



BANK FOR INTERNATIONAL SETTLEMENTS

Systemic Risk Contributions

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* The views do not necessarily represent those of the BIS, the Federal Reserve Board or the Federal Reserve System.



Background

- Macroprudential regulation after the recent global financial crisis
 - Cross-section dimension: SIFIs (FSB, BCBS)
 - Time dimension: procyclicality
- Identifying SIFIs (BIS/FSB/IMF report)
 - Size or too-big-to-fail
 - Interconnectedness or too-connected-to-fail
 - Substitutability
 - Leverage (or default probability or vulnerability) ...
- (An economically meaningful way to aggregate nonlinearly)



Objectives of this paper

- Measuring systemic risk
 - Distress insurance premium (DIP): a market-based indicator (Huang, Zhou and Zhu 2009 JBF)
- Allocating systemic risk to individual banks, or identifying SIFIs
 - Comparison with the leading alternatives (CoVaR, MES)
- Policy implications: a basis for regulatory surcharges on SIFIs



Literature on systemic risk

- Analysis based on balance sheet data: FSAP
 - Backward-looking; Lags
- Network analysis
 - Data requirement; No endogenous response
 - Business connection is only part of the crisis story
- Supervisory assessments based on confidential data: US and EU
 - Cost is high



Literature: market-based

- Systemic risk indicator
 - Probability of joint defaults: IMF GFSR, Lehar (2005)
- Systemic importance of individual banks
 - Adrian and Brunnermeier (2008): CoVaR
 - Acharya et al (2010): MES
 - Tarashev, Borio and Tsatsaronis (2009): “Shapley value” approach
- Publicly available information, easy to update, forward-looking
- Restricted by market information

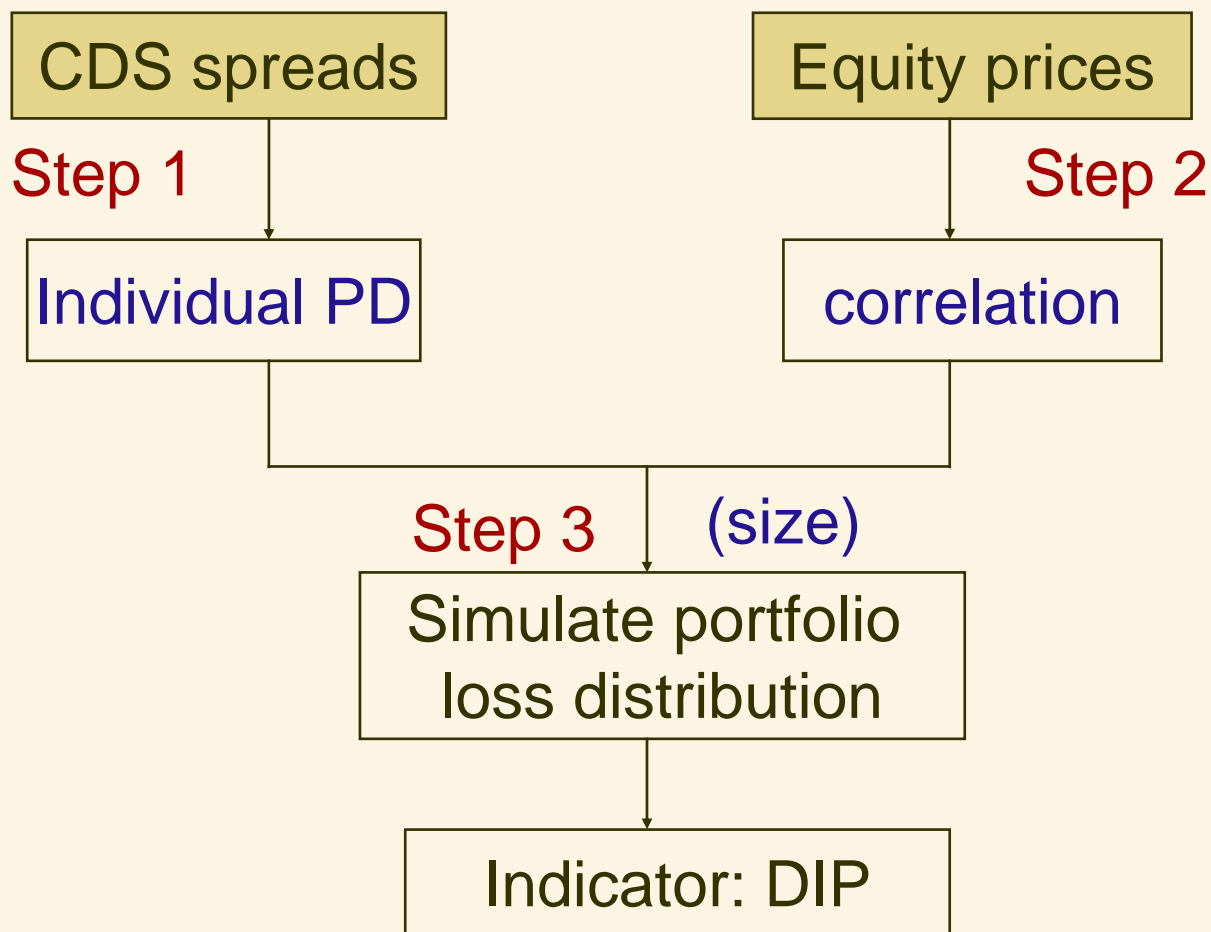


Methodology: Measuring systemic risk

- Distress insurance premium (DIP): Huang, Zhou and Zhu (2009)
- Suppose that a hypothetical 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?



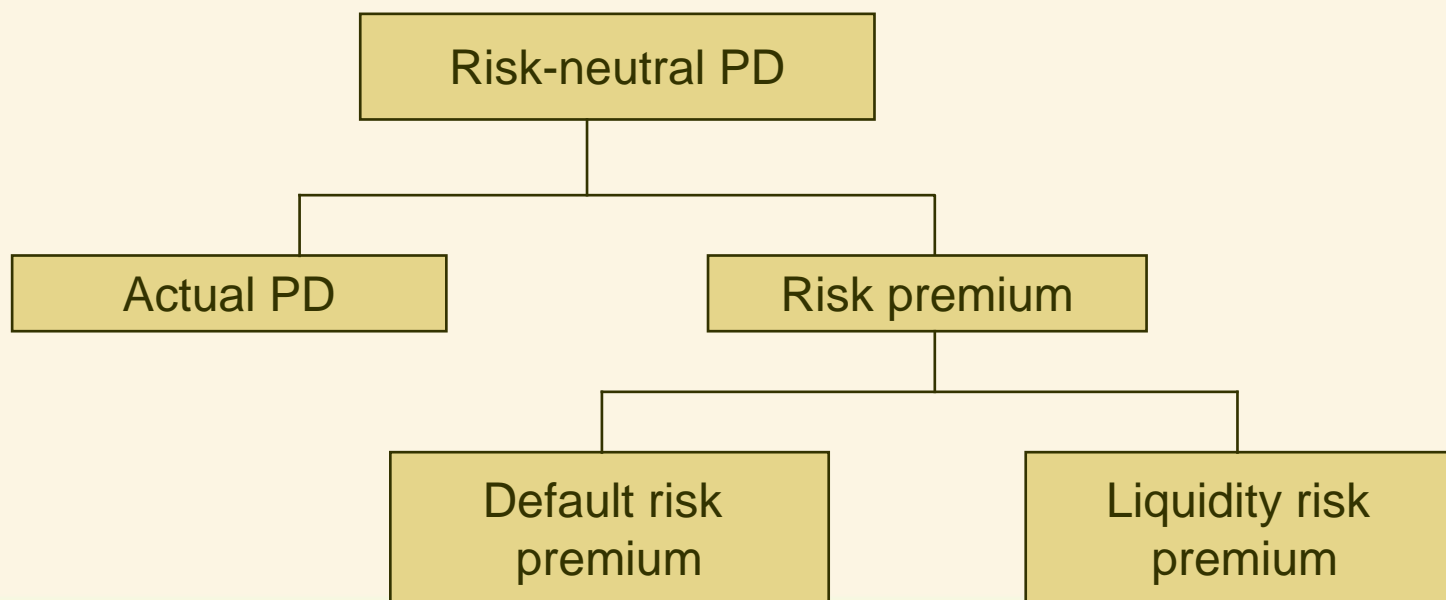
Methodology: an overview





Methodology

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





Methodology

- Step 2: estimating asset return correlations
 - Use equity return correlations as a proxy
- Step 3: simulate (risk-neutral) portfolio loss distribution
 - $L = \sum L_j$
 - $DIP = E(L \mid L \geq L_{min})$



Methodology: measuring systemic risk contribution

- Allocating systemic risk to individual banks
 - Marginal contribution of bank i to the systemic risk

$$MC_i = \frac{\partial DIP}{\partial L_i} = E[L_i | L \geq L_{\min}]$$

- $DIP = \sum MC_i \Rightarrow$ *additive property*

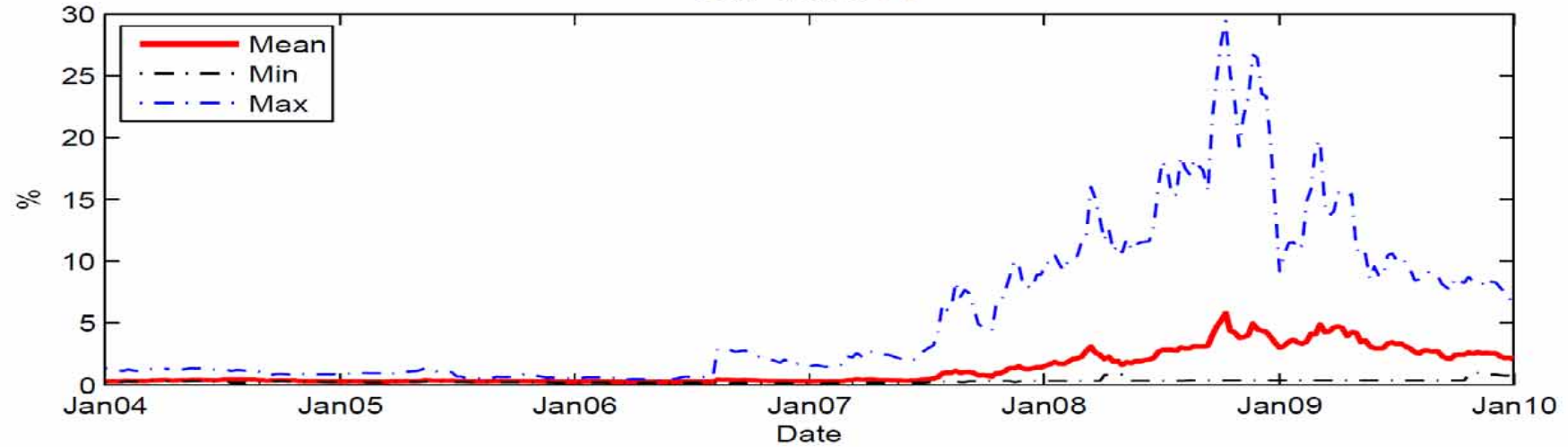


Application of our method

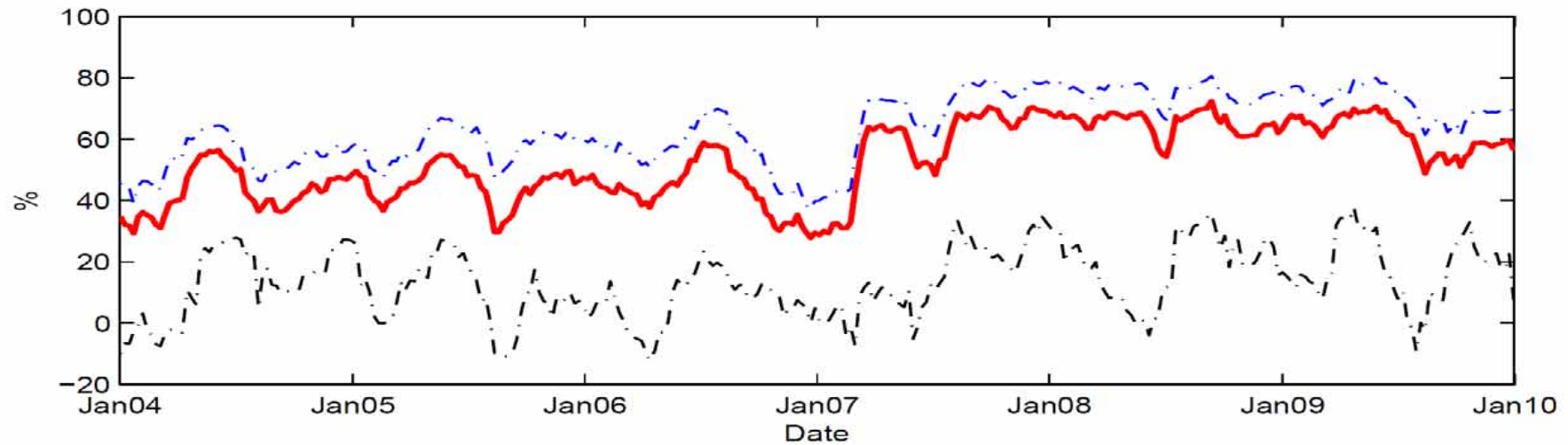
- 19 US banking holding companies included in the US SCAP exercise
 - Total assets exceeding 100 billion USD at end-2008
 - Collectively 2/3 of total assets and half of total loans in the US banking system

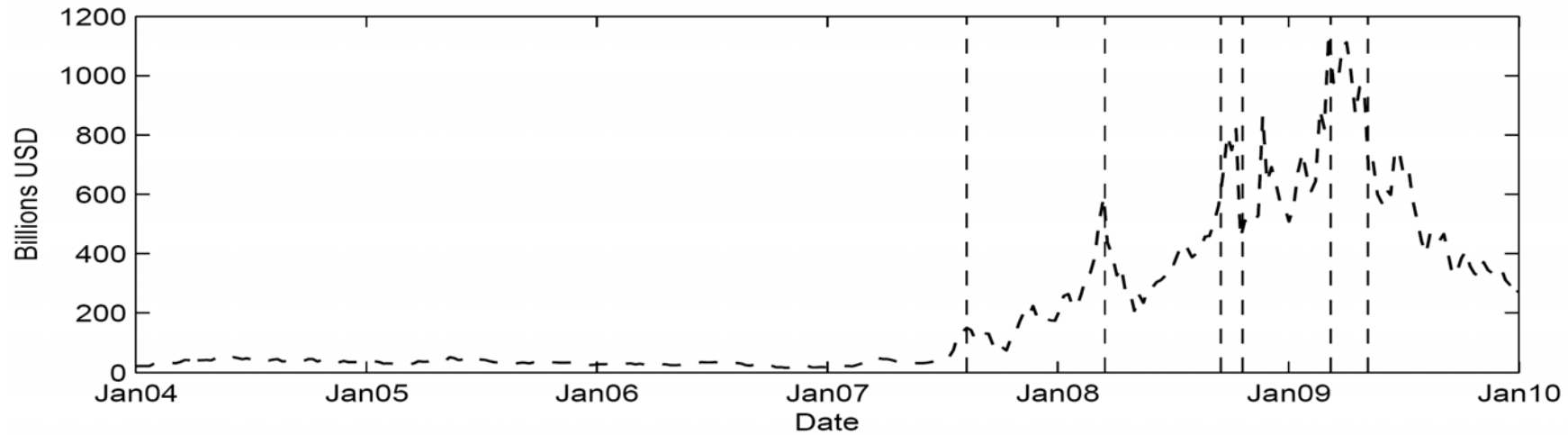
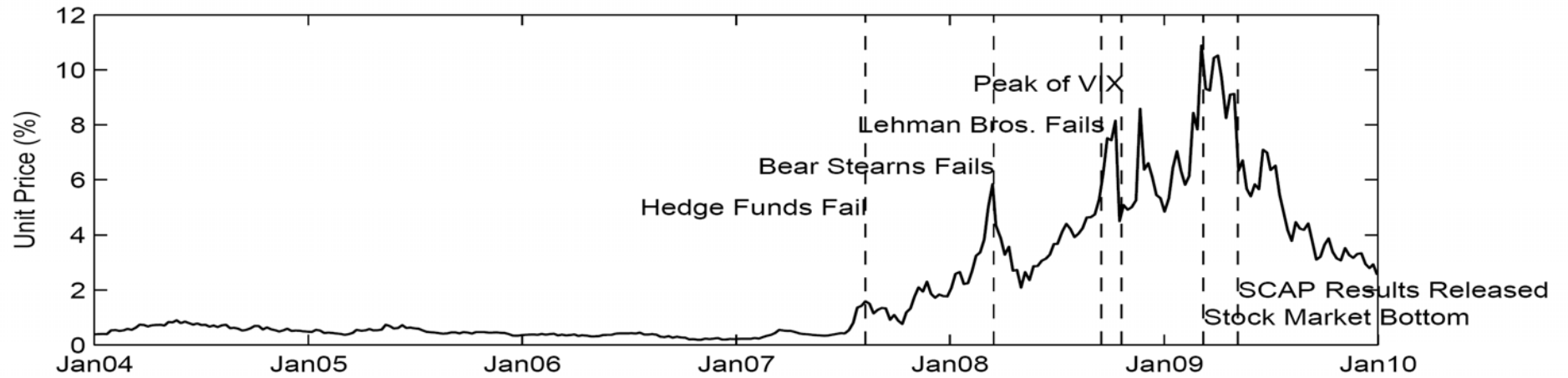


Risk-neutral PD



Correlation







Driving factors of systemic risk

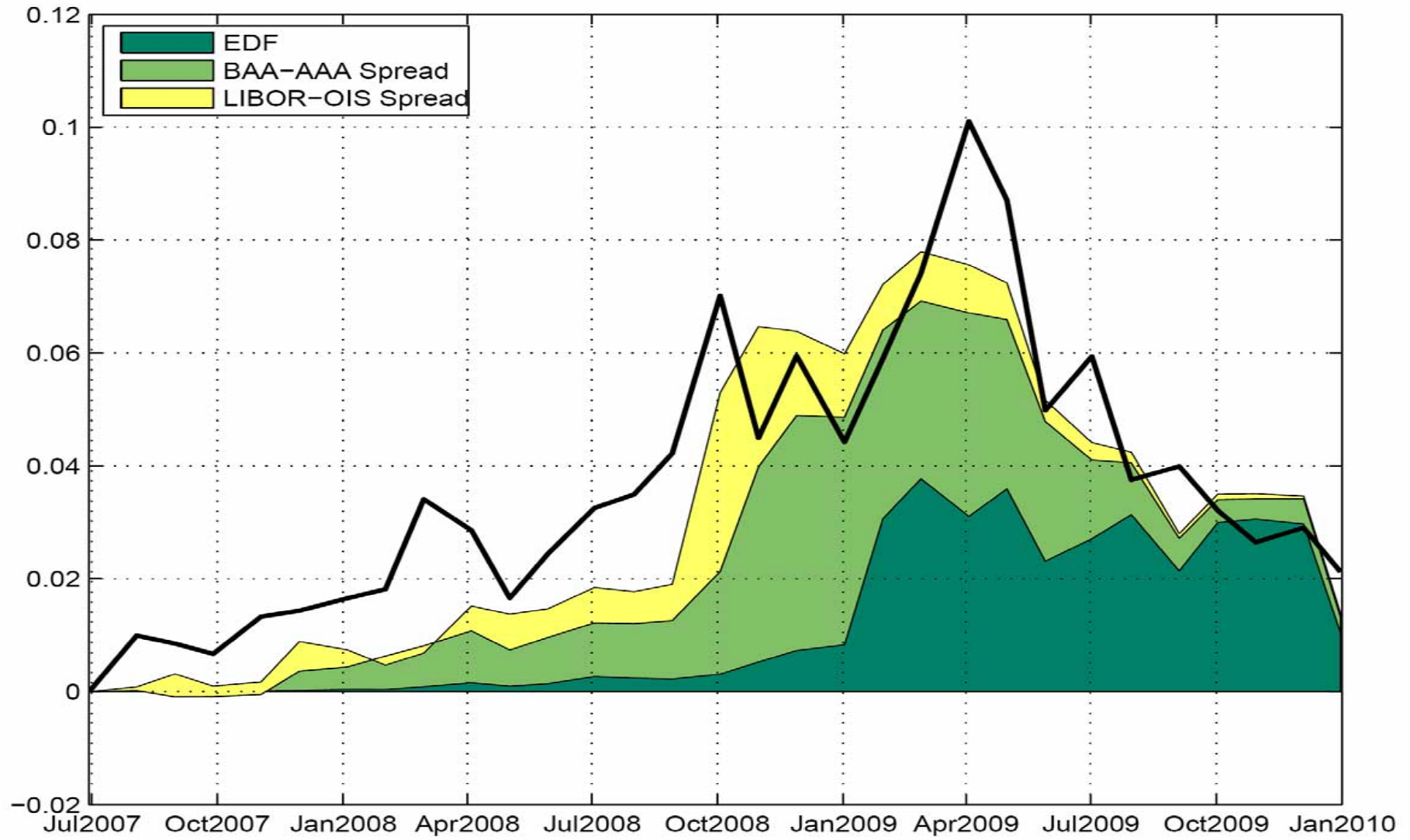
- Average PD (weighted by size) is the predominant determinant factor of the DIP measure
- Correlations and other factors have additional explanatory power but they are of secondary importance
- What does it imply?
 - Average PD (or average CDS spreads) is a reasonable first-order proxy to monitor the (aggregate) systemic risk



Driving factors of systemic risk

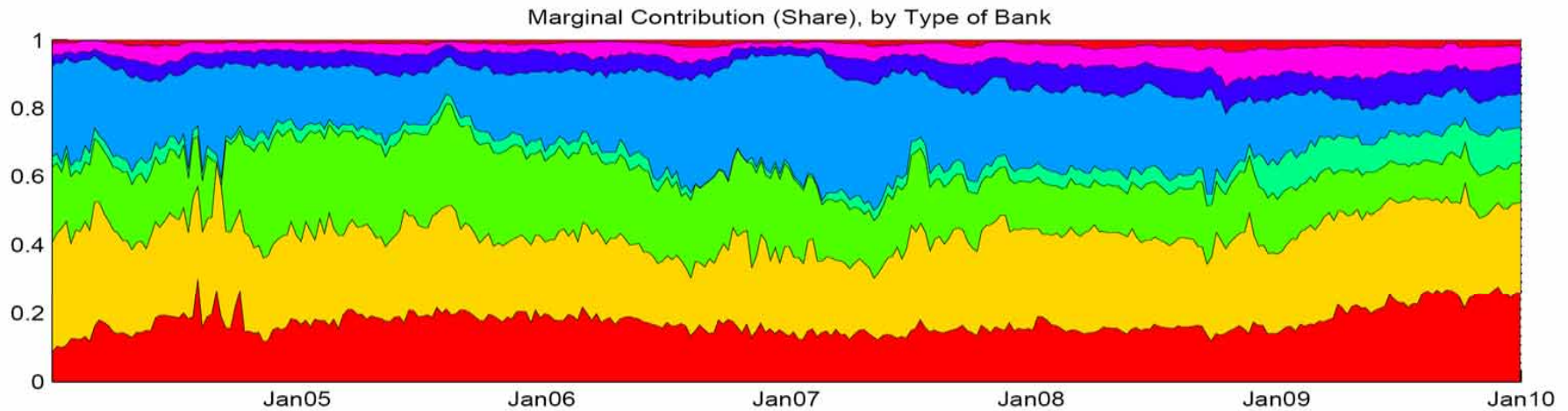
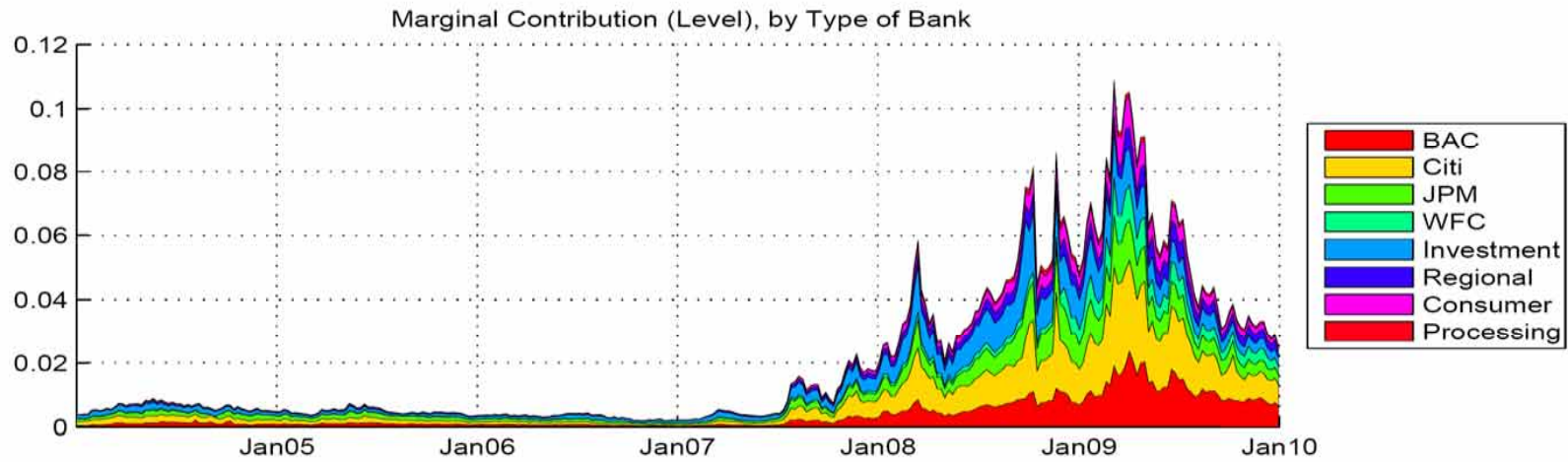
- Regression-based analysis
 - Actual default
 - Default risk premium
 - Liquidity risk premium

Independent Variables	Regression 1	Regression 2	Regression 3	Regression 4
Constant	1.07 (5.1)	-1.68 (6.0)	0.92 (3.2)	-0.91 (3.9)
Average EDF (%)	1.93 (9.8)			1.14 (7.8)
BAA-AAA Spread (%)		3.07 (15.1)		1.64 (6.2)
LIBOR-OIS Spread (%)			2.52 (6.2)	0.91 (3.5)
Adjusted-R ²	0.57	0.76	0.34	0.87





Systemic risk contributions of each bank



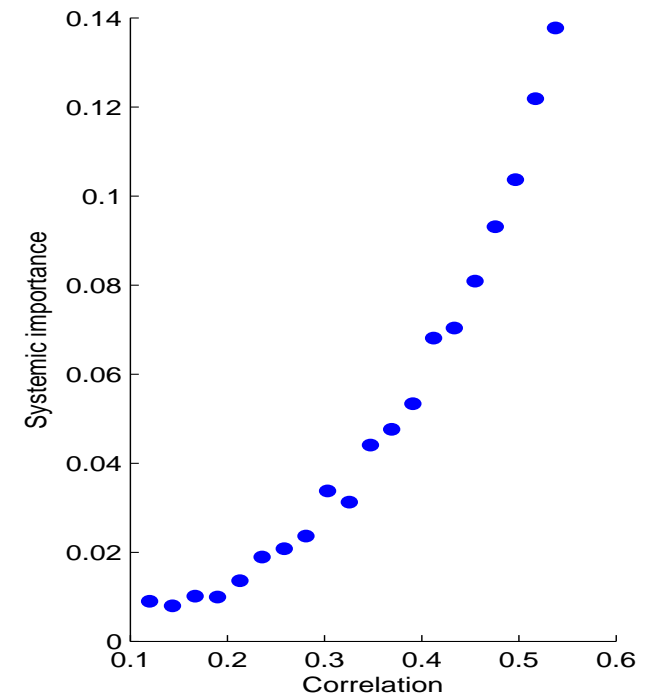
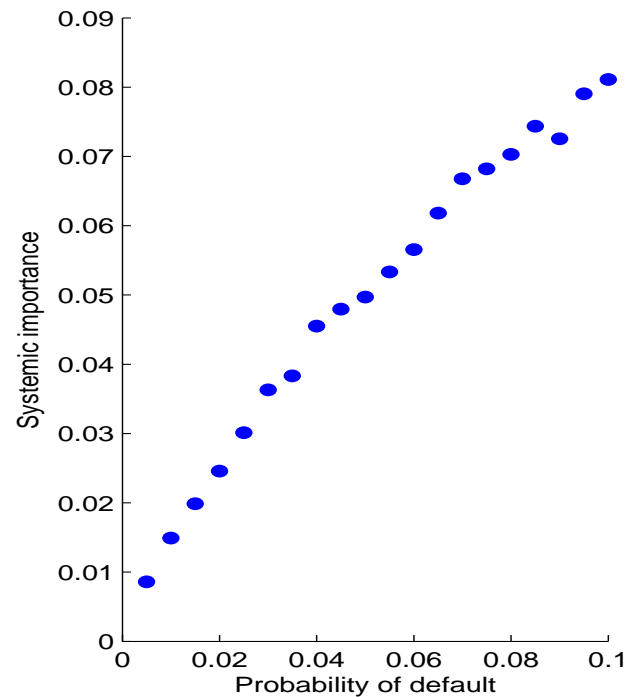
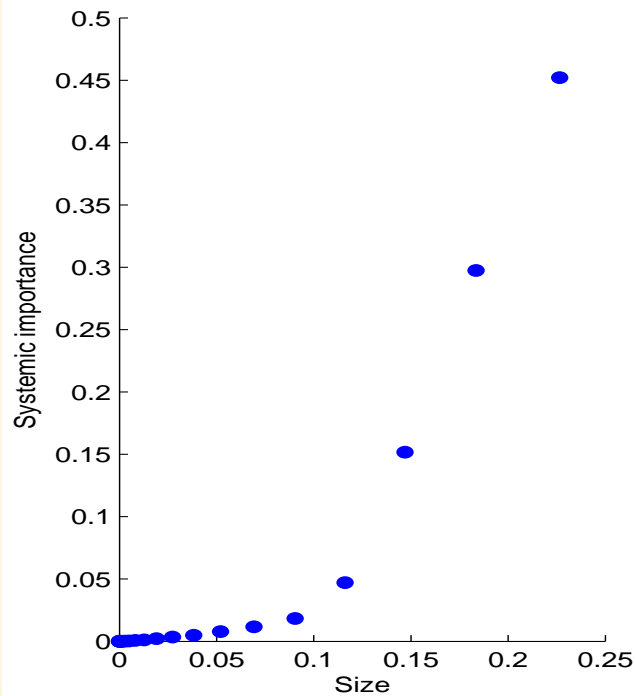


What determines systemic risk contributions?

- Regressions (table 5) show that size, correlations, PDs (and their interactive terms) are all important determinants of systemic risk contributions
- What does it imply?
 - Individual PD (CDS spread), size weighted or not, is a poor first-order proxy of systemic importance of individual banks



- What explains systemic importance? Illustrative examples
 - Size matters most → “too big to fail”
 - Correlation → common exposures, interconnection
 - PD → leverage





Comparison to other market-based measures

- *DIP*: $MC_i = E(L_i | L \geq L_{min})$

- CoVaR (CoES): Adrian and Brunnermeier (2009)

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

- MES: Acharya et al (2010)

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

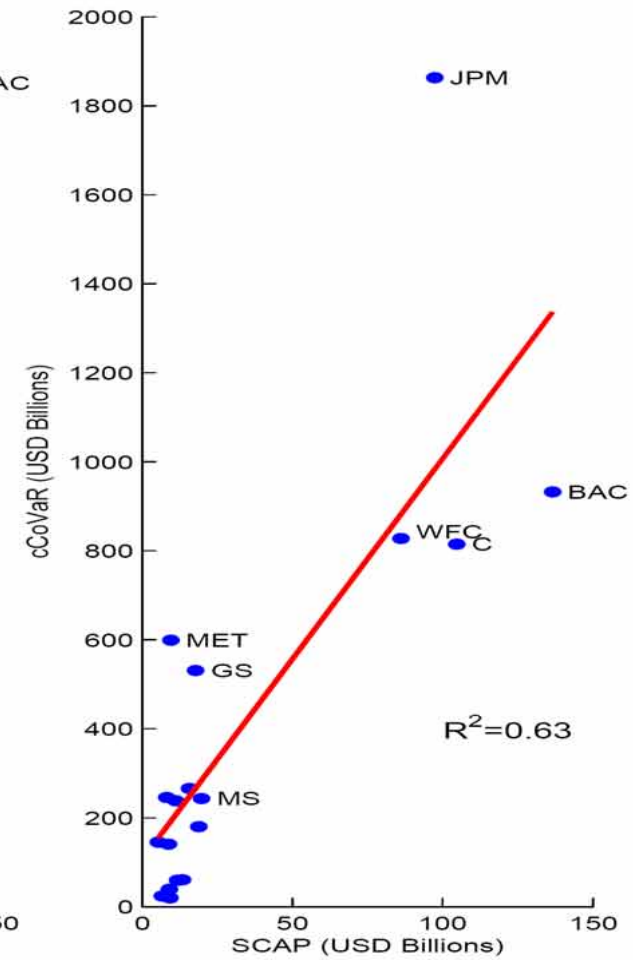
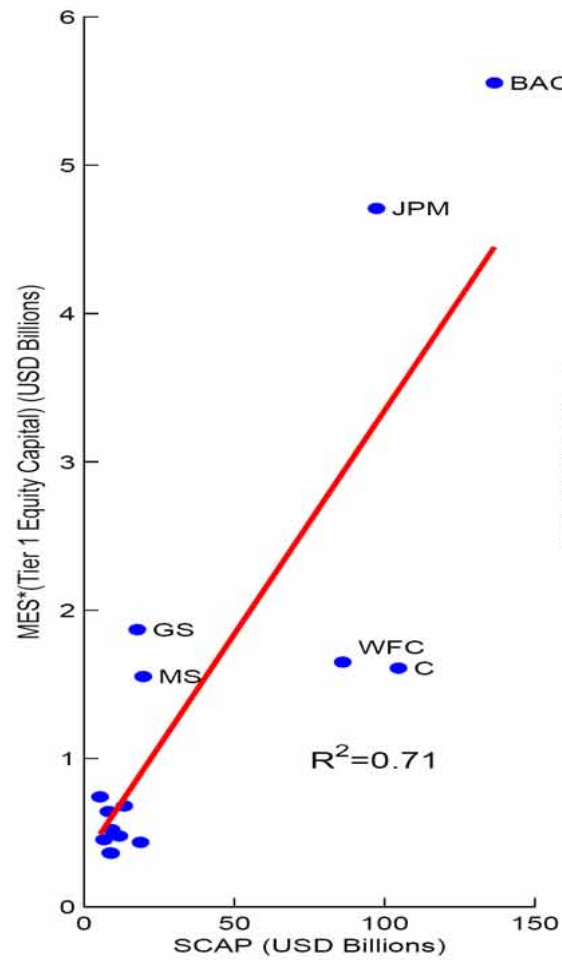
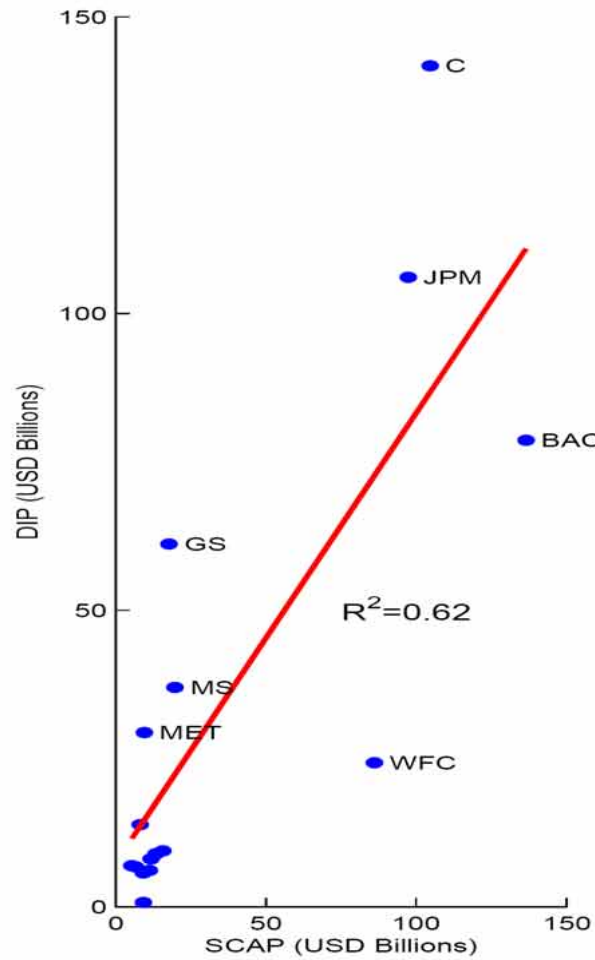


These measures are complimentary to each other

	DIP	CoVaR	MES
Direction	system → bank	bank → system	system → bank
Data	CDS + equity	Equity	Equity
Calculation	Simulation-based	Regression-based	Statistical measure
Definition of distress	Pre-specified threshold	--	Percentile loss
Property	Additive	Not additive	Additive



Compared with SCAP results: end-2008





Conclusions

- Our approach provides a possible tool for macro-prudential regulation
 - To identify systemically important financial institutions
 - To understand sources of systemic risk
 - To impose capital surcharge for systemic banks
- Challenges remain
 - Risk-neutral vs. actuarial expected losses
 - Integration with the time dimension
 - Banks' responses to changing regulatory framework