

Discussion of the talk
**“Quantification of systemic risk from overlapping
portfolios in the financial system”**

by Sebastian Poledna, Serafin Martinez Jaramillo, Fabio Caccioli
and Stefan Thurner

Discussant Stefano Battiston (Univ. of Zurich)

The paper in a nutshell

Context

- Systemic risk: several possible contagion channels, an important one:
 - indirect interconnections from *overlapping portfolios*

Aim

- Quantify systemic risk arising from overlapping portfolios using information of security holdings for Mexican banking system

Results

- Show that focusing only on direct exposures underestimates total systemic risk levels by up to 50%.

Methods

- Builds on notion of expected systemic loss due to SR (Poledna et al. 2015;2016) using the notion:
 - *expected loss due to a bank l default = (bank l default prob.) \times (impact of bank l 's default)*
 - *Impact of bank's l default is computed using DebtRank*
 - *Bank's default probability is estimated independently*
- Extends the notion to bipartite financial networks (institutions and securities)
- Compares SR from direct exposures (default contagion) and indirect exposures (overlapping portfolios).
- Compares marginal contributions to the overall SR due to individual direct and indirect exposures

Methods

- Mechanism of fire sale contagion builds on the idea of balance-sheet contagion by Kyiotaki & Moore 2001, used also in Cifuentes ea. 2005 and later in Shin 2009.
- Chain of events (in those works)
 - Negative shock on asset a or bank i
 - Bank i sells some amount of asset a
 - Asset sales impact on asset a's price
 - Change in price implies a further loss for bank i

Methods

- Manage to decompose systemic loss in $V^{\text{Comb}} = V^{\text{direct}} + V^{\text{OP}}$
- EL^{sys} = expected systemic loss (in all possible combinations of defaulting and surviving institutions and by assuming independent probabilities)

$$EL^{\text{sys}} = V \sum_{S \in \mathcal{P}(B)} \prod_{i \in S} p_i \prod_{j \in B \setminus S} (1 - p_j) R_S \quad , \quad (9)$$

- Approximation (small default probabilities and/or low interconnectedness)

$$EL^{\text{sys}} \approx V \sum_{i=1}^b p_i R_i \quad , \quad (10)$$

DATA

- Exceptional supervisory data of financial networks gathered by Statistics Unit of Financial Stability General Directorate at Banco de Mexico:
 - every single funding transaction on a daily basis
 - daily, weekly and monthly reports e.g. “operaciones de captacione interbancarias en moneda nacional y en moneda extranjera” (OCIMN, OCIME)
- transaction data that is converted to bilateral exposures
- daily unsecured exposures between banks were used e.g. in stress testing study by Solorzano-Margain et al.

FINDINGS

- Aggregate statistics: total exposure from overlapping portfolios about three times larger 1×10^{12} Mex\$ the direct exposures
- Focusing only on direct exposures underestimates total systemic risk levels by up to 50%.
- marginal SR of individual exposures depend not only on the two parties involved, but also on conditions of all nodes in the network.
- marginal SR of small and medium-size exposures can vary by three orders of magnitude.

Comment 1: **Compare to the right benchmark.**

- The term **“direct losses” is confusing** because to many people it means the losses on the balance sheet deriving simply from changes in external asset prices without any network effect
- You could use “direct contagion losses” but I think it is still misleading (although I have no solution at the moment).
- **Compare to the right benchmark.** The reason why the comment above is important is because many policy makers still do not understand when and why network effect (direct/ indirect) matter. You may want to compare:
 - the losses you get with contagion (both direct or indirect i.e. via OP)
 - with those the regulator would estimate in the absence of any kind of network effect
- Suggestion: plot and discuss the relative magnitude of:
 1. Direct losses from asset shocks (without any contagion),
 2. “direct contagion losses” (i.e. with distress contagion)
 3. overlapping portfolio losses

Comment 2: on mechanics of fire-sale contagion channel

- **Suggestion: better clarify if there an exact chain of events is assumed and the magnitude of the effects at each step**
- Chain of events
 - Negative shock on asset a or bank I
 - Bank i sells some amount of asset a (**how much do they sell? Possibly consider concept of target leverage¹: sell as much as needed to keep leverage at a target**)
 - Asset sales impact on asset a's price (**how much? Market impact**)
 - Change in price implies a further loss for bank i

1. Shin 2009; Tasca and Battiston 2016; Luu, Napoletano, Barucca, Battiston 2017. In particular see the third round in stress-test framework Appendix A.3 in Battiston, D'Errico, Gurciullo, Caldarelli 2016
Leveraging the network: A stress-test framework based on DebtRank

Comment 3 on Expected systemic loss

- EL^{syst} = expected systemic loss (in all possible combinations of defaulting and surviving institutions and by assuming independent probabilities)

$$EL^{\text{syst}} = V \sum_{S \in \mathcal{P}(B)} \prod_{i \in S} p_i \prod_{j \in B \setminus S} (1 - p_j) R_S \quad EL^{\text{syst}} \approx V \sum_{i=1}^b p_i R_i \quad , \quad (10)$$

- **Approximation valid for small default probabilities and/or low interconnectedness**
- Definitely useful quantity. However, assumptions need clarification. Why can we assume independent defaults with low probability if we want to describe systemic risk?
 - In a systemic default, defaults are by definition not independent and probability may not be low.
 - I think the approximation is useful but its justification needs better argumentation (e.g. could it be a lower bound?)

Comment 3 on magnitude of overlapping portfolio

- Aggregate statistics: total exposure from overlapping portfolios about three times larger 1×10^{12} Mex\$ the direct exposures
- Focusing only on direct exposures underestimates total systemic risk levels by up to 50%.
- Not sure I get what is 3 times larger and what is 50% larger.
Suggestion (repeated, sorry): discuss the relative magnitude of:
 - External asset exposures, Interbank exposures, Overlapping portfolio exposures

Comment 3 on magnitude of losses

- The paper claims that OP can have a large effect.
- But it is important to clarify (and repeat next to the final claims) the specific assumptions under which OP contagion matters
- I suppose these assumptions are
 - Market impact (relative changes in prices from relative changes in asset quantity) is close to 1: is this a distressed market?
 - Dynamics of sales: do banks need to be in distress to follow that selling dynamics?
 - Debrank assumes recovery rate 0 on short run on external assets in case of default and maturity in the future (see Barucca ea. 2016 NEVA for analytical conditions)
- The fact that these assumptions may be reasonable in many empirical cases is up to the reader to agree on and cannot be given for granted.

Conclusion

A great read, the paper makes several important contributions

1. Provides an estimate of expected systemic loss EL and demonstrate its use on daily supervisory network data
2. Shows empirically that overlapping portfolio contagion effect can be large compared to other effects
3. Analyses for the first time the marginal contribution of individual exposures to SR
4. ...a great paper that pushes DebtRank to a new level ;)

Minor issues/notations

- “ α may be calibrated so that e.g. the asset price falls by 10% when one tenth of assets have been sold.” : not clear
- “ $X_{ij}^{\alpha}(t)$ with $\alpha = 1, 2$ labels the layers “direct exposures” “indirect exposures” respectively” : but it seems the authors then use “OP” ?
- “Alternatively, we incorporate absorption effects of financial markets”. I recognize the functional form as in Cifuentes but what do you mean by “absorption”?
- “ R_i^{OP} measures the fraction of the total economic value affected by the distress of bank i from indirect exposure”: but the formula seems to sum over i .
- “by assuming independent equal loss probabilities of individual institutions”: assumption of independent is necessary, but no assumption needed for being equal I think