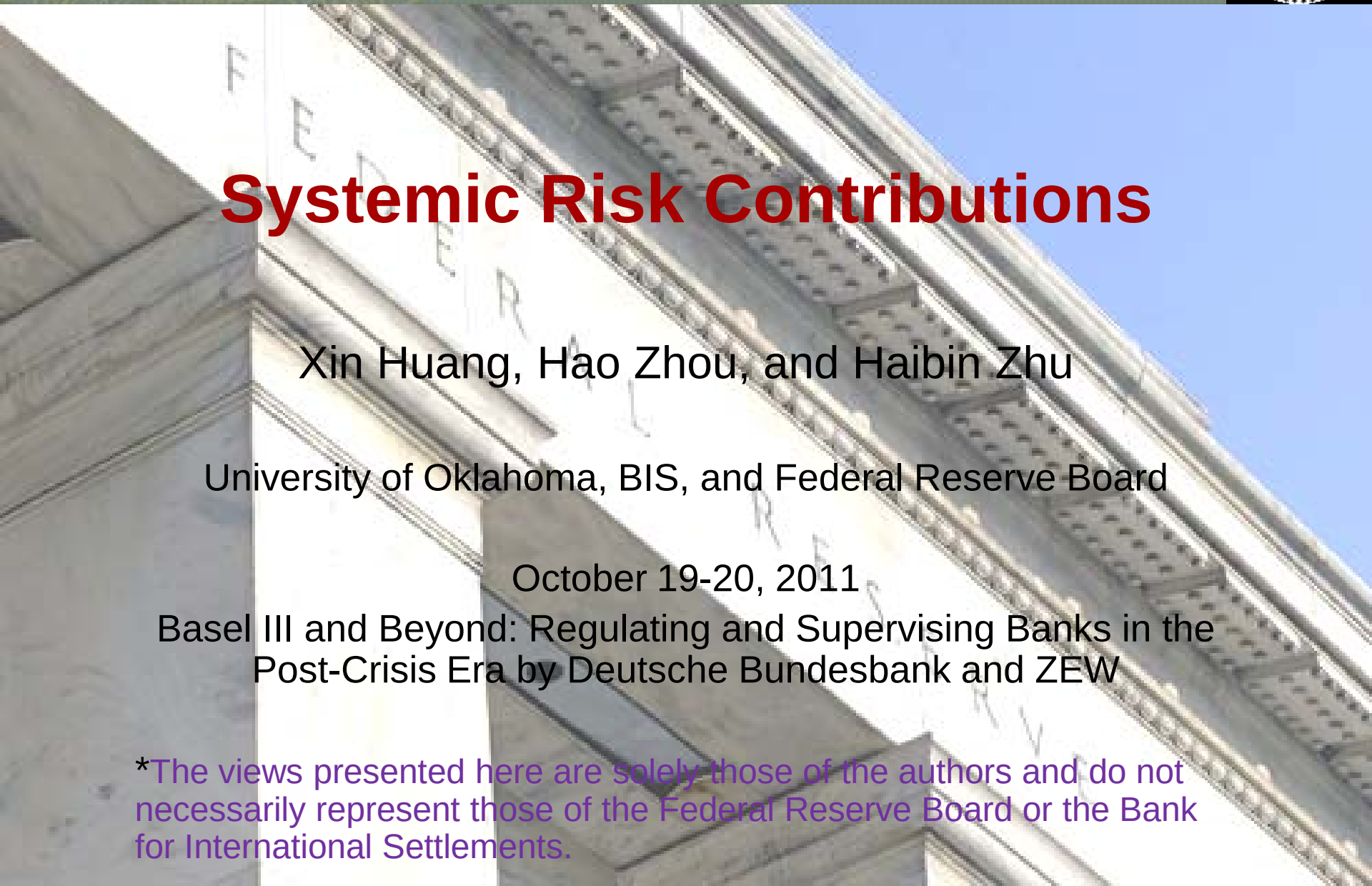

Systemic Risk Contributions

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Basel III and Beyond: Regulating and Supervising Banks in the Post-Crisis Era by Deutsche Bundesbank and ZEW

*The views presented here are solely those of the authors and do not necessarily represent those of the Federal Reserve Board or the Bank for International Settlements.

Background

- "Macroprudential" regulation after recent financial crisis
  - Basel I & II: Soundness of individual banks - microprudential
  - Basel III: Macroprudential perspective of banking system
  - Dodd-Frank Bill: Financial Stability Oversight Council

- Key ingredients in macroprudential regulation
  - How to measure systemic risk in a financial system?
  - How to measure each bank's contribution to systemic risk?
  - How to assess systemic risk surcharge or fee or capital?

Plan of the presentation

- Dodd-Frank Bill on Systemic Risk Regulation
- Introduction and macroprudential literature
- Methodology of Distress Insurance Premium (DIP)
- Empirical findings of systemic risk and bank rankings
- Conclusion and policy implications

1. Reform Bill and Systemic Risk Provisions

- Financial Stability Oversight Council (FSOC) to monitor systemic risk and delegation to Federal Reserve Board
- FSOC designates nonbank systemically important financial institutions (SIFI), subject to Federal Reserve regulation
- Federal Reserve to develop enhanced prudential standards for all bank holding companies ("BHCs") with $50 billion or more in assets and systemically designated nonbank financial firms
- Orderly resolution of failing, systemically-significant BHCs or nonbank SIFI
- (This line of research contributions to first three items)

Financial Times reported G-SIFI surcharge

SIFI surcharge
Expected capital surcharge above minimum requirement of 7% in 2016 (%)

No Banks expected to be in this cluster	3.5
Bank of America	2.5
Barclays	2.5
BNP Paribas	2.5
Citigroup	2.5
Deutsche Bank	2.5
HSBC	2.5
JPMorgan Chase	2.5
Royal Bank of Scotland	2.5
Credit Suisse	2.0
Goldman Sachs	2.0
Morgan Stanley*	2.0
UBS	2.0
Crédit Agricole	1.5
Dexia	1.5
ING	1.5
MUFG*	1.5
Santander	1.5
Société Générale	1.5
UniCredit	1.5
BBVA	1.0
BNY Mellon	1.0
BPCE	1.0
Commerzbank	1.0
Mizuho Financial	1.0
Nordea Bank	1.0
Rabobank	1.0
State Street	1.0
Wells Fargo	1.0

*Sources: BIS; Morgan Stanley; * FT research*

1. Introduction

Objectives

- Definition and measurement of systemic risk: market implied hypothetical distress insurance premium (DIP, Huang, Zhou and Zhu 2009 JBF)
- How to allocate systemic risk to individual banks? Marginal contribution of each bank (Huang, Zhou and Zhu 2011 JFS)
- Policy implications: A basis for systemic capital surcharge and bailout costs (building on this paper JFSR)

Features

- Additivity for operational convenience in macroprudential-microprudential regulation framework
- Decompose into different sources: e.g., actual default risk versus credit and liquidity risk premia
- Economically aggregating key systemic risk ingredients
  - Size or too-big-to-fail
  - Concentration or interconnectedness
  - Default probability or leverage ratio

Preview of findings for 19 SCAP banks

- DIP around $50bn before 2007, peaks at $1.1tn in March 2009, falls to $300bn in December 2009

  (How large should EFSF be?)

- DIP largely linear in PD, nonlinear in correlation and size

- DIP-SCAP expected loss 0.72, rank correlation 0.90

- DIP is more GS and JPM; SCAP is more BoA and WF

Literature

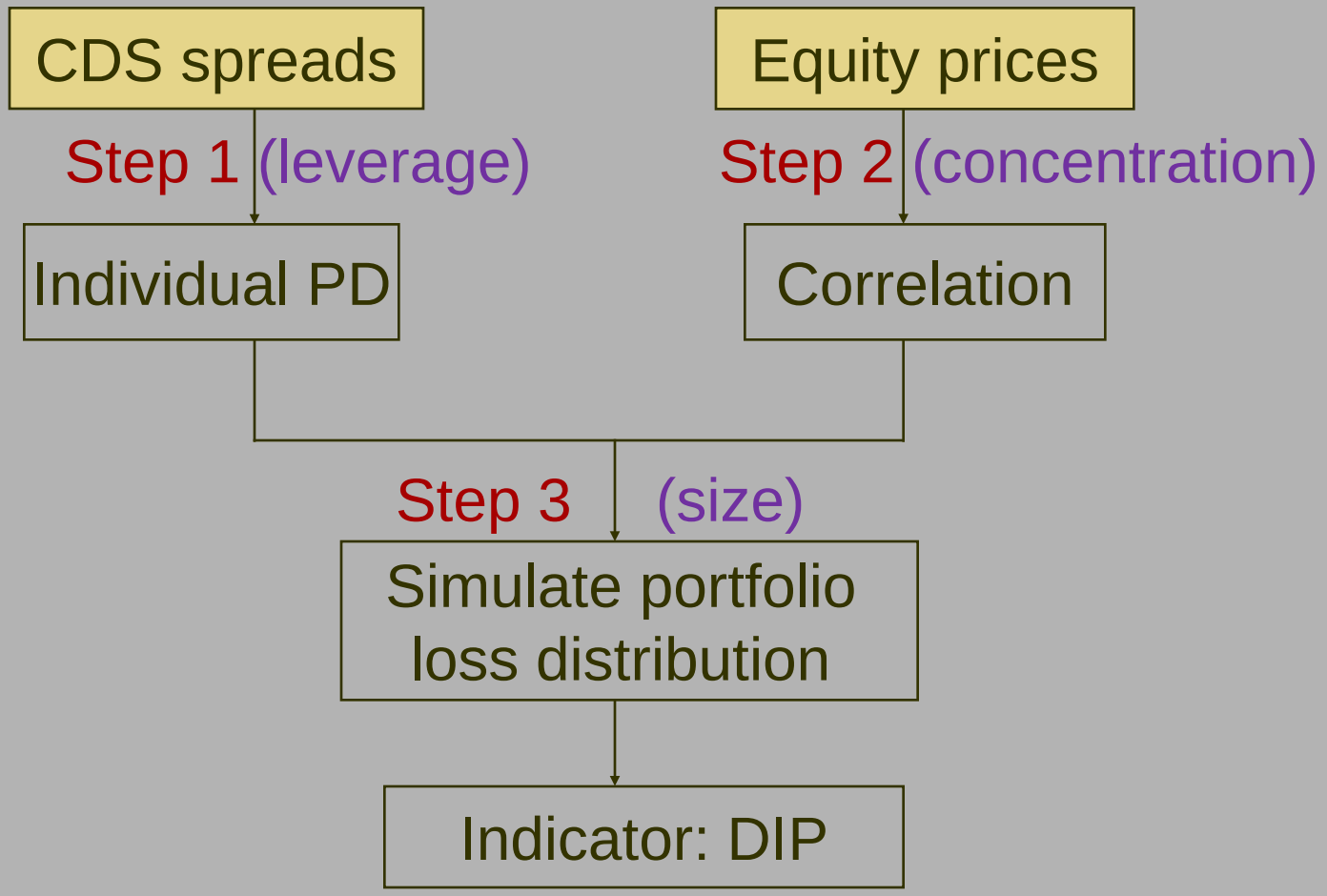
- Market-based systemic risk indicator
  - Probability of joint defaults: Lehar (2005), Chan-Lau and Gravelle (2005), Avesani et al (2006)
- Stress test: IMF FSAP, SCAP (US), EBA (EU)
- Alternative systemic risk measures of individual banks
  - Adrian and Brunnermeier (2008): CoVaR approach
  - Acharya et al (2010): MES approach

2. Methodology

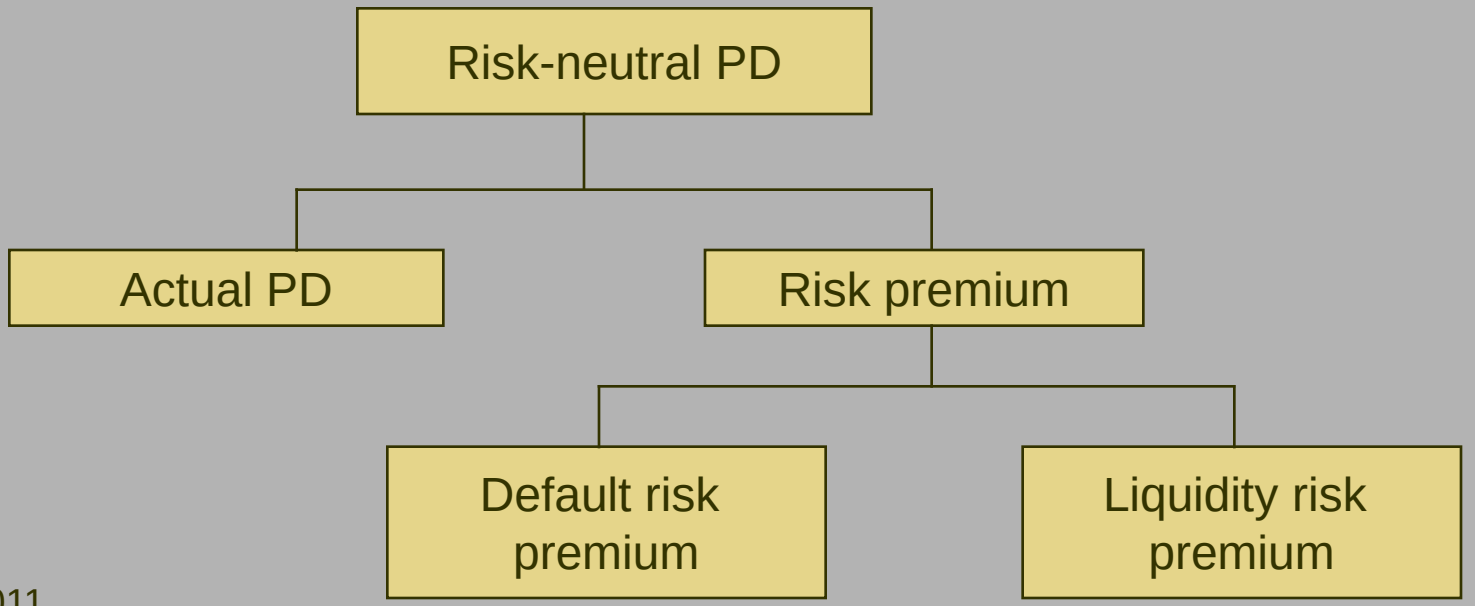
- Phase I: Construct a systemic risk indicator (3 steps)
- Phase II: Measure each bank's contribution to systemic risk

- Basic idea of distress insurance premium (DIP): Suppose that a hypothetic insurance contract is issued to protect distressed losses in a banking system (at least a significant portion of total liabilities in default), what is the fair insurance premium? Similar to real option, replicated by market prices.

Phase I: Distress insurance premium (DIP)



- Step 1: Estimating PDs from CDS spreads
  - A standard exercise in the literature: PD ≈ CDS / LGD
  - PDs are *risk-neutral* and *forward-looking*



$$s_{i,t} = \frac{(1 - R_{i,t}) \int_t^{t+T} e^{-r_\tau \tau} q_{i,\tau} d\tau}{\int_t^{t+T} e^{-r_\tau \tau} \left[1 - \int_t^{\tau} q_{i,u} du\right] d\tau}$$

$$PD_{i,t} = \frac{a_t s_{i,t}}{a_t LGD_{i,t} + b_t s_{i,t}}$$

$$a_t \equiv \int_t^{t+T} e^{-r_t \tau} d\tau,\ b_t \equiv \int_t^{t+T} \tau e^{-r_t \tau} d\tau, \text{ and } LGD_{i,t} = (1 - R_{i,t})$$

- Step 2: Estimating asset return correlations
  - Use equity return correlation proxy, but to ensure consistency:
    - Vasicek (1991) latent factor approach (Gordy 2003)

$$\Delta \log(A_{i,t}) = B_i M_t + \sqrt{1 - B_i' B_i} \cdot Z_{i,t}$$

$$\min_{B_1 \cdots B_N} \sum_{i=2}^{N} \sum_{j<i}^{N} \left(\rho_{ij} - B_i B_j'\right)^2$$

- Step 3: Simulate (risk-neutral) portfolio loss distribution
  - Main inputs: PDs, correlations, liability sizes
  - Other inputs: risk-free rate, LGDs

$$L = \sum_{i=1}^{N} L_i$$

$$\mathrm{DIP} = \mathrm{E}^{Q}\left[L | L \geq L_{\min}\right]$$

- Similar to “expected shortfall” but with a threshold value

Phase II: Allocating systemic risk to each bank

- Marginal contribution of bank *i* to the systemic risk

$$\frac{\partial \mathrm{DIP}}{\partial L_i} \equiv \mathrm{E}^{Q}[L_i | L \geq L_{\min}]$$

- Additive property for macro- & micro- prudential regulation

- CoVaR (Adian and Brunnermeier 2009)

$$\text{Prob}\left(L \geq \text{CoVaR}_q | L_i \geq \text{VaR}_q^i\right) = q$$

  - Statistical measure, not risk-neutral as DIP
  - Portfolio conditional on bank, opposite to DIP
  - VaR is not sub-additive, aggregation problem
  - Implicitly captures PD and correlation, but not size

- MES (Acharya, Pedersen, Philippon, and Richardson 2010)

$$\mathrm{MES}_q^i \equiv \mathrm{E}\left(L_i | L \geq \mathrm{VaR}_q\right)$$

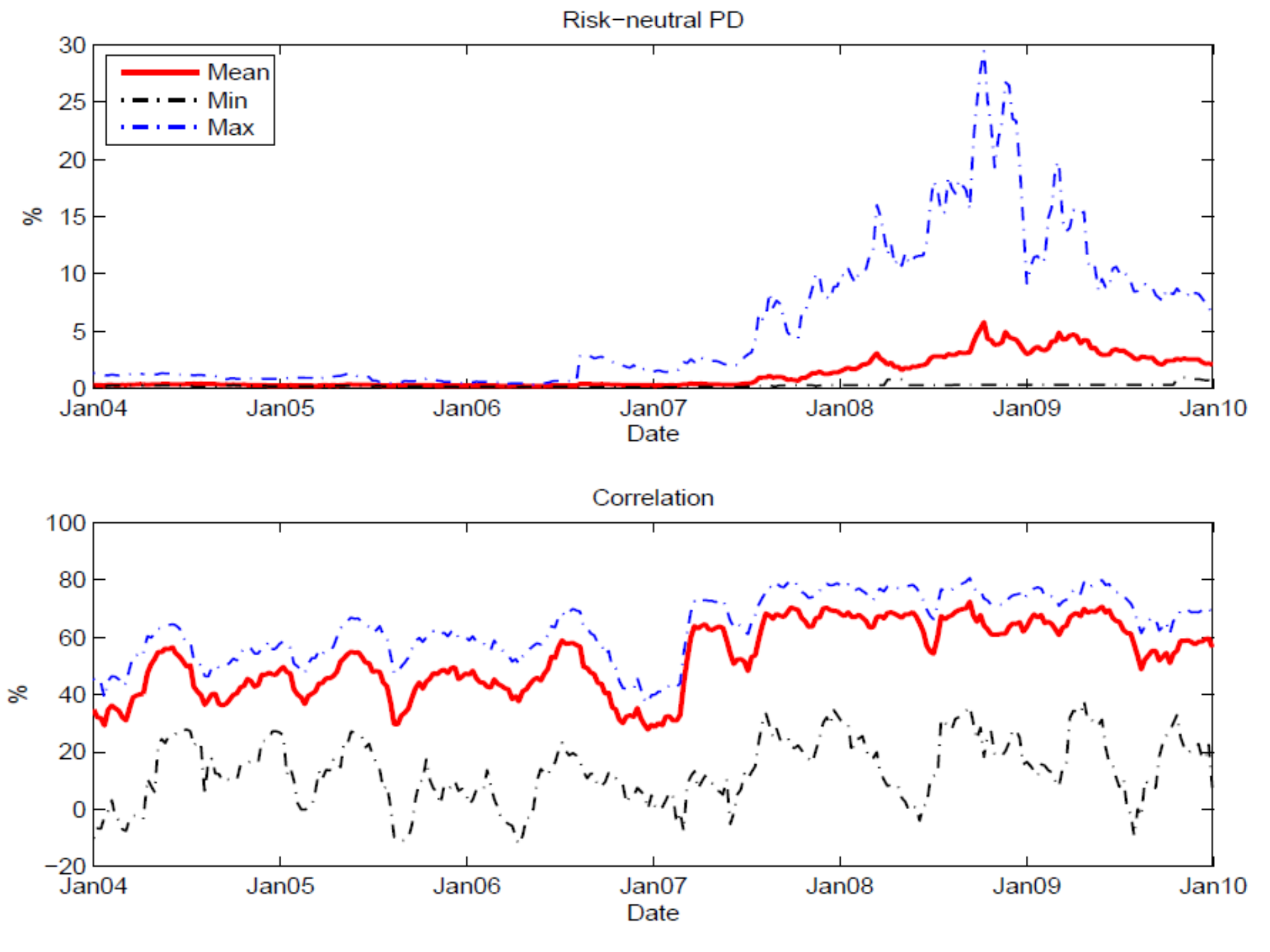
  - Statistical measure, not risk-neutral as DIP
  - Extreme condition is percentile, DIP is threshold
  - Implement on equity returns
  - Implicitly capture PD and correlation, but not size

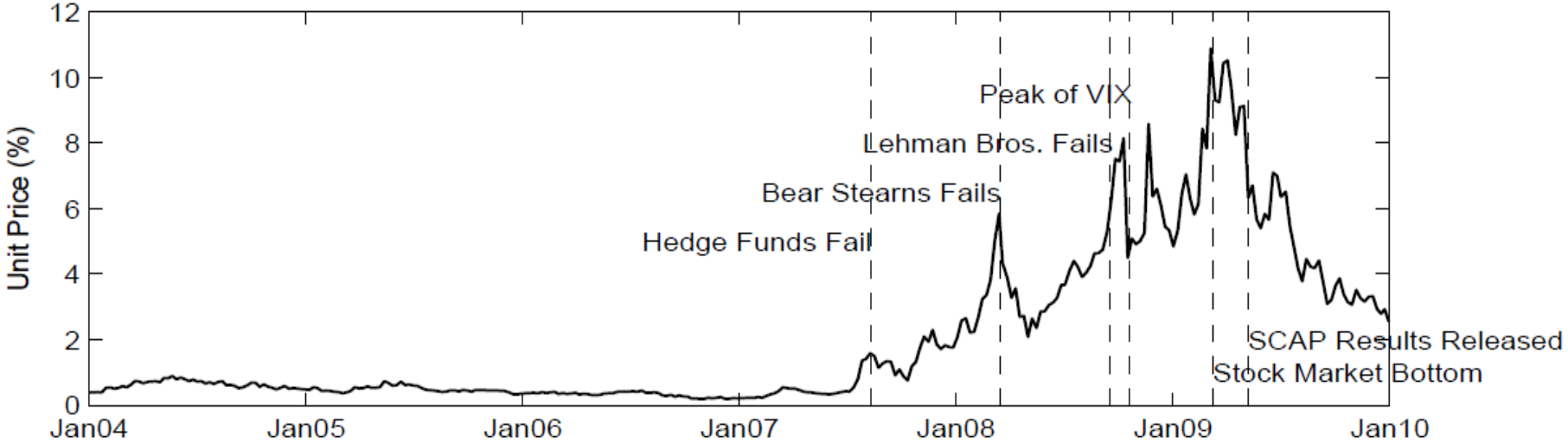
3. Empirical finding

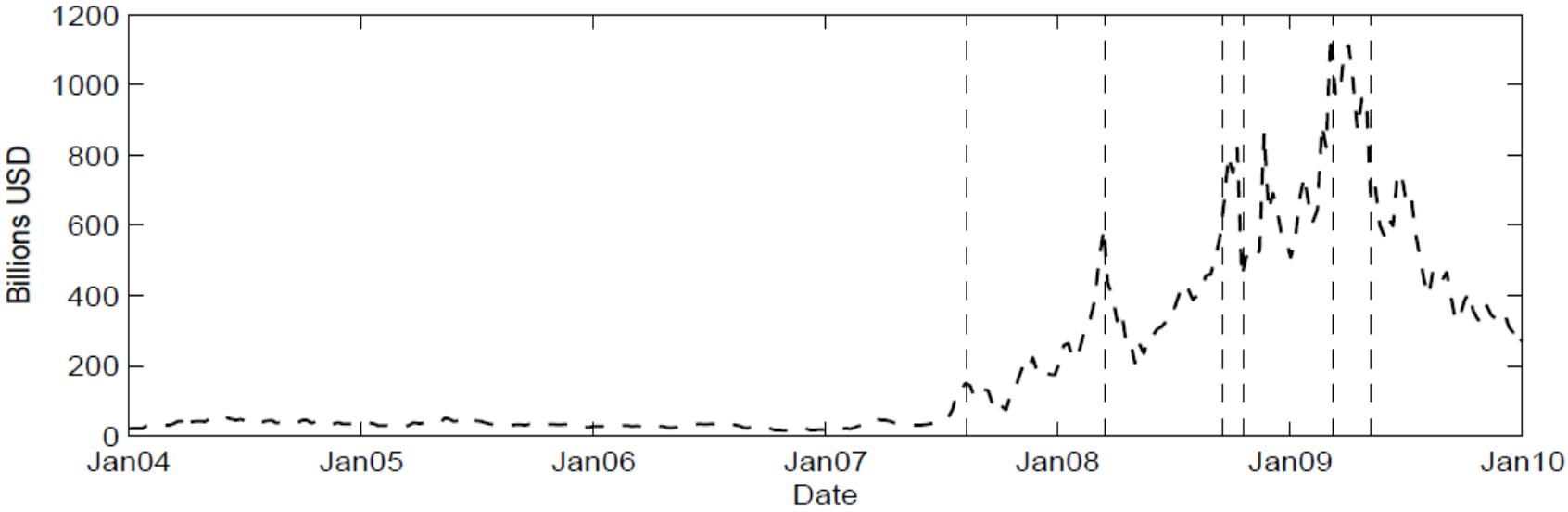
- Systemic risk indicator (economic meaning)
- Risk premium decomposition (which leads?)
- Marginal contributions (how to identify SIFI?)
- Alternative measures (CoVaR and MES)

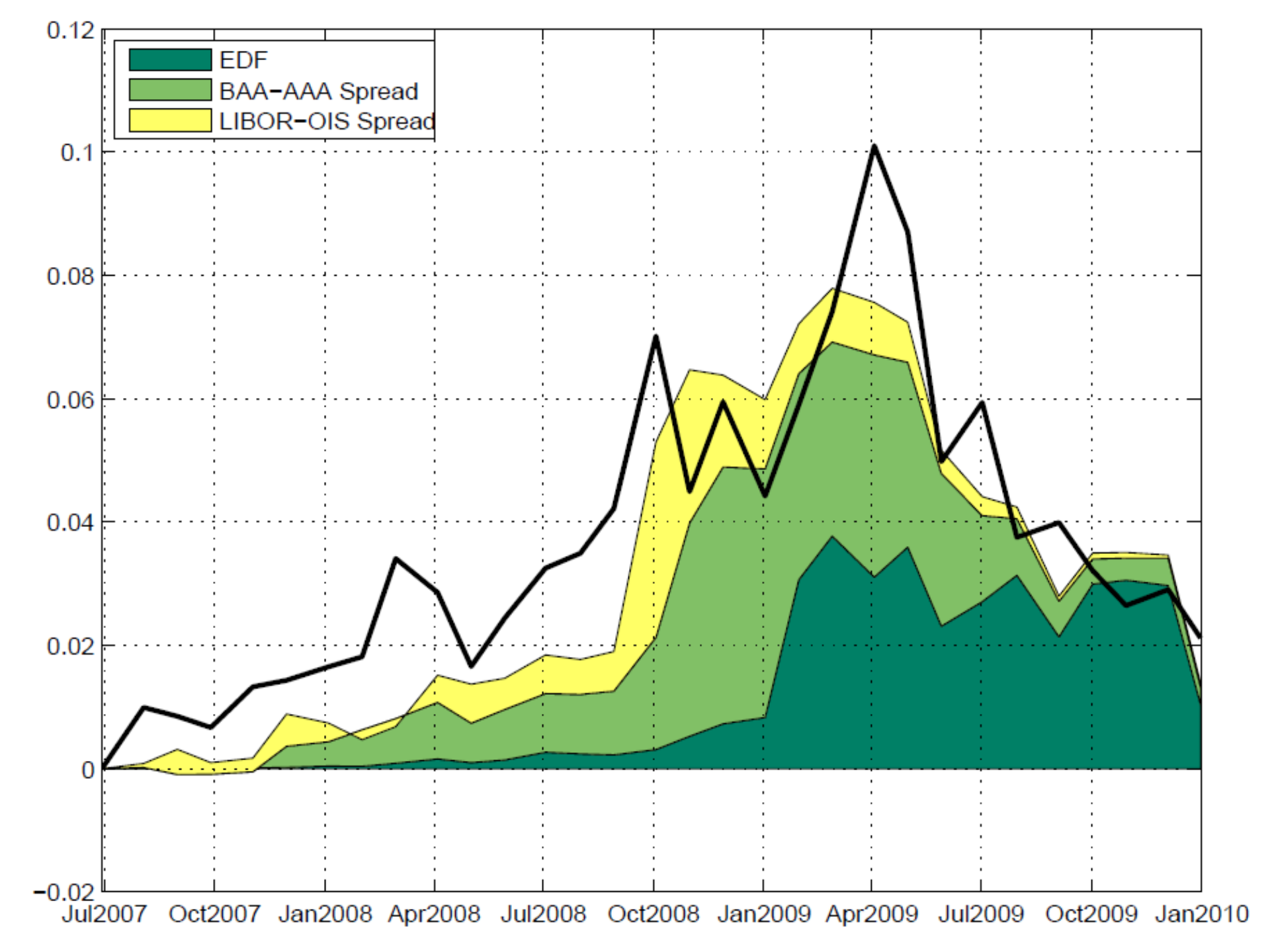
Example:

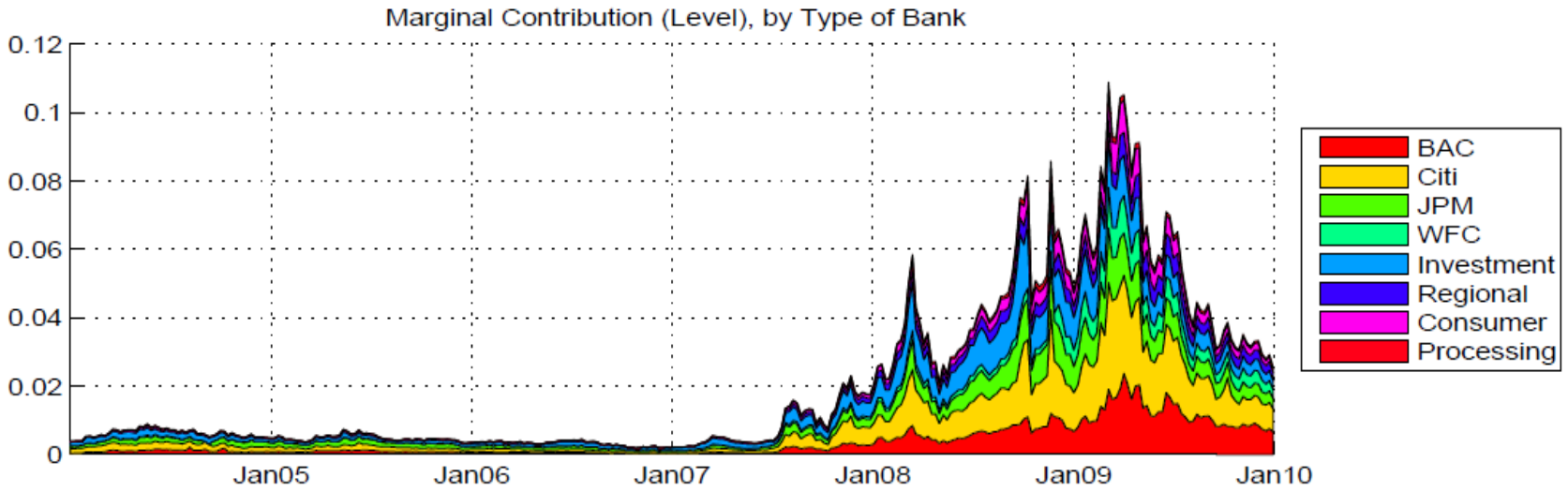
- 19 BHCs US SCAP (stress test)
- Critical step in stabilizing the financial markets

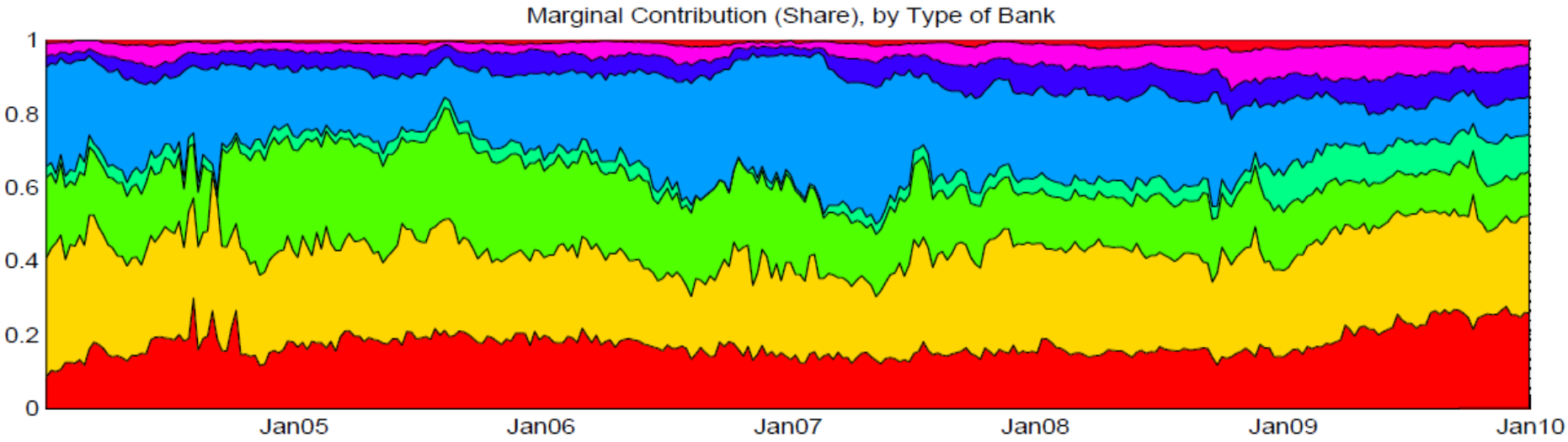

Risk−neutral PD
Mean
Min
Max
%
30
25
20
15
10
5
0
Jan04
Jan05
Jan06
Jan07
Jan08
Jan09
Jan10
Date
Correlation
%
100
80
60
40
20
0
−20
Jan04
Jan05
Jan06
Jan07
Jan08
Jan09
Jan10
Date

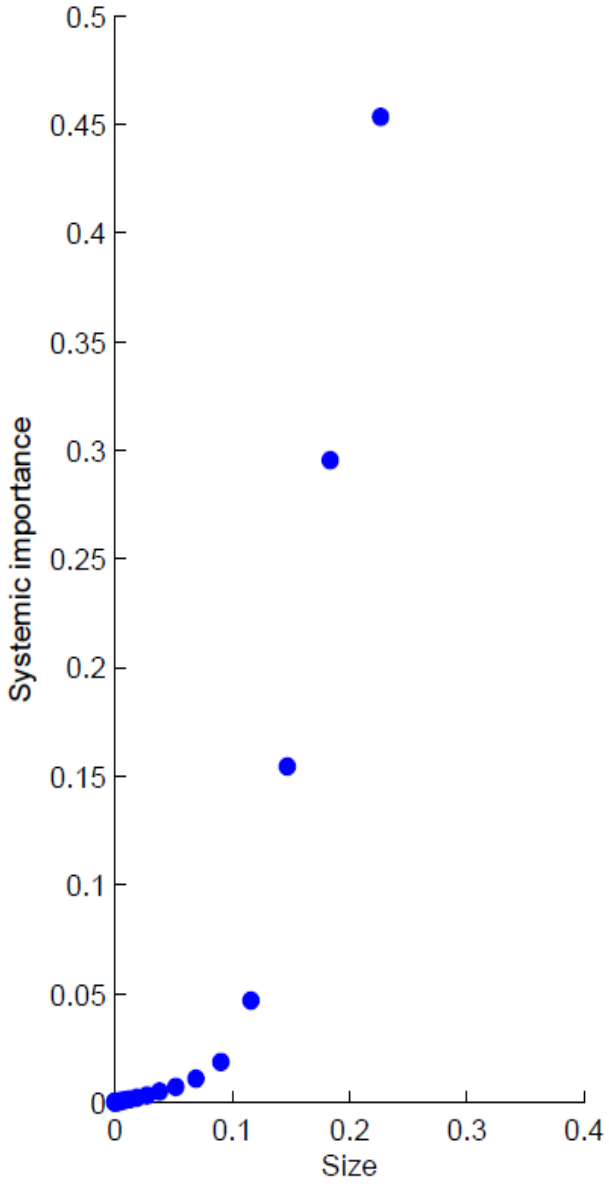

Unit Price (%)
12
10
8
6
4
2
0
Peak of VIX
Lehman Bros. Fails
Bear Stearns Fails
Hedge Funds Fail
SCAP Results Released
Stock Market Bottom
Jan04
Jan05
Jan06
Jan07
Jan08
Jan09
Jan10

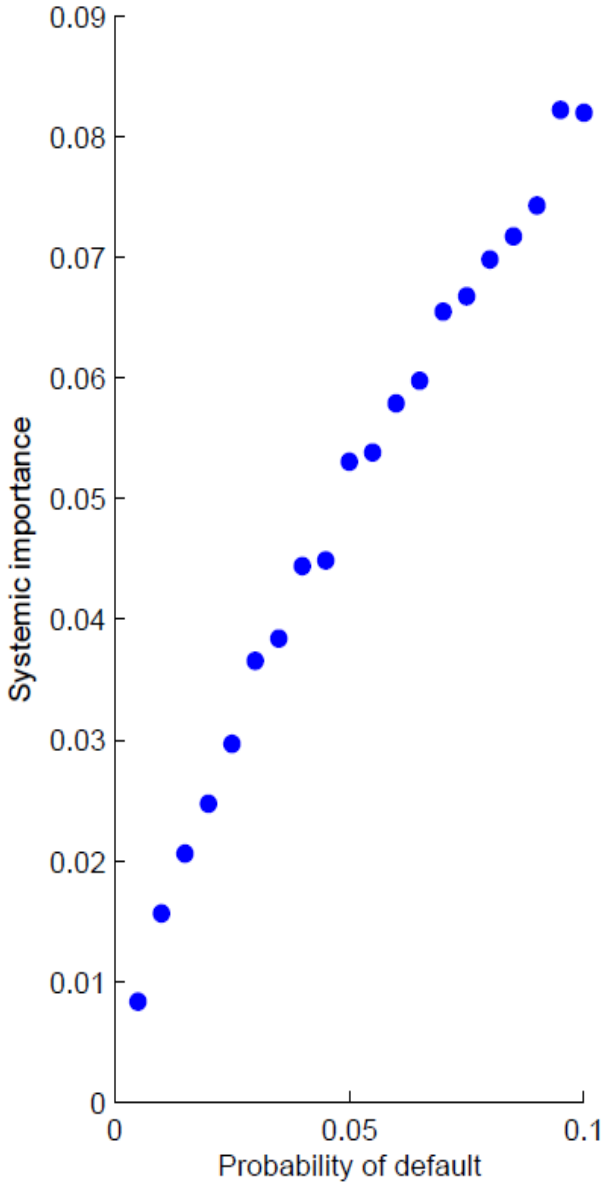

Billions USD
1200
1000
800
600
400
200
0
Jan04
Jan05
Jan06
Jan07
Jan08
Jan09
Jan10
Date

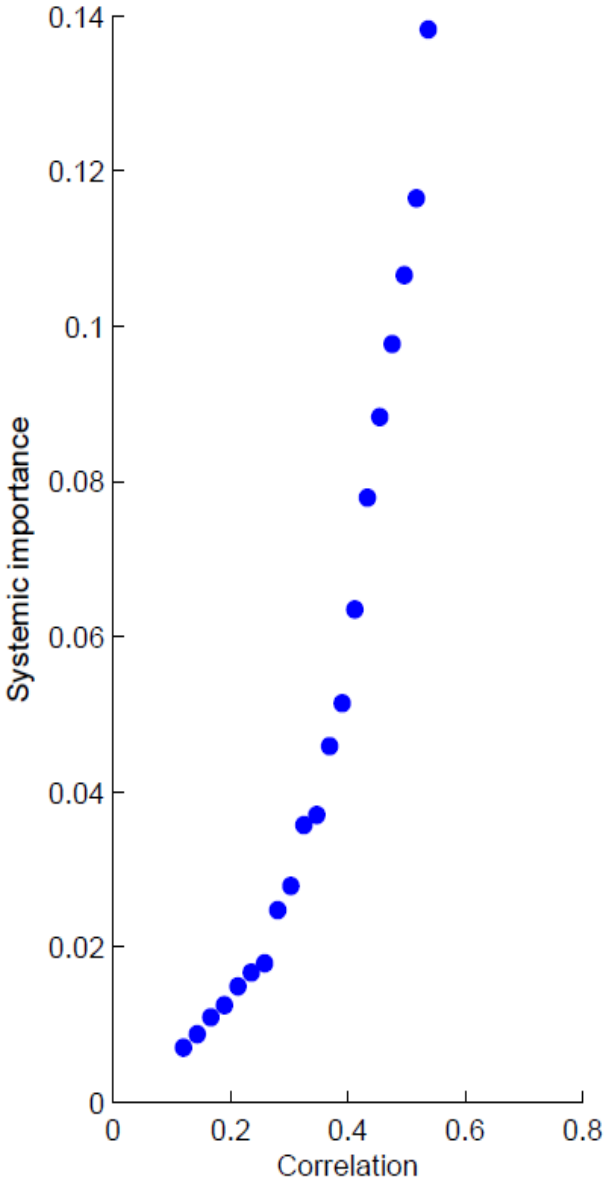

EDF
BAA−AAA Spread
LIBOR−OIS Spread
0.12
0.1
0.08
0.06
0.04
0.02
0
−0.02
Jul2007
Oct2007
Jan2008
Apr2008
Jul2008
Oct2008
Jan2009
Apr2009
Jul2009
Oct2009
Jan2010

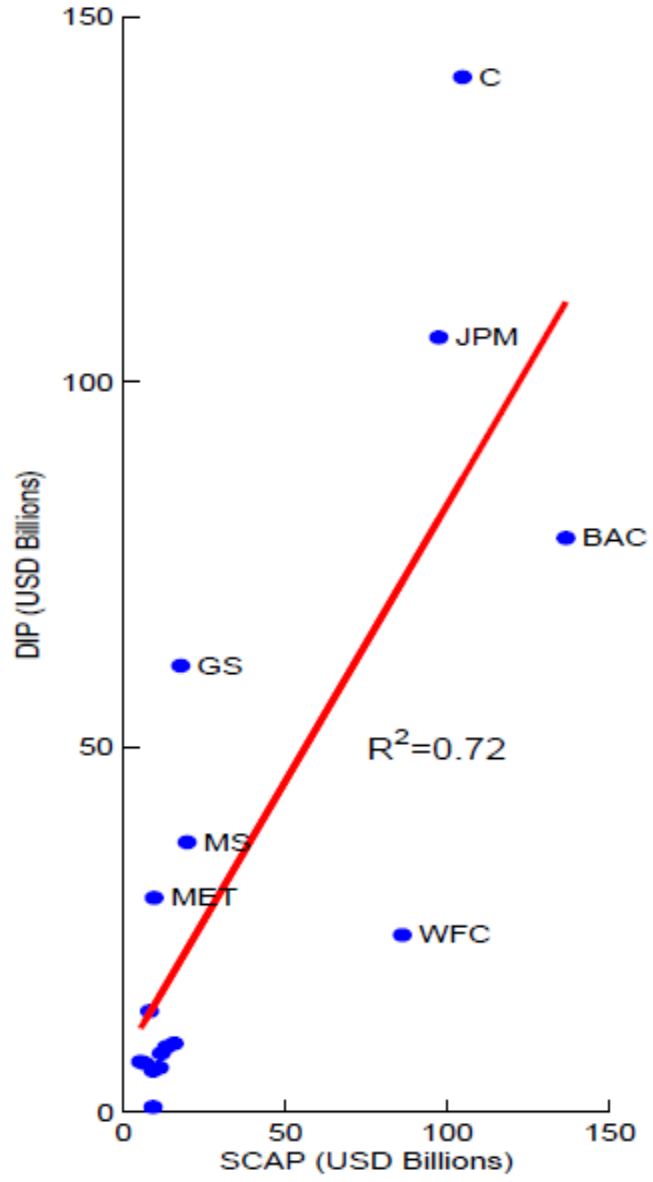

Marginal Contribution (Level), by Type of Bank
0.12
0.1
0.08
0.06
0.04
0.02
0
Jan05
Jan06
Jan07
Jan08
Jan09
Jan10
BAC
Citi
JPM
WFC
Investment
Regional
Consumer
Processing

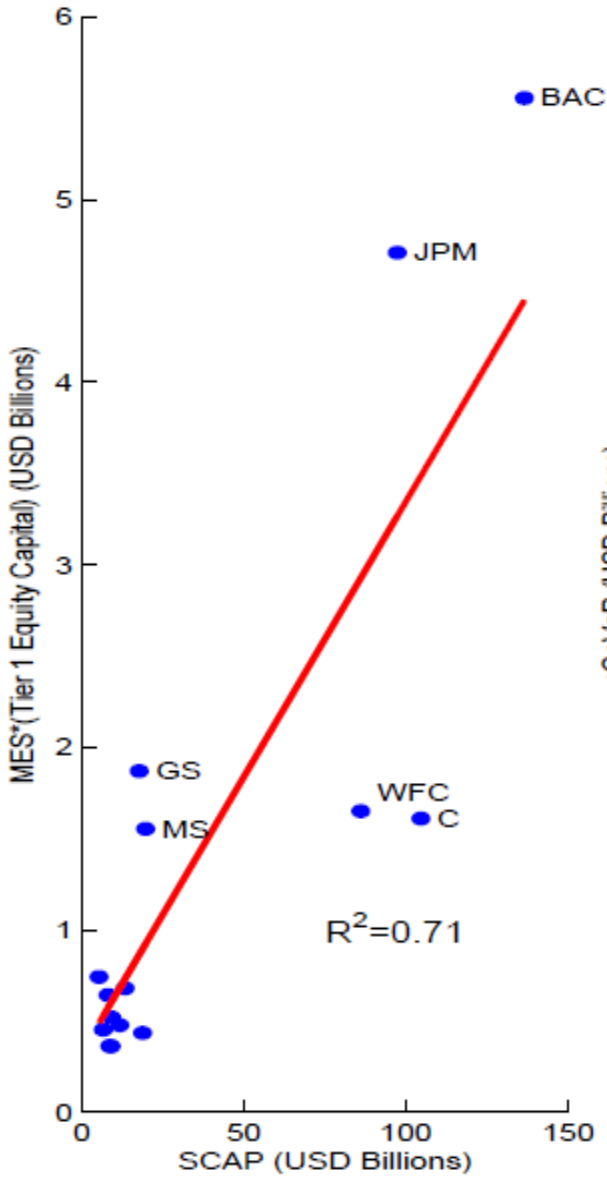

Marginal Contribution (Share), by Type of Bank
1
0.8
0.6
0.4
0.2
0
Jan05
Jan06
Jan07
Jan08
Jan09
Jan10


Systemic importance
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
0.1
0.2
0.3
0.4
Size


Systemic importance
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
0.05
0.1
Probability of default


Systemic importance
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
0.2
0.4
0.6
0.8
Correlation


DIP (USD Billions)
SCAP (USD Billions)
C
JPM
BAC
GS
MS
MET
WFC
R^2=0.72
0
50
100
150


MES*(Tier 1 Equity Capital) (USD Billions)
SCAP (USD Billions)
BAC
JPM
GS
WFC
C
MS
R^2=0.71
0
1
2
3
4
5
6
50
100
150

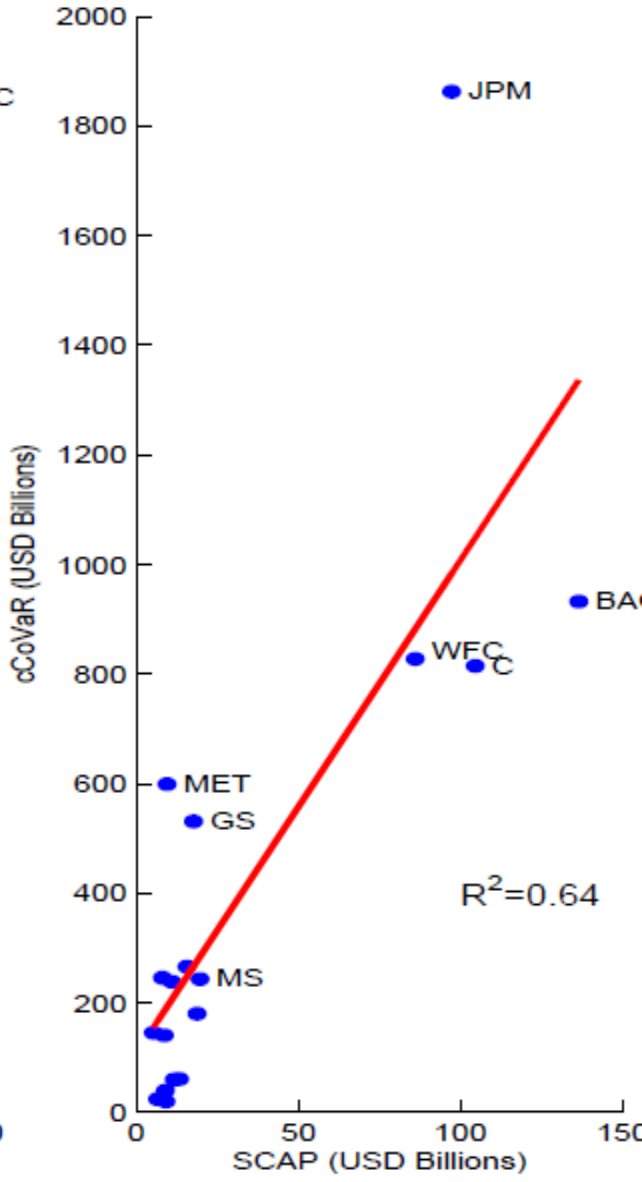

ΔCoVaR (USD Billions)
SCAP (USD Billions)
JPM
WFC
C
MET
GS
MS
R^2=0.64
0
200
400
600
800
1000
1200
1400
1600
1800
2000
50
100
150

Table 6 Marginal Contributions under Various Risk Measures, 2008 Q4

Ranking	DIP		MES		CoVaR		SCAP	
1	Citi	131.91	BOA	5.55	JPMC	1863.06	BOA	136.60
2	JPMC	97.49	JPMC	4.71	BOA	932.48	Citi	104.70
3	BOA	78.56	GS	1.87	WFC	827.73	JPMC	97.40
4	GS	62.22	WFC	1.65	Citi	814.98	WFC	86.10
5	WFC	55.04	Citi	1.61	MET	599.28	MS	19.70
6	MS	41.33	MS	1.55	GS	530.98	PNC	18.80
7	MET	29.00	BNY	0.74	USB	265.97	GS	17.80
8	USB	10.26	COF	0.68	STT	245.59	USB	15.70
9	COF	9.49	STT	0.64	MS	243.27	COF	13.40
10	STI	8.88	RF	0.52	AXP	238.26	STI	11.80
11	STT	7.75	STI	0.48	PNC	180.19	AXP	11.20
12	AXP	7.29	KEY	0.45	BNY	145.44	MET	9.60
13	KEY	6.78	PNC	0.44	BBT	140.81	GMA	9.20
14	BNY	6.03	BBT	0.36	COF	60.82	RF	9.20
15	GMA	6.01	FITB	0.36	STI	59.64	FITB	9.10
16	RF	0.79	AXP	NaN	FITB	39.47	BBT	8.70
17	BBT	NaN	GMA	NaN	KEY	24.21	STT	8.20
18	FITB	NaN	MET	NaN	RF	20.11	KEY	6.70
19	PNC	NaN	USB	NaN	GMA	NaN	BNY	5.40

Rank Correlations

		Spearman ρ			
		DIP	MES	CoVaR	SCAP
Kendall τ	DIP		0.80	0.87	0.90
	MES	0.64		0.81	0.67
	CoVaR	0.71	0.64		0.70
	SCAP	0.74	0.49	0.52	

4. Conclusions

- Our approach provides a tool for macro-prudential regulation

- To identify systemically important financial institutions
- To understand sources of systemic risk
- To relate systemic risk with capital regulation (future research)

Policy Implications

- GSIFI 1-2.5%, 28 banks global SIFI's, how to justify?
  - Switzerland: UBS and Credit Suisse 19% with 2% contingent capital and 7% macroeconomic buffer
  - China: 11.5% for large banks and 10% for small and medium-sized banks
- How to define nonbank SIFI's?
- How much is needed for the recapitalization of banks in Europe?
  - How large should EFSF be?