Reforming Prudential Regulation of Insurance

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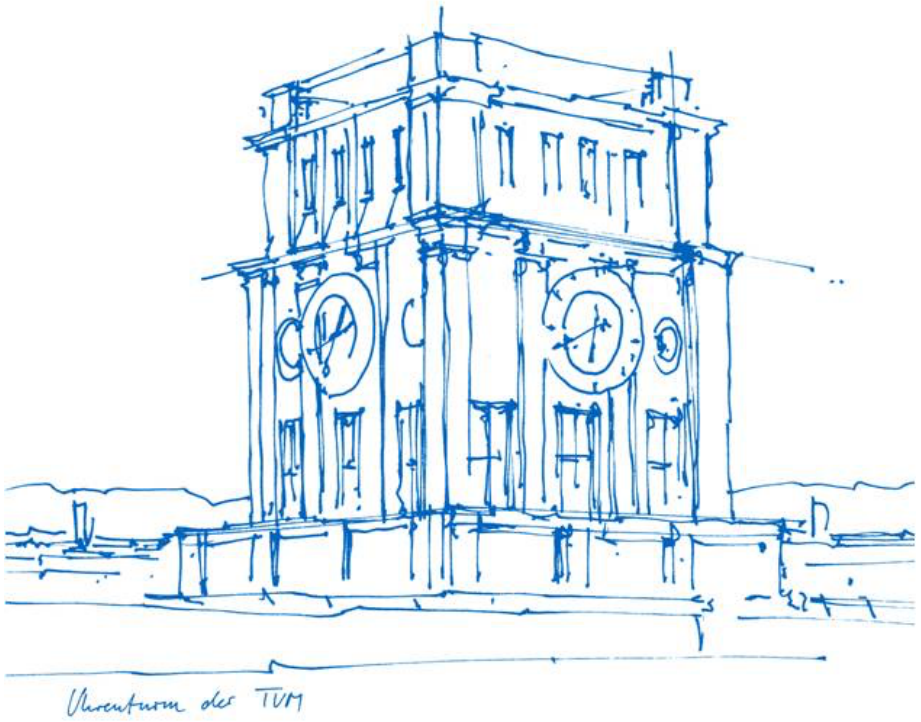

Systemic Risk in Financial Markets: How Systemically Important are Insurers?

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based on: Kaserer/Klein (2019), JoRI

Insurers experienced distress in the financial crisis; however, systemic risk in insurance remains disputed

- While **policy measures** are now **being phased in**, there is still much **controversy**
- **Empirical studies** on systemic risk in insurance **remain limited**

Source: News vendors' websites

There is controversy on whether insurers pose a systemic risk, how it should be measured, and how it should be regulated

Does the insurance sector pose a systemic risk?

- *Kessler (2013):* insurers enhance financial stability rather than posing a systemic risk
- *Acharya and Richardson (2014):* insurance sector is no longer traditional and poses a systemic risk
- *Billio et al. (2012):* insurers part of highly interconnected financial system, may propagate shocks
- *Chen et al. (2014):* impact of banks on insurers stronger than in the other direction

How should systemically important insurers be identified?

- Initial regulatory assessment approach relied on insurers' size, global activity, interconnectedness, non-core activities, and substitutability
- *Weiß and Mühlnickel (2014):* only size explains insurers' contribution to systemic risk
- *Bierth et al. (2015):* insurers' contribution to systemic risk is primarily driven by leverage

How should systemically important insurers be regulated?

- *Harrington (2009):* systemic risk regulator for insurers would give rise to negative externality and reduce market efficiency
- *Acharya and Richardson (2014):* acknowledging systemic risk in insurance, there should be a central systemic risk regulator

We analyze whether insurance sector poses a systemic risk. We address three main questions:

- What is the **contribution** of the insurance sector **to total systemic risk** in the global financial system?
- **How risky** is the insurance sector compared to the banking sector **on a per dollar basis**?
- To what degree are **individual insurers systemically important**?

We empirically assesses systemic risk in insurance using a simulation-based modeling approach

I Sample Data

Global sample financial system

- 50 insurers (primary and reinsurers) and 133 banking firms
- Period Jan '05 to Dec '14
- Covers 44% of global insurance and 47% of global banking assets[1]

Data requirements and sources

- *CDS spreads*: 5-year senior contracts, sourced from Datastream
- *Liabilities*: Sourced from Bloomberg and annual reports

II Risk Parameters

Risk-neutral probabilities of default

Inferred from CDS spreads based on no-arbitrage[2]

Asset return correlations

Estimated based on risk-neutral default probabilities[2]

Recovery rates

Modeled based on insurers' and banks' liability structure

III Modeling Approach

Simulation of systemic events[3]

- Multifactor model for portfolio credit risk
  - Extension of Merton model to multiple firms
  - Captures inhomoge-neous correlations among institutions
- Systemic event if total loss exceeds given systemic loss threshold
- Monte Carlo simulation with importance sampling procedure to improve efficiency of estimators

IV Risk Measures

A

Measures of aggregate systemic risk

Assess the level of risk in the financial system or a subsector thereof

B

Measures of individual systemic importance

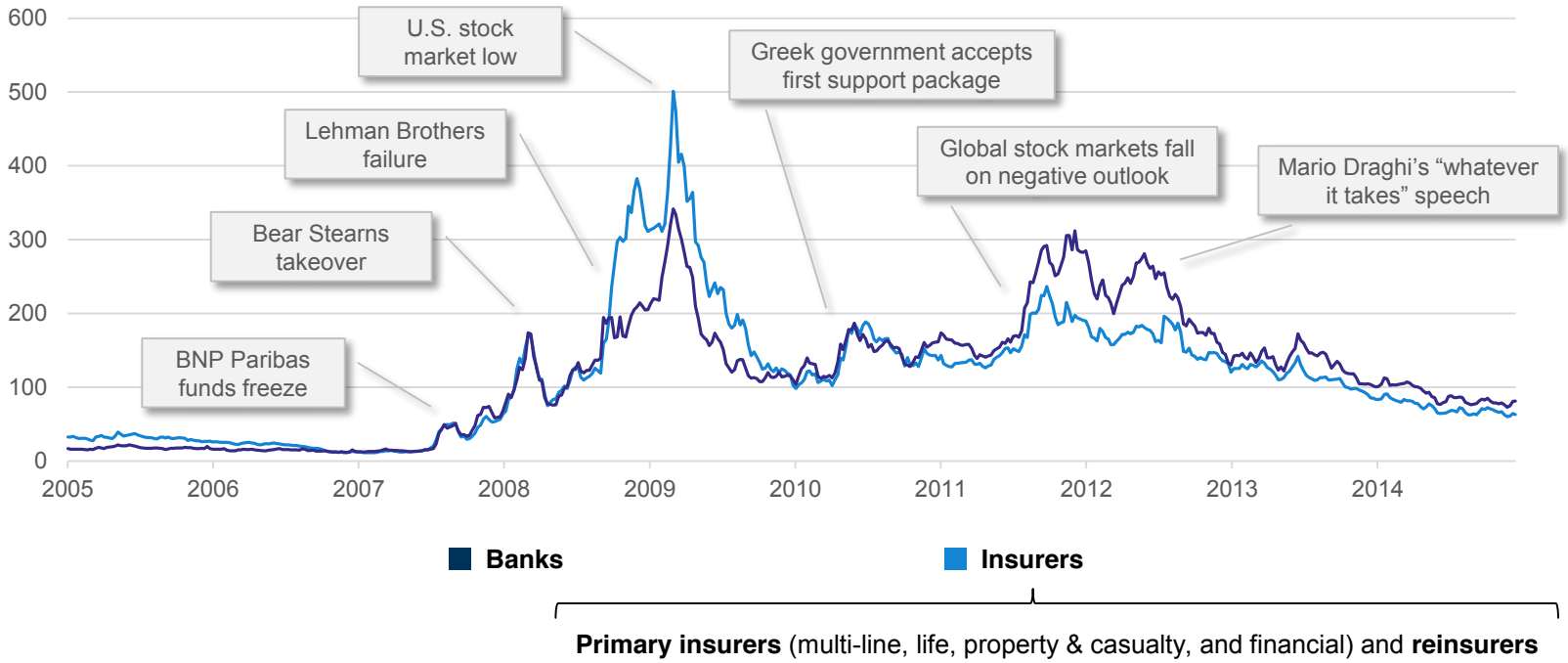
Assess the risk associated with individual institutions

1 For the year 2009, based on data from the Financial Stability Board 2 Methodology based on Tarashev and Zhu (2008)
3 Approach based on Huang et al. (2009,2012a,2012b)

I SAMPLE DATA

CDS spreads of banks and different types of insurers serve as a key input for the modeling approach

CDS spreads of sample financial institutions (5-year senior contracts, in bps)[1]



- **CDS spreads** of banks and insurers **reflect major events throughout** the **crisis episodes**
- Rodríguez-Moreno and Peña (2013) find that the **CDS market is a good indicator of systemic distress**

1 Median of weekly CDS spreads

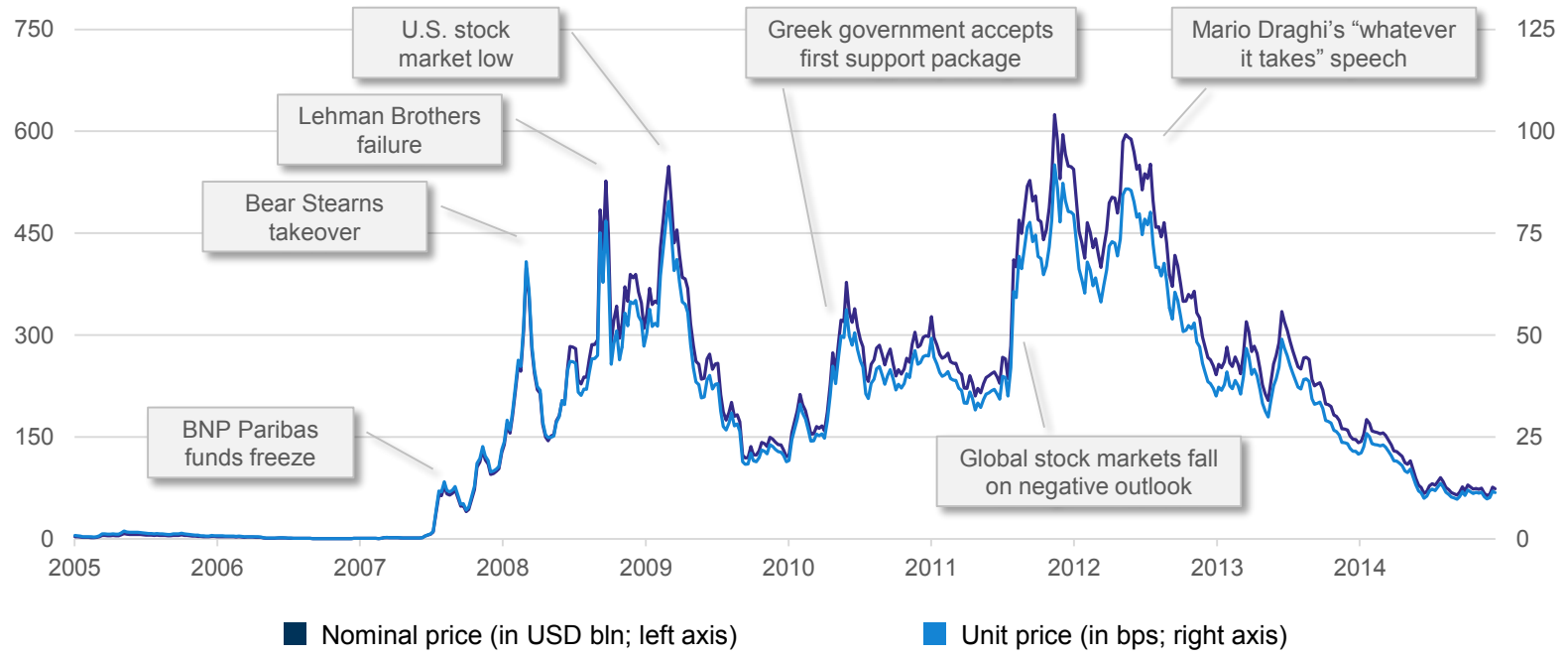
The outcome of the systemic event simulations is assessed using a diverse set of aggregate and firm-level risk measures

			Mathematical Definition	Description
A	Measures of aggregate systemic risk	Distress insurance premium (DIP)[1]	$DIP = \mathrm{P}(L > SLT)\,\mathrm{E}(L \mid L > SLT)$ where L is the total loss and SLT is the systemic loss threshold (taken as 10% of sample liabilities)	▪ Market value of losses exceeding a certain share of sample liabilities ▪ *"How much would you have to pay to protect the sample against distress?"*
B	Measures of individual systemic importance	Marginal DIP[1]	$DIP_i = \mathrm{P}(L > SLT)\,\mathrm{E}(L_i \mid L > SLT)$ where L_i is the loss of firm i	▪ Expected loss of an individual firm conditional on a systemic event ▪ *"Which share of the loss in a systemic event is due to the firm?"*
		Conditional probability of systemic distress (CoPSD)[2]	$CoPSD_i = \mathrm{P}\left(L > SLT \middle\vert R_i < r_{i,\alpha}\right)$ where R_i is the asset return of firm i and $r_{i,\alpha}$ is the α-quantile of its asset return distribution (taken as 1%)	▪ Risk-neutral probability of a systemic event conditional on distress of a firm ▪ *"To what degree is distress of the firm associated with a systemic event?"*
		Conditional probability of default (CoPD)[2]	$CoPD_i = \mathrm{P}(R_i < -DTD_i \mid L > SLT)$ where DTD_i is the distance-to-default of firm i	▪ Risk-neutral probability of default conditional on systemic event ▪ *"How vulnerable is the firm in times of financial turmoil in the broader market?"*

1 See Huang et al. (2009,2012a,2012b) 2 See also Malz (2013)
Note: All risk measures are calculated in weekly frequency for a one-year horizon

Systemic risk in the global financial system

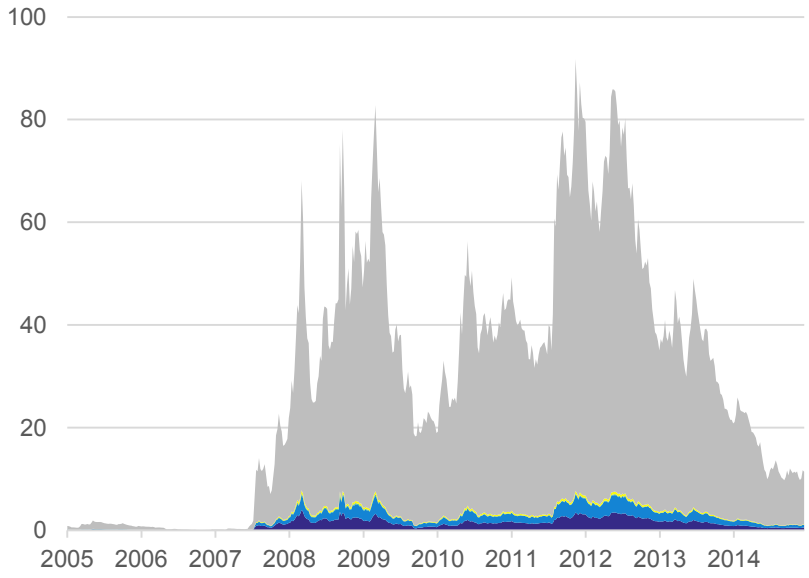
DIP in nominal price and unit price



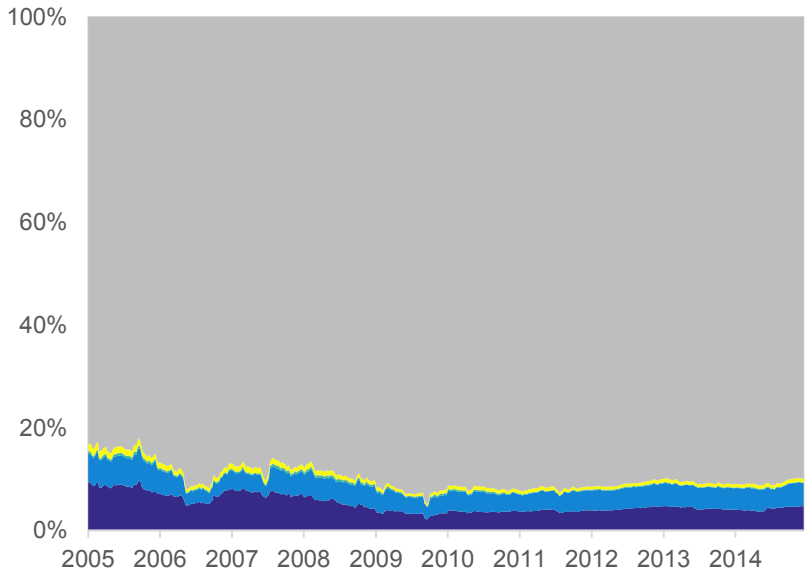
- Highest level of systemic risk during financial crisis: March 13, 2009 (USD 548 bln, 83 bps)
- Highest level of systemic risk during European sovereign debt crisis: November 25, 2011 (USD 625 bln, 92 bps)

Systemic risk in the global financial system by sector

DIP in unit price (in bps)



DIP as share of total (in %)

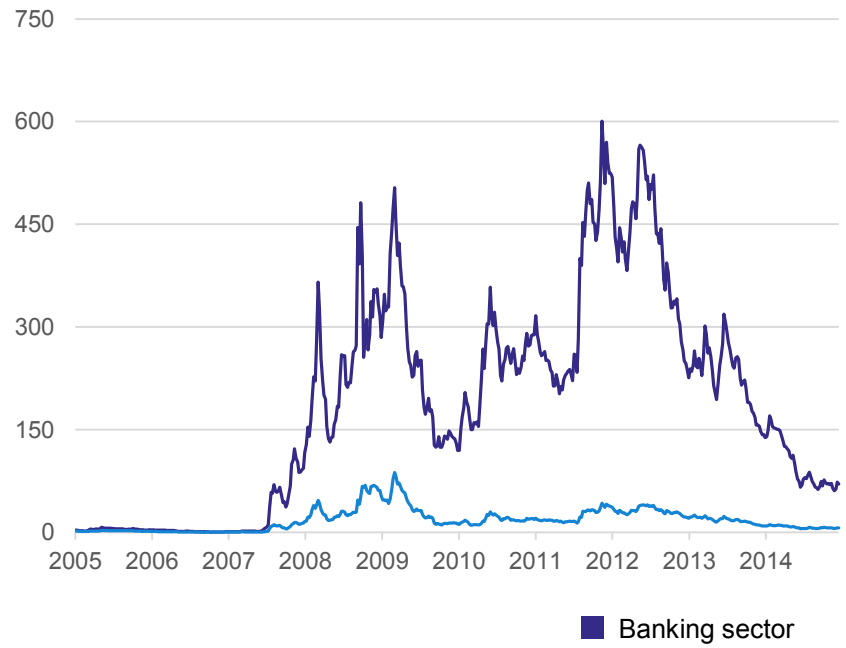


Banking Multi-line Life Property & casualty Financial Reinsurance

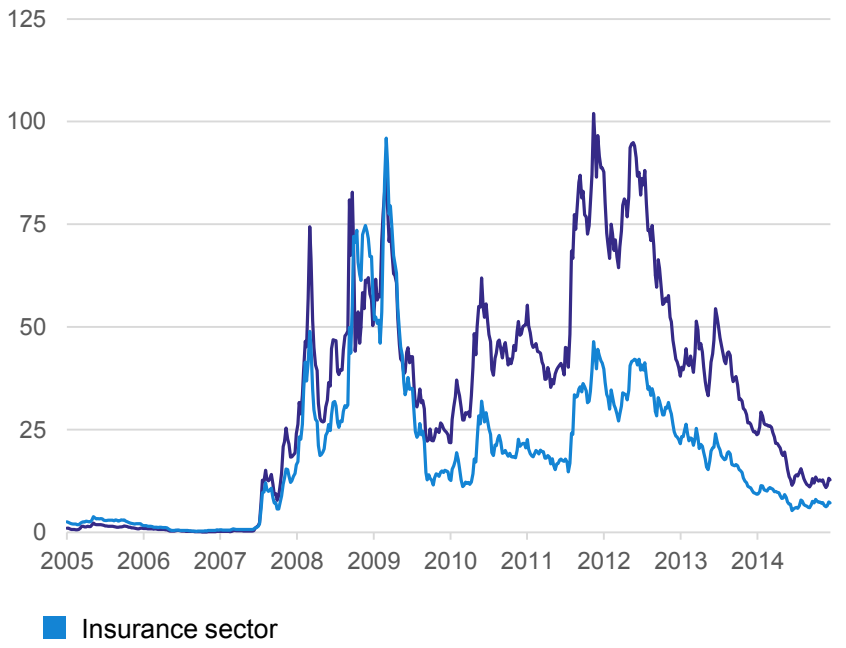
- Over the **financial crisis** and the **European sovereign debt crisis**, **insurers' contribution averaged 9%**
- **Multi-line and life insurers each accounted for 4%**, other insurers collectively accounted for 1%

Systemic risk in the global banking and insurance sectors

DIP in nominal price (in USD bln)



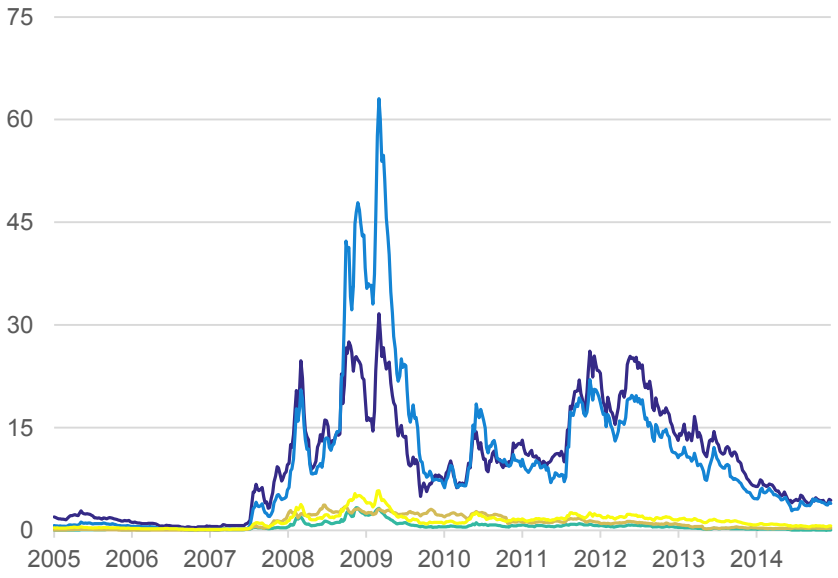
DIP in unit price (in bps, relative to sector liabilities)



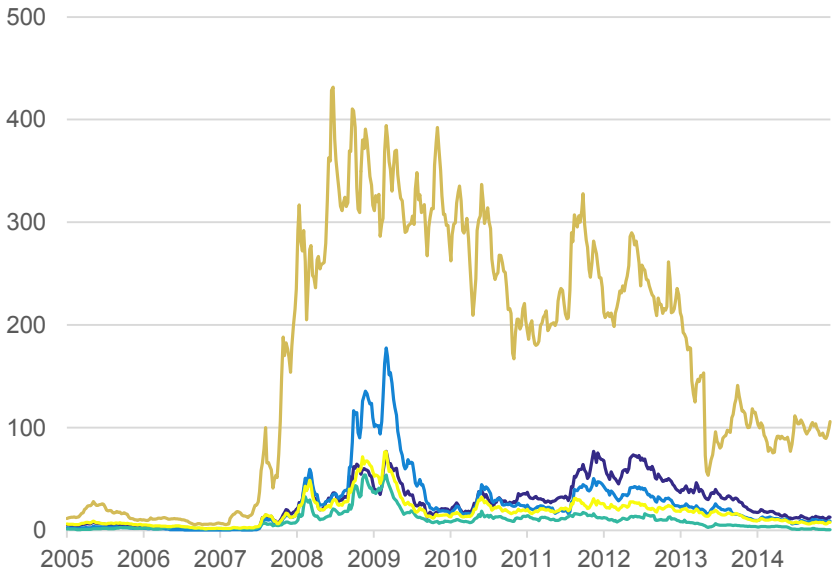
- **Over crisis periods,** absolute **DIP averaged USD 250 bln for banking** and **USD 24 bln for insurance**
- **On a relative basis**, **insurance sector** appears **more risky from 3Q2008 to 2Q2009** – possible explanations: (i) insurers more dependent on common factors around AIG bailout, (ii) higher government guarantees for banks

Systemic risk in the global insurance subsectors

DIP in nominal price (in USD bln)



DIP in unit price (in bps, relative to sector liabilities)



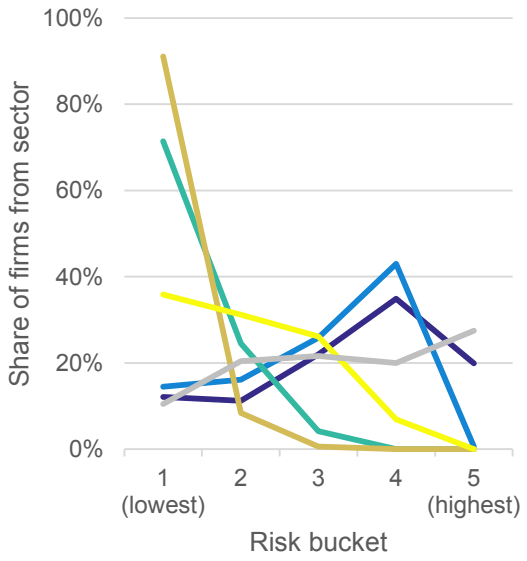
Multi-line Life Property & casualty Financial Reinsurance

- **Multi-line and life insurance sectors** with **highest absolute distress risk** during both crisis periods
- **Other insurance sectors** with **very low absolute distress risk** throughout sample period
- **Property & casualty insurance relatively least risky** whereas **financial insurance relatively most risky**

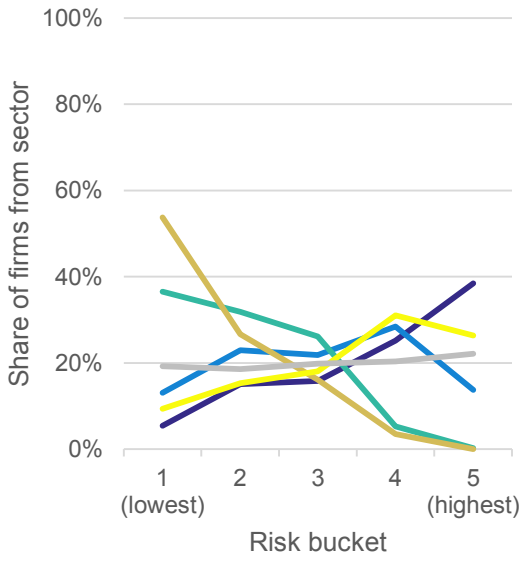
Ranking distribution of sample financial institutions

Average share of firms from each sector in five equally sized risk buckets

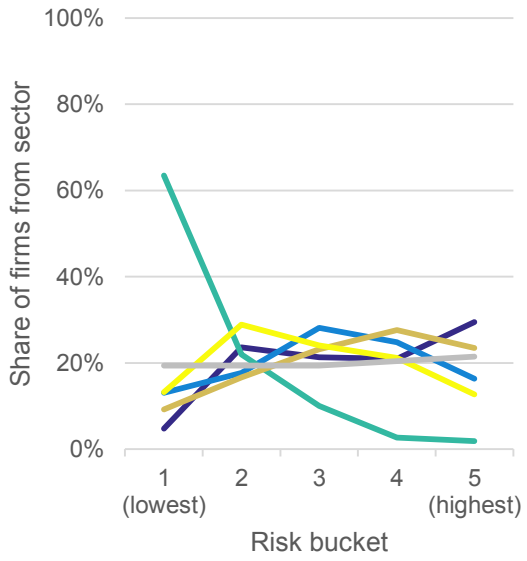
Marginal DIP



CoPSD



CoPD



Banking | Multi-line | Life | Property & casualty | Financial | Reinsurance

- **Multi-line** and **life insurers represented in highest buckets** for each risk measure
- **Property & casualty insurers consistently** rank **low**; **financial insurers exposed but otherwise rank low**
- Ranking of **reinsurers depends on the risk metric** – low marginal DIP but may show elevated CoPSD

Note: Full sample period from January 2005 through December 2014 considered

Riskiest sample financial institutions

Firms ranking in risk buckets 4 or 5 at least half of their respective sample period

	Marginal DIP		CoPSD		CoPD	
	Total	G-SIFIs[1]	Total	G-SIFIs[1]	Total	G-SIFIs[1]
Full sample	**67**	**37**	**54**	**28**	**65**	**26**
Insurers	**10**	**9**	**13**	**7**	**16**	**7**
Multi-line	4	4	5	4	5	4
Life	6	5	4	3	4	3
Property & casualty	-	-	-	-	-	-
Financial	-	-	-	-	5	-
Reinsurers	-	-	4	-	2	-
Banks	**57**	**28**	**41**	**21**	**49**	**19**

- Rankings by **marginal DIP** and **CoPSD closely replicate official G-SII lists**
- **Multi-line** and **life insurers consistently among riskiest** sample financial **institutions**
- **Property & casualty insurers consistently not among riskiest** sample financial **institutions**

1 G-SIBs and G-SIIs designated from 2011 through 2015

Summary and policy implications (1/2): Systemic risk by line of insurance

Multi-line and life

- **High relative distress risk, most risky** insurers based on **marginal contribution**
- **Some evidence of systemic relevance** – potentially due to size and banking-like activities

Property & casualty

- Consistently **tend to rank low** in aggregate and firm-level risk measures
- Overall do **not** appear to be **systemically risky**

Financial

- **Very high distress risk** during times of **financial turmoil**
- **Default not associated with** increased likelihood of **systemic event**

Reinsurers

- **Low to intermediate relative distress risk**
- **Default** of some reinsurers **associated with high probability of systemic distress**

- On **sector level**, **insurance less systemically risky compared to banking**
- On **institution level**, **some insurers** appear to be **as systemically important as banks**

Summary and policy implications (2/2): Regulation of systemic risk in insurance

Sector level

- On **sector level**, **insurance less systemically risky compared to banking**
- Findings do **not support** a **generally stricter regulation of** global **insurance sector**
- **Most effort** to enhance financial stability **should be directed towards banking** sector
- **Role of insurance sector may** however **vary across regions and countries**

Institution level

- On **institution level**, **some insurers** appear to be **as systemically important as banks**
- **Stricter regulation** of **these firms** seems **justified**
- Regulation should be **activity-based rather than entity-based**
- E.g., **higher capital requirements in proportion** to **business activities' systemic risk**

Discussion

Appendix A
Modeling approach

CDS-implied default probabilities and correlations are used to calibrate a Merton-style multifactor credit risk model

Risk Parameters

Risk-neutral probabilities of default

- Estimated from CDS spreads of sample institutions
- No-arbitrage consideration: expected present values of spread payments and incurred loss initially equal

Asset return correlations

- Estimated from default probabilities:

$$\rho_{ij} = \text{corr}(\Delta \ln A_{i,t}, \Delta \ln A_{j,t}) = \text{corr}(\Delta DTD_{i,t}(h), \Delta DTD_{j,t}(h))$$

- Fit factor structure solving quadratic optimization problem

Recovery rates

- Different recovery rates for insurers and banks
- Estimated based on sectors' liability structures: 80% recovery rate for customer deposits and technical provisions and 40% recovery rate for all other liabilities

Modeling Approach

Simulation of systemic events[1]

- Model asset values as geometric Brownian motion (as in the Merton model) with multifactor model for random part:

$$dA_{i,t} = rA_{i,t}dt + \sigma_i A_{i,t} dW_{i,t}$$

$$dW_{i,t} = F_i dY_t + \sqrt{1 - F_i F_i^T}\, dZ_{i,t}$$

- Risk-neutral probability of default by individual firm is

$$\begin{aligned} PD_{i,t}(h) &= \text{P}(A_{i,t+h} < D_i) \\ &= \text{P}(R_{i,t:t+h} < -DTD_{i,t}(h)) \\ &= \Phi(-DTD_{i,t}(h)), \end{aligned}$$

  where $R_{i,t:t+h} \sim N(0,1)$ with $\rho_{ij} = \text{corr}(R_{i,t:t+h}, R_{j,t:t+h}) = F_i F_j^T$, and the distance-to-default $DTD_{i,t}(h)$ is linear in $\ln A_{i,t}$

- Systemic event assumed if total loss exceeds systemic loss threshold (10% of sample liabilities)
- Use Monte Carlo simulation with importance sampling to derive risk-neutral risk measures over one-year horizon

1 Approach based on Huang et al. (2009,2012a,2012b) Note: $A_{i,t}$ = asset value, r = risk-free rate, σ_i = volatility, $W_{i,t}$ = Wiener process, $Y_t = [Y_{1,t}, \dots, Y_{M,t}]^T$ = common factors, $Z_{i,t}$ = idiosyncratic factor, $F_i = [F_{i,1}, \dots, F_{i,M}]$ = common factor loadings, D_i = default point

Appendix B
Descriptive statistics

Sample size, liabilities, and CDS spreads

		Liabilities (in USD bln)[1]		CDS spreads (in bps)[2]		
	N	Median	Total	Pre-crisis	Financial crisis	Sovereign debt crisis
Global	**183**	**166**	**68,353**	**33**	**277**	**232**
Banks	**133**	**211**	**59,035**	**28**	**193**	**227**
Insurers	**50**	**86**	**9,318**	**42**	**471**	**247**
Multi-line	8	459	3,800	31	218	155
Life	15	247	4,044	36	298	166
Property & casualty	12	54	614	65	141	80
Financial	8	8	74	38	1,799	984
Reinsurers	7	52	786	30	120	122
Northern America	**38**	**95**	**11,349**	**46**	**647**	**336**
Banks	**12**	**1,129**	**8,350**	**28**	**264**	**180**
Insurers	**26**	**40**	**2,998**	**56**	**769**	**388**
Europe	**92**	**285**	**44,391**	**20**	**155**	**240**
Banks	**74**	**266**	**38,508**	**17**	**155**	**274**
Insurers	**18**	**314**	**5,883**	**27**	**158**	**124**

Note: Pre-crisis: January 2004 to July 2007; financial crisis: August 2007 to April 2010; sovereign debt crisis: May 2010 to December 2014
1 For 2009; adjusted for consolidation 2 Averages of 5-year senior unsecured CDS spreads

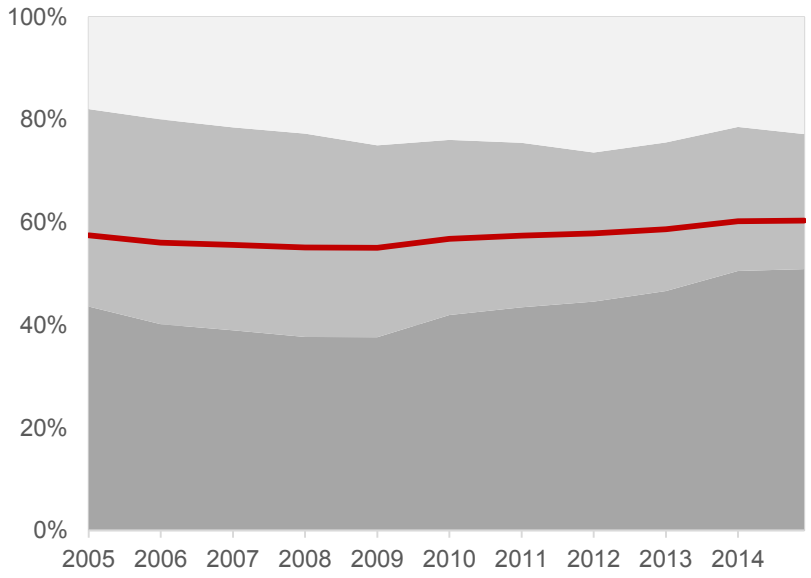
Probabilities of default and asset return correlations

	Risk-neutral probabilities of default (in %)[1]			Asset return correlations (in %)[2]		
	Pre-crisis	Financial crisis	Sovereign crisis	Pre-crisis	Financial crisis	Sovereign debt crisis
Global	**0.5**	**3.3**	**3.2**	**25.0**	**49.4**	**46.6**
Banks	**0.4**	**2.8**	**3.2**	**23.7**	**49.3**	**47.2**
Insurers	**0.6**	**4.7**	**3.1**	**27.7**	**49.3**	**45.0**
Multi-line	0.4	2.9	2.4	33.4	55.8	52.0
Life	0.5	3.8	2.5	28.3	53.1	48.0
Property & casualty	0.9	2.1	1.3	22.8	45.7	37.8
Financial	0.6	14.0	9.7	26.7	37.2	33.0
Reinsurers	0.4	1.8	1.9	29.4	53.7	50.6
Northern America	**0.7**	**6.1**	**4.0**	**27.5**	**45.9**	**46.4**
Banks	**0.4**	**3.6**	**2.7**	**30.9**	**49.0**	**53.1**
Insurers	**0.8**	**7.0**	**4.4**	**25.9**	**45.1**	**43.9**
Europe	**0.3**	**2.3**	**3.4**	**27.2**	**52.9**	**49.0**
Banks	**0.3**	**2.3**	**3.8**	**24.9**	**51.3**	**48.0**
Insurers	**0.4**	**2.3**	**1.9**	**33.8**	**57.2**	**52.1**

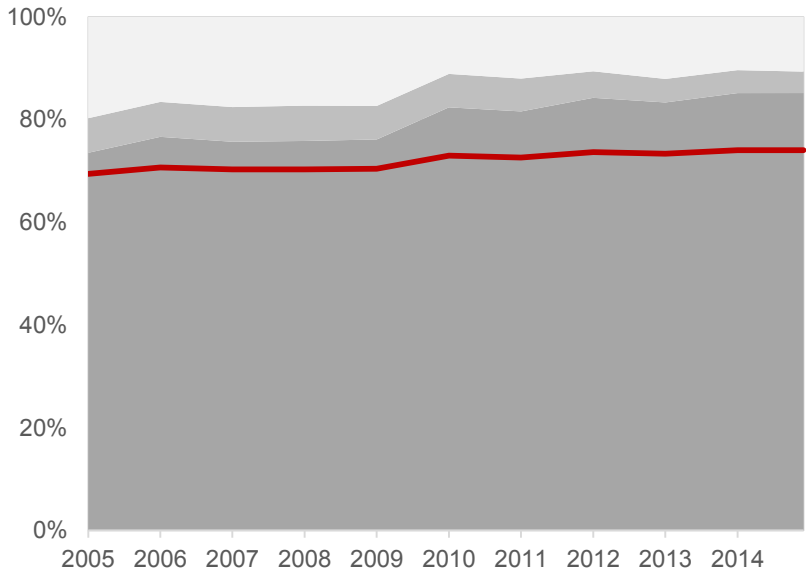
Note: Pre-crisis: January 2005 to July 2007; financial crisis: August 2007 to April 2010; sovereign debt crisis: May 2010 to December 2014
1 For one-year horizon 2 Average of average correlation of firm with all other sample firms; calculated using a rolling window of one year

Liability structure and recovery rates

Banking sector



Insurance sector



Customer deposits/ technical provisions | Borrowings | Other | Recovery rate

- Assume recovery rate of 80% for *customer deposits/ technical provisions* and 40% for *borrowings* and *other*
- **Average recovery rate** of **banks** is **57%** – consistent with evidence for U.S. bank failures reported by James (1991)
- **Average recovery rate** of **insurers** is **72%**

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