Looking at the tail: price-based measures of systemic importance

Chen Zhou – DNB
Nikola Tarashev – BIS

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This paper

- A price-based measure of systemic importance
- Make good use of tail observations
  - Tail dispersion: LGD approximation
  - Tail dependence: systemic linkage
- Check the usefulness of such measure
  - Distinctiveness in the cross-section
  - Time variation with respect to drivers
  - Predictable from exogenous information
  - Reaction from market participants

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Systemic importance

- Top-down concept
  - System-wide risk
  - Systemic risk of one institution
- Measurement
  - Contribution: the impact for causing a systemic event
  - Participation: the impact during a systemic event
- We take the latter approach

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Price-based measures

- Why price-based?
  - High frequency observations, thus high frequency measure
  - Reflect market perception on SI
    - Market may not be good at perceive systemic risk on the time dimension
    - But good in distinguish in cross-section
    - At least, they react on their perception
- Subject to all critiques on such measures

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The construction

- DIP (Huang, X, H Zhou and H Zhu (2009))
- The expected contribution to the extreme losses of a credit portfolio of the system
- Credit portfolio of the system $\sum_{j=1}^{\mathrm{N}} Size_j \cdot LGD_j \cdot I_j$
- Systemic event:
  $\sum_{j=1}^{\mathrm{N}} Size_i \cdot LGD_i \cdot I_i > \alpha \sum_{j=1}^{\mathrm{N}} Size_j$
- Systemic importance

$$SI_i = Size_i \cdot LGD_i \cdot Pr(I_i = 1 \mid Systemic\ Event).$$

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Data

- Recall the formula (in a brief version)

  SI=Size*LGD*PDS

- PDS: the PD given a systemic event
  - Unconditional PD: EDF
- Size: Total Liability (Deposit)
- LGD, PDS, estimated from CDS spreads
  - LGD: tail dispersion in a single CDS series
  - PDS: tail dependence in multiple CDSes

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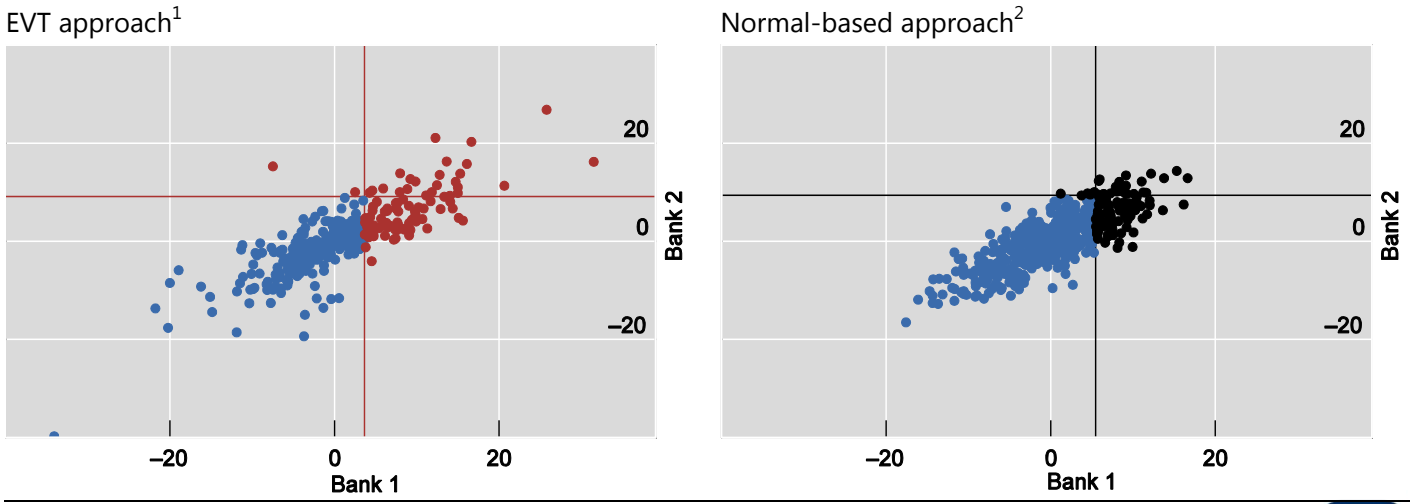
Tail properties: a graphical view

- Focus on observations above a threshold determined by EDF
- LGD: the dispersion above threshold
- PDS: the co-occurence above thresholds

Two approaches to estimating the tail

In basis points

Graph 1



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The LGD

- We consider LGD as the depth in a tail event
  - The ES above a high threshold (VaR)
  - LGD is approximated by (ES-VaR)/ES
  - Always in between zero and one
- Under a heavy-tailed setup $Pr(X > x) \sim Ax^{-\alpha}$
  - (ES-VaR)/ES has the limit $1/\alpha$
- We estimate the tail index of daily CDS spread changes and normalize the average LGD to 0.5

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The PDS

- We use extrapolation idea in multivariate EVT
  - Estimation window: 2 years (520 obs)
  - Threshold for each bank
    - Unconditional PD: according to EDF
    - Extrapolation factor: amplifying PD
  - Identifying systemic events from definition
  - PDS: counting the occurrences
- The factors used: EDF, Size, LGD, CDS(es)

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Empirical setup

- Banks: 50 large global banks
  - 24 EU, 8 US, 5 Japan, 4 Australia, 9 EM
- Time horizon: 2007-2011
  - First estimate: Nov 2007
  - Monthly moving till end 2011
- An initial experiment
  - EVT v.s. normal: average rank changes: 5-7
  - It is necessary to consider the tail properties

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Results

- Cross-sectional distinctiveness
  - Snapshot with confidence intervals
- Time variation with respect to drivers
  - Dynamic when fixing one of the four drivers
- Predictable by exogenous drivers
  - Regress on past balance sheet information
- Reaction from market participants
  - Correlation with future CDS spreads

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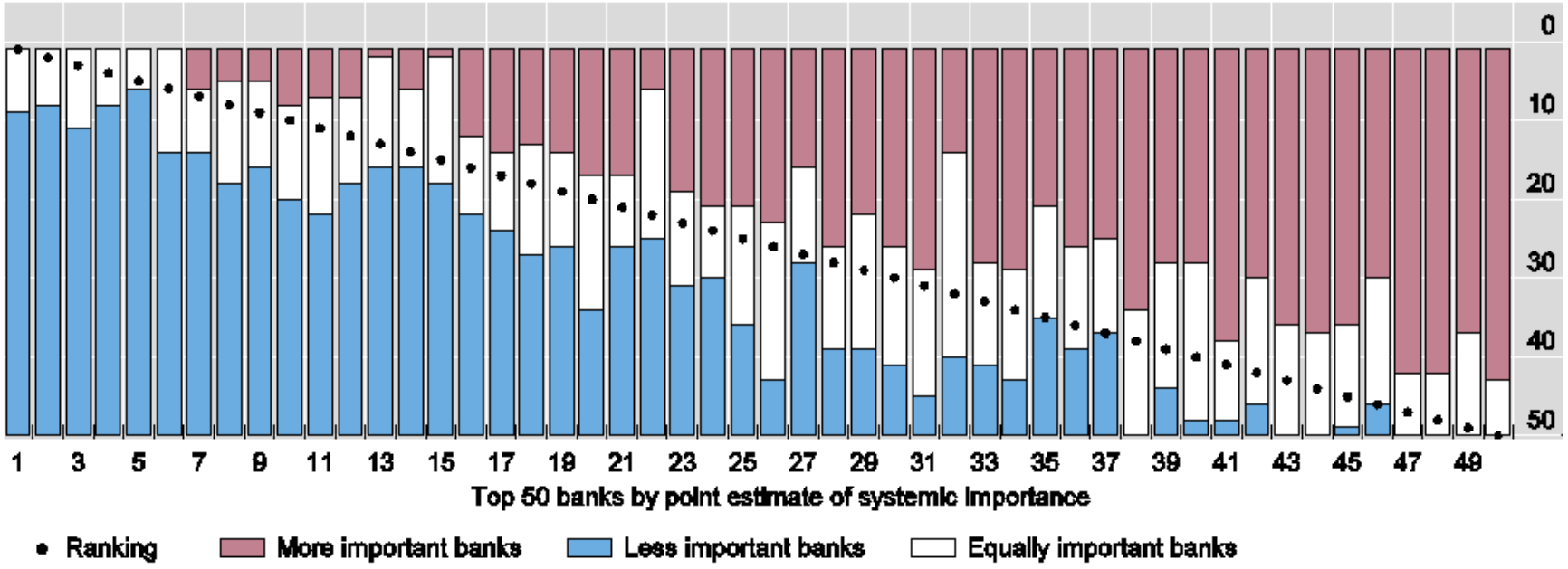
Cross-sectional comparison

- Differentiating based on the measure



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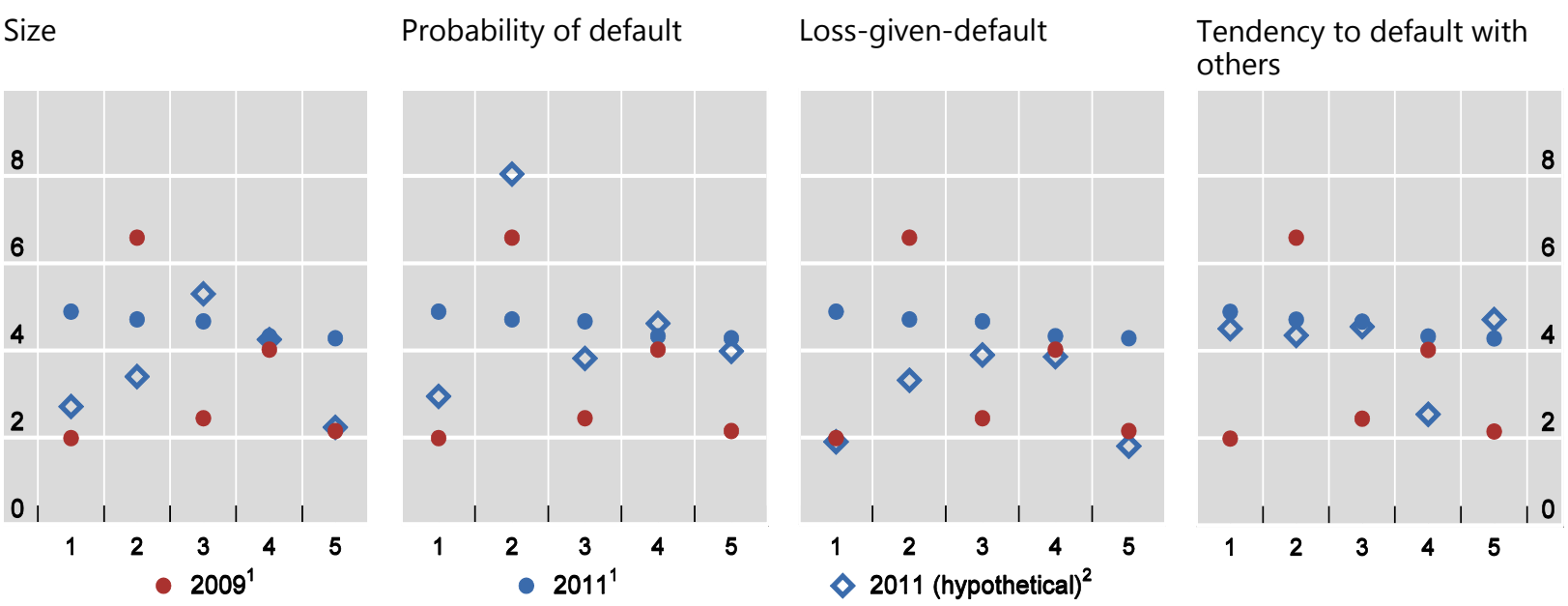
Strength of endogenous drivers

Strength of different drivers

In per cent

Graph 4



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Significance on the drivers

- The average rank changes when controlling for one driver
- The number of banks for which the driver is a (only) significant driver

Drivers of systemic importance

Table 1

	Average rank change[1]		Impact on relative systemic importance[2]	
	All 50 banks	Top 25 banks	Significant impact[3]	Only significant driver[4]
Size	8	6	29	7
Probability of default	7	7	39	12
Loss-given-default	8	6	25	2
Tendency to default with others	8	7	1	0

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Exogenous drivers

- Balance sheet characteristics
  - TL, TA/TE, OE/TNI, NII/TNI, SF/TL, IA/TA

Simple bank characteristics and probability of default in a systemic event[1] Table 2

	Bivariate relationships[2]					Multivariate regression: decomposing the goodness of fit[3]				
	2007	2008	2009	2010	2011	2007	2008	2009	2010	2011
Size	0.29**	0.19	0.25*	0.47***	0.36**	0.03	0.03	0.05	0.18***	0.08**
Leverage	0.41***	0.07	0.18	0.33**	0.41***	0.09	0.00	0.03	0.07*	0.13***
Cost-to-income	0.41***	0.25*	0.33**	0.43***	0.50***	0.12**	0.06*	0.09**	0.14***	0.21***
Interest income	–0.28*	–0.06	–0.09	–0.24*	–0.26*					
Stable funding	–0.01	–0.21	–0.18	–0.20	–0.33**					
Interbank links	0.18	0.36**	0.13	0.31**	0.30**					
Total R-squared						*0.24*	*0.09*	*0.17*	*0.39*	*0.42*

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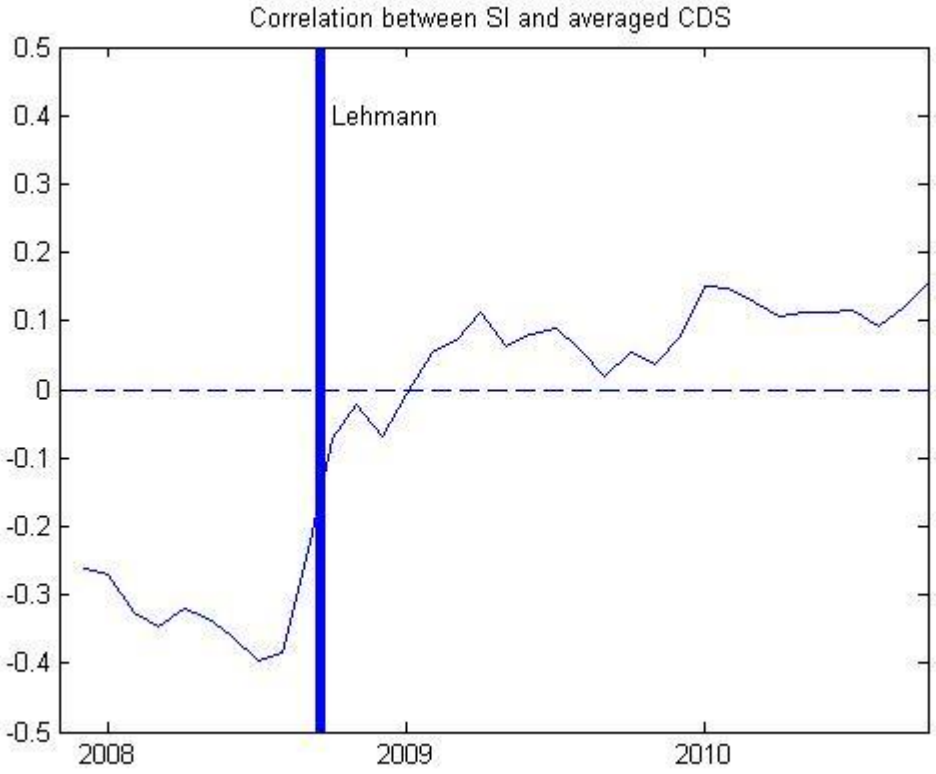
Correlation with future CDS spreads

- Average CDS spreads: one year after estimation
- Cross-sectional Spearman's correlation



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Conclusions

- Use tail observations properly when constructing price-based measures on systemic importance
- Price-based measures can distinguish systemic importance on the cross-section
- Tail properties play crucial role in the dynamics
- Price-based measures agree with regulatory measures in terms of identifying SIFIs
- Before Lehmann, SIFIs benefit from higher perceived systemic importance

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