: none"> • Discussion of systemic risk in Solvency II • Which activities of insurance companies contribute to systemic risk? • How should regulation be framed? 	<ul style="list-style-type: none"> • Whether companies contribute to systemic risk should be decided according to size, interconnectedness, substitutability, and the speed of potential liquidity outflow • Regulation should focus on activities, not institutions • Traditional insurance activities do not contribute to systemic risk • Non-traditional activities can contribute to systemic risk <ul style="list-style-type: none"> - Short-term funding and securities lending - Derivatives trading (e.g., CDS writing)
6	Geneva Association	2010	Key Financial Issues in Insurance / Report	<ul style="list-style-type: none"> • Systemic risk • Life, non-life • Qualitative discussion based on descriptive statistics 	<ul style="list-style-type: none"> • Follow-up report on the report: 'Systemic Risk in Insurance' 	<ul style="list-style-type: none"> • Severe decline in asset values would affect insurance companies • Traditional business model does not incorporate liquidity or 'insurance run' risks because <ul style="list-style-type: none"> - There is normally no short-term funding - Upfront fees exist - No withdrawals at will possible • Uninsurability is not a systemic risk but a reflection of reality and regulation in this regard would create systemic risk
7	International Association of Insurance Supervisors (IAIS)	2010	Position Statement on Key Financial Stability Issues / Report	<ul style="list-style-type: none"> • Regulation • Life, non-life, reinsurance • Qualitative discussion 	<ul style="list-style-type: none"> • Position statement 	<ul style="list-style-type: none"> • Traditional insurance business does not generate systemic risk, but is affected by systemic risk in other sectors • Life insurers might amplify a crisis in case of an equity downturn • Insolvencies no problem, since policyholder claims are not instantly due and no risk of fire sales • Cross-sectorial macro-prudent (banks + insurance) supervision as well as international (group-wide) supervision desirable
8	Geneva Association	2011	Variable Annuities with Guarantees and Use of Hedging / Insurance and Finance SC10	<ul style="list-style-type: none"> • Systemic risk • Life • Qualitative discussion 	<ul style="list-style-type: none"> • Discussion of systemic risk regarding annuities/hedging • Do variable annuities with guarantees and hedging activities contribute to systemic risk? 	<ul style="list-style-type: none"> • Neither variable annuities with guarantees nor hedging activities are a potential source of systemic risk
9	International Association of	2011	Insurance and Financial Stability	<ul style="list-style-type: none"> • Systemic risk • Life, non-life, 	<ul style="list-style-type: none"> • Which business lines of insurers 	<ul style="list-style-type: none"> • Life and non-life insurance activities neither cause nor amplify systemic risk

	Insurance Supervisors (IAIS)		/ Report	<ul style="list-style-type: none"> reinsurance Qualitative discussion 	<ul style="list-style-type: none"> contribute to systemic risk? How should regulation be framed? 	<ul style="list-style-type: none"> Non-traditional and non-insurance activities like CDS writing can contribute to systemic risk Group-wide supervision including insurance and non-insurance businesses should be established
10	Philipp Keller (Geneva Association)	2011	Solvency II and Incentives for Systemic Risk Exposure / Progres No. 54	<ul style="list-style-type: none"> Regulation Life, non-life, reinsurance Qualitative discussion 	<ul style="list-style-type: none"> Discussion of Solvency II How will Solvency II deal with the future risks? 	<ul style="list-style-type: none"> Despite opposition, market-consistent valuation of assets and liabilities should be kept since in this way the highest number of securities can be priced most accurately Sovereign debt risks are neglected Solvency II provides incentives to use standard formula, which can cause systemic risk (aligned behaviour) Solvency II provides incentives to invest in illiquid and risky assets
11	Geneva Association	2012	Insurance and Resolution in Light of the Systemic Risk Debate / Report	<ul style="list-style-type: none"> Systemic risk Life, non-life, reinsurance Qualitative discussion 	<ul style="list-style-type: none"> Do failing insurers contribute to systemic risk? 	<ul style="list-style-type: none"> Impaired insurers that need to be wound up generally do not contribute to systemic risk Exceptions could be mismanagement of short-term funding and extensive underwriting of CDS
12	International Association of Insurance Supervisors (IAIS)	2012	Reinsurance and Financial Stability / Report	<ul style="list-style-type: none"> Systemic risk Reinsurance Qualitative discussion based on descriptive statistics and quantitative stress tests 	<ul style="list-style-type: none"> Does reinsurance contribute to systemic risk? 	<ul style="list-style-type: none"> Reinsurance does not contribute to systemic risk <ul style="list-style-type: none"> Interconnectedness is mainly vertical between reinsurers and insurers; interconnectedness on a horizontal level is weak Stress tests show that reinsurers can absorb severe catastrophic events and financial market stress simultaneously In the past, insurers did not fail due to reinsurance insolvencies Engagement in insurance derivatives without an insurable interest could make the insurer vulnerable and be a potential cause of systemic risk
13	International Association of Insurance Supervisors (IAIS)	2012	Global Systemically Important Insurers: Proposed Assessment Methodology / Report	<ul style="list-style-type: none"> Systemic risk assessment Life, non-life, reinsurance Methodology description 	<ul style="list-style-type: none"> How to assess systemically important insurers? How should regulation be framed? 	<ul style="list-style-type: none"> Indicator-based assessment according to <ul style="list-style-type: none"> Size Global activity Interconnectedness Non-traditional and non-insurance activities Substitutability Structural proposed regulation measures <ul style="list-style-type: none"> Separate legal structures for non-traditional/non-insurance activities Restrictions on cross-subsidies within a group Disallowance of certain diversification benefits from non-traditional/non-insurance activities for calculating solvency requirements Regulation of subsidiaries with non-traditional/non-insurance activities within a group

Table A2: Papers on systemic risk in insurance

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