EUROPEAN CENTRAL BANK

BANKING SUPERVISION

Reverse Stress Testing

Authors M. Baes and E. Schaanning
Discussant Klaus Düllmann*

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* Any views expressed are those of the author and do not necessarily reflect those of the ECB

Overview

Contribution

Development of a algorithmic and systematic methodology to design stress test scenarios, assuming banks' react optimally by minimising losses from forced liquidations.

Policy relevance from …

… a **Microprudential perspective**

- Which banks are most vulnerable to worst-case stress test scenarios?
- How important is the selection of "the most appropriate scenario"?

… a **Macroprudential perspective**

- Which worst-case economic scenarios maximize contagion in the financial system?
- How do shocks spill over from one institution to another?

Three step approach

1. **Economic model**: banks react optimally to minimise fire-sale losses in light of an adverse exogenous shock to the value of their non-tradable assets.
2. **Simulation approach**: Identify worst-case scenarios leading to maximal contagion from fire-sale losses.
3. **Empirical Analysis**: For the identified worst-case scenarios, investigate what characterises these scenarios: which banks / asset classes are most affected?

Data

- **EBA 2016 EU-wide ST**: notional exposures for 51 European banks, across hundreds of asset classes (marketable: corp & sov).
- **BIS**: residual and commercial property prices to ensure stress scenarios are consistency with historical asset price co-movement.

OVERVIEW

Banks' balance sheets

Assets	Liabilities
Non-tradable	CET1
Tradable	Other liabilities

Regulatory constraint can be

1. **Leverage constraint**
$$\frac{\text{Non tradable + tradable}}{\text{CET1 capital}} \leq \lambda_{\max}$$

2. **RWA constraint**
$$\frac{\text{Non tradable} \times \text{RW} + \text{tradable} \times \text{RW}}{\text{Capital}} \leq \phi_{\max}$$

Stress scenario
Exogenous adverse shock to non-tradable assets results in an immediate loss for a bank

Deleveraging
To comply with the regulatory constraint, a bank deleverages by selling tradable assets

Price impact
Selling tradable assets triggers ↓ their value, depending on total sales in the system and their market depth

Fire sale losses
Marking-to-market ↓ value of tradable assets in portfolio; Realised losses on tradable assets sold with ↓ value

Contagion
Fire sales by one institution spill over to another, initiating potential feedback loops

Main findings

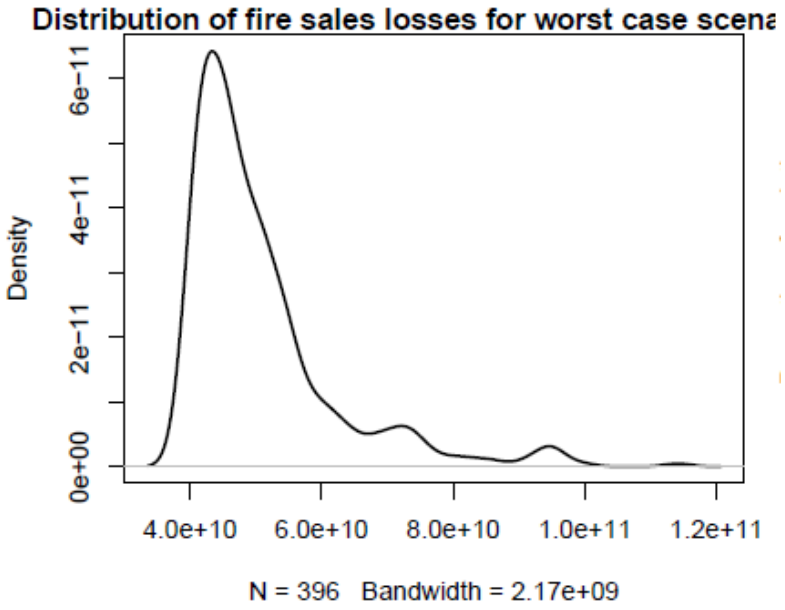
1. **Worst-case scenarios**
   Those scenarios leading to maximal contagion from fire-sale losses can be **heterogeneous in terms of the underlying factor shocks**.

2. **Macroprudential perspective**
   In the identified worst-case scenarios, banks with the largest initial loss from the shocks to non-tradable assets differ from those with the largest fire-sale losses, suggestive of a predominantly **non-overlapping contagion channel**.

3. **Microprudential perspective**:
   Despite heterogeneity in the identified worst-case **scenarios**, **all target a small subset of banks**, which drive contagion within the financial system.

1. Definition of worst-case scenarios

- **Evaluate 22 500 shock scenarios**, which are
  1. Historically consistent (i.e. capture the co-movement of historical asset prices);
  2. The initial shock can not be too severe (i.e. maximum initial monetary loss in the system < 10%).
- Subsequently, **400 worst-case scenarios are selected for further analysis** (i.e. those where fire-sale losses >40 EURbn*).
- **This severity threshold warrants further motivation**, as it determines the sample/results.
- **Potential suggestions**:
  - Could we miss a relevant part of the loss distribution by looking only at the 400 scenarios of highest losses?
  - Consistency with historical narratives?**



* What is the metric being used as a cut-off: solely initial losses or including feedback effects?

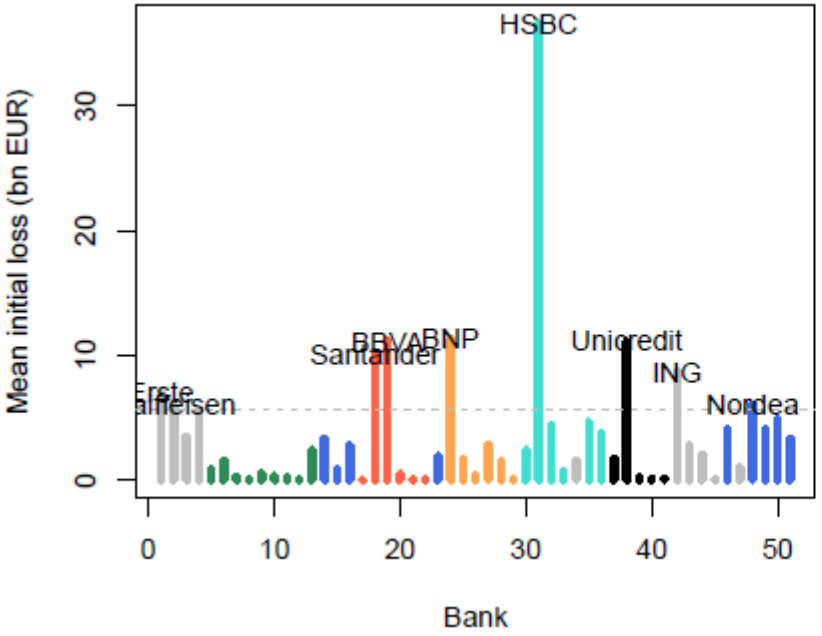
** Nevertheless, designing stress test scenarios independently from historical data provides the advantage of quantifying known-unknown scenarios.

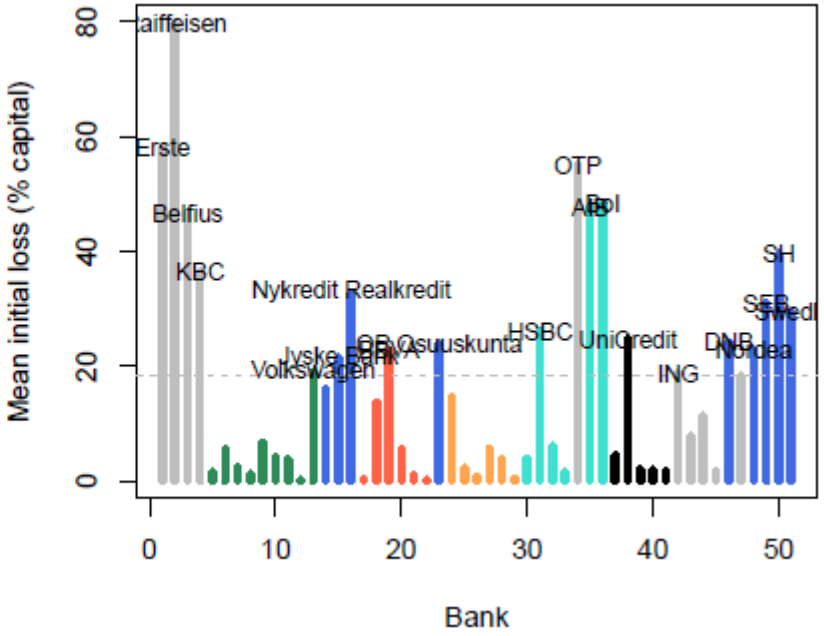
2. Plausibility of worst-case scenario

- "…**the Basel Committee on Banking Supervison's requirement that stress tests be** (i) **plausible**, (ii) **severe** and (iii) suggestive of risk-reducing actions." [Baes and Schaanning (2019, p. 3)]
- The **paper focusses primarily on severity**, yet from a policy perspective, one should consider as relevant also the (different) **plausibility** of the **identified worst-case scenarios**.
- **Already take into account that the initial shock**
  - **is not so severe that all institutions default immediately**
    However, **further motivation necessary** for the chosen maximum
    - percentage shock (i.e. $\bar{\epsilon}_k = 20\%$);
    - initial monetary loss across the system (i.e. $L_{\max} \in [0.1\%, 10\%]$)
  - **makes economic sense (i.e. be historically consistent)**
    However, this **consistency only pertains** to the **historical correlation structure** between shocks, and not to the plausibility of the identified worst-case scenario.

3. Distributional statistics empirical results

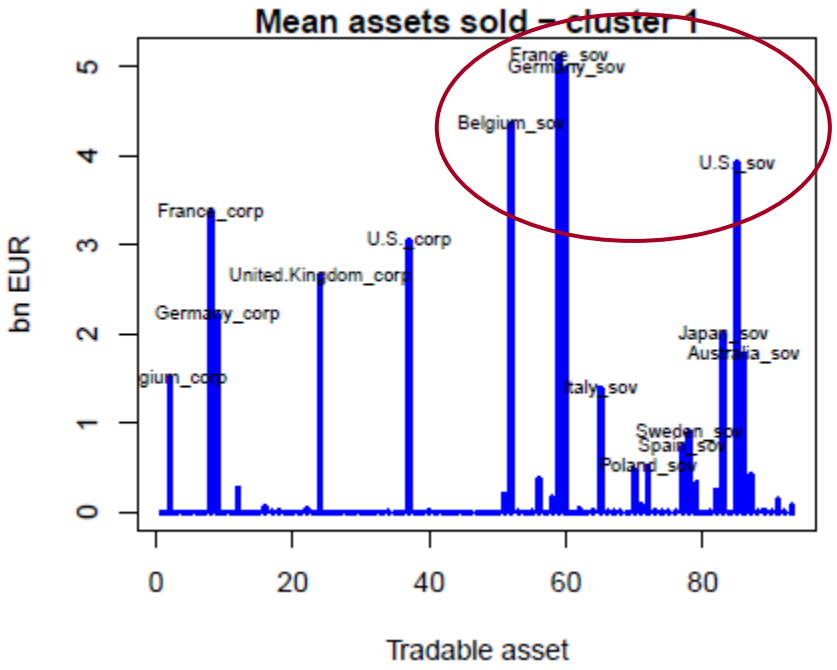
- **Key results** describe **averages across identified worst-case scenarios** (e.g. mean fire-sale losses for a bank), and conditional means for different scenario clusters.
- However, **other moments of the distribution** (e.g. standard deviation, skewness) would prove useful to **understand whether results** are **consistent across worst-case scenarios or driven by outlier** scenarios.

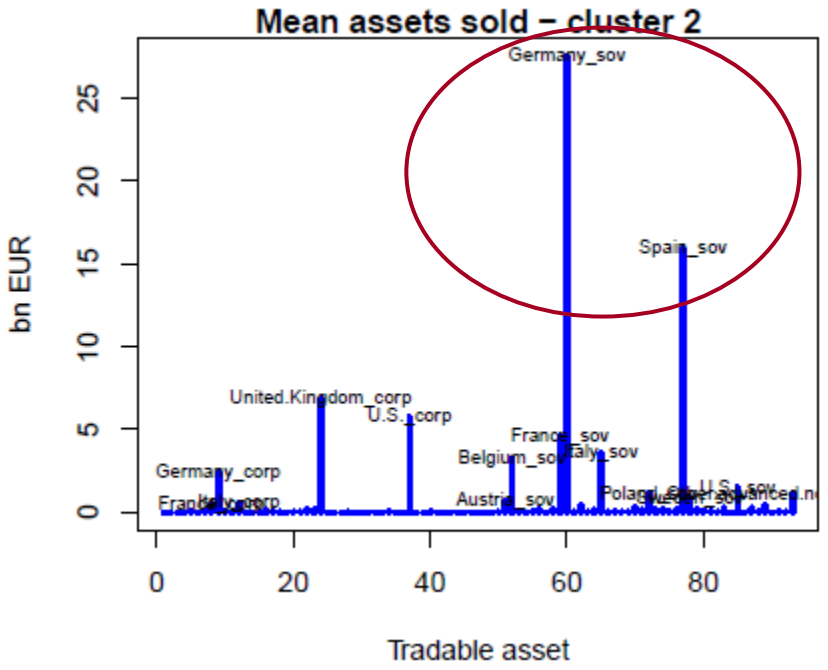




4. Risk-weighted assets constraint

- **How do the empirical results change** when considering **a risk-weighted asset constraint** to determine banks' optimal behaviour, as opposed to the **leverage constraint**?
- In Section 3.4.3, results show a **predominance** of **sovereign assets being sold**.





Minor Comments

1. **Section 2.2**: Further motivation warranted for the chosen
   - form of the market depth equation?
   - liquidation horizon?
2. **Section 2.3**: To improve readability, further details could be provided for the transition from equation (5) to the optimization problem in (6) - (9).*
3. **Section 3.2**:
   - For the benefit of the reader, the paper could elaborate in further detail the characteristics of the empirical datasets being used.
   - Corporate exposures are identified as marketable assets, but this will depend on their respective ratings.
4. **Section 3.3**: Which banks are ultimately most vulnerable to the worst-case scenarios? Figures on the joint impact from initial losses (Figure 5) and fire-sale losses (Figure 6) could help in this area.
5. **Section 3.3 onwards**: Existing empirical methods could be motivated more to clarify how these methods best allow to answer the questions being set forth.

* For instance, no definition provided for variable l_i in equation (7) and (9).