

THE MULTIVARIATE NATURE OF SYSTEMIC RISK: DIRECT AND COMMON EXPOSURES

P. Giudici, P. Sarlin, A. Spelta

University of Pavia and University of Helsinki

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CONTEXT

Previous literature

Minou and Reyes (JFS, 2013) propose network models on the bilateral bank aggregate exposures of countries (from the BIS statistics full reporting countries).

Giudici and Spelta (JBES, 2016) propose correlation network models on the total bank aggregate exposures of countries (from a wider set of BIS statistics reporting countries)

Brunetti et al. (FED, 2015) compare a "physical" network based on interbank transactions with a correlation network based on bank market prices.



CONTRIBUTION

Our contributions

- ▶ Apply correlation network models to BIS bilateral exposures
- ▶ Compare physical and correlation networks, as predictors of bank crisis.
- ▶ Develop a combined early warning predictive measure.



SUMMARY PROPOSAL

Direct exposures of countries

Interbank flows \rightarrow Physical network between countries.

+

Common exposures between countries

Interbank flows similarities \rightarrow Correlation network between countries

=

A combined early warning predictive measure

- ▶ Strength of direct exposure networks: direct funding/credit risk
- ▶ Strength of common exposure networks: funding/credit concentration risk



LINK TYPES

A link between two countries:

- ▶ in a physical (direct) network, it represents a flow of funds between a lender country and a borrowing country
- ▶ in a correlation (common exposure) network, it measures the proximity between the funding composition (in flows) or between the credit allocations (out flows) of two countries.



CORRELATION NETWORK PROXIMITY: IN-FLOWS

$ln^i \in \mathbb{R}^{1 \times N}$: vector of flows from countries that fund i

In-flow proximity

$$d_{ij}^{ln} = 2 - \sqrt{2(1 - C_{ln^i, ln^j})} \quad (1)$$

where C_{ln^i, ln^j} is the correlation between the funding vectors of countries i and j .

A high value of d_{ij}^{ln} means that the funding that i and j receive has a similar composition: they have a similar funding risk composition.



CORRELATION NETWORK PROXIMITY: OUT FLOWS

$Out^i \in \mathbb{R}^{N \times 1}$: vector of flows to countries that receive credit from i .

Out-flow proximity

$$d_{ij}^{Out} = 2 - \sqrt{2(1 - C_{Out^i, Out^j})} \quad (2)$$

with C_{Out^i, Out^j} the correlation between the investor vectors of countries i and j .

A high value $d_{i,j}^{Out}$ means that i and j invest similarly in other countries: they have a similar credit risk composition.



DIRECT NETWORK: IN AND OUT STRENGTH

Let $w_{i,j,t}$ be the quantity lent from j to i at time t .

In-strength

The in-strength of country i in a direct network at time t is:

$$S_{i,t}^{I,R} = \sum_j w_{i,j,t} \quad (3)$$

Out-strength

The out-strength of country j in a direct network at time t is:

$$S_{i,t}^{O,R} = \sum_i w_{i,j,t}. \quad (4)$$



COMMON EXPOSURE NETWORK: IN AND OUT STRENGTH

In-strength

The in-strength of country i in a common exposure network at time t is:

$$S_{i,t}^{I,C} = \sum_j d_{i,j,t}^{in} \quad (5)$$

Out-strength

The out-strength of country j in a common exposure network at time t is:

$$S_{i,t}^{O,C} = \sum_i d_{i,j,t}^{out} \quad (6)$$



MIXED STRENGTH

Definition

A mixed link i, j at time t can be defined as follows:

$$m_{i,j,t} = \alpha_t \hat{w}_{i,j,t} + (1 - \alpha_t) \hat{d}_{i,j,t} \quad (7)$$

where $\hat{w}_{i,j,t}$ and $\hat{d}_{i,j,t}$ are the normalized links between country i and country j at time t , obtained from the direct and from the common exposure matrix.

The parameter α_t , which governs the relative strength of the two components, can be obtained from PCA at each time point.

Summing over mixed links, a mixed strength can be obtained, for both in and out flows.



DATA

- ▶ Consolidated Banking Statistics BIS data, from Q3–1998 to Q4–2013
- ▶ For the funding side, we restrict the analysis to the 33 largest economies.
- ▶ For the credit side we use the 15 fully reporting countries.



IN-STRENGTHS

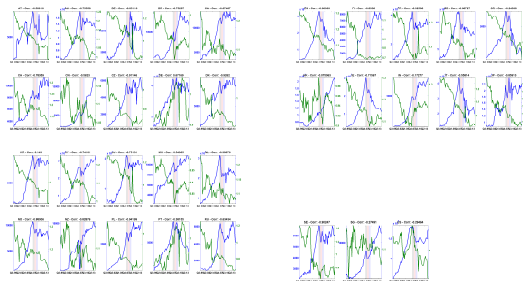


FIGURE: In-strengths of each country for the direct (blue) and for the common exposure (green) networks.



IN-STRENGTHS RESULTS

Results: in strength

- ▶ For most countries, before the crisis, total funding increases and total proximity decreases: funding risk decreases in absolute terms but becomes concentrated on fewer lenders.
- ▶ Germany (DE) is an exception: a flight to quality effect?
- ▶ After the crisis, total funding decreases but proximity keeps decreasing, also for Germany.



OUT-STRENGTHS

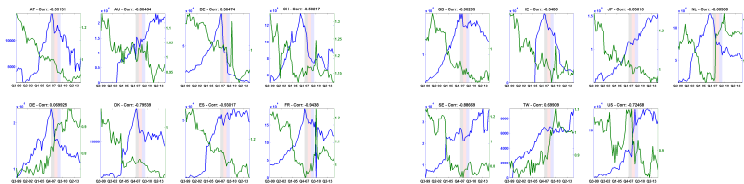


FIGURE: Out-strength of each country for the direct (blue) and for the common exposure (green) networks.



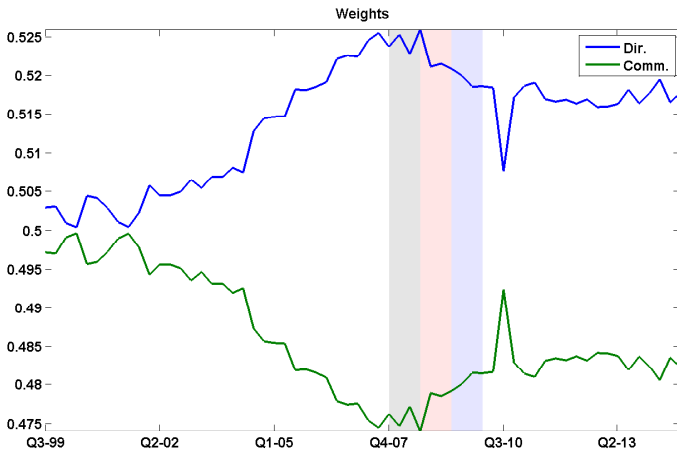
RESULTS FROM OUT-STRENGTHS

Out strength results

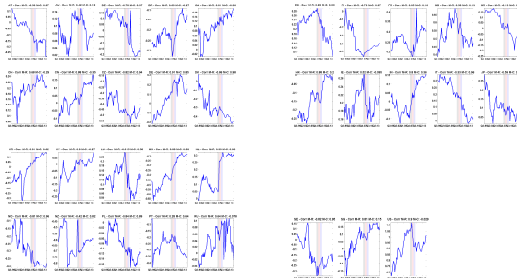
- ▶ European countries have decreased their credit flows after their crisis, the contrary has occurred outside Europe.
- ▶ In both cases proximity has decreased: credit risk is smaller in absolute terms but is concentrated on fewer borrowers.



MIXED STRENGTHS



MIXED STRENGTHS



RESULTS FROM MIXED STRENGTHS

Mixed strengths results - in flows

The higher the mixed in-strength, the lower the risk (both from a total funding and from a funding composition viewpoints)

- ▶ Many countries present a fall of the mixed in-strength measure during the financial crisis.
- ▶ Some of them: ES, GR, IT, PT, AT, BE, CZ, PL, UK and JP have not yet recovered. Others: IE, FR, NL, LU, FI, SE, BR together with US, have instead recovered.
- ▶ Another group of countries has not been affected by the crisis, and maintain a low risk profile throughout: off-shore countries (HK, LU, KY); flight to quality countries (CH, DE, DK, SG); emerging countries (CN, IN, KR, MX).



PREDICTIVE COMPARISON

- ▶ We compare direct and common exposures networks with the RiskRank measure (Mezei and Sarlin, 2015), based on individual risk and interconnectedness.
- ▶ The crisis events are based upon the IMF database by Laeven and Valencia (2008), while the individual risk indicators include 14 macro-financial indicators.
- ▶ The forecast horizon is of 5–12 quarters prior to crisis events, as common in the literature.



PREDICTIVE COMPARISON - RESULTS

