Liquidity Coverage Ratio in a payments network

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Overview

Background

- The Liquidity Coverage Ratio (LCR) requirement of the Basel III framework is aimed at making banks more resilient against liquidity shocks;

  A bank should be able to fulfill its payment obligations during a 30-day stress period ($LCR = 1$)

- Focus is on liquidity coverage of a single bank

- FMI data is granular and contains network dimension

Possible Research Questions

- Can data from the LVPS add a network dimension to LCR?
- What happens after a major participant becomes stressed $(LCR < 1)$?
- What is the impact of the size of the shortage $(1 - \sigma)$?
- How resilient are (the other) participants?
  How important is an additional buffer $(1 + \alpha)$?
- Which participants cause most damage?
- Which participants are most vulnerable?
- What is the relationship with ECB and FSB lists of important institutions? [1]
- What effects can be observed during consecutive rounds ρ ?
- What can be observed when generating a high frequency LCR?
- ...

[1] ECB internal list of Critical Particiants; FSB published lists of global systemically important institutions (G-SIBs) and insurers (G-SIIs).

Methodology

- Define 100 largest institutions ($L100$): [2]
  - ECB list of Critical Participants $\mathbb{C}$
  - FSB list of Systemically Important Financial Institutions $\mathbb{S}$
  - complete L100 based on value of outgoing payments and centrality
- Define values for additional buffer α and shortage σ
- For all banks calculate initial liquidity Buffer, assuming their LCR equals $(1+\alpha)$
- Stress each of the $L100$ participants individually, by lowering their LCR to $(1-\sigma)$
- Start stress cascade for each bank, using payment network, applying decreased outflows
- Each round ρ all other participants can also become stressed, in case $(LCR < 1)$
- Store cascade calculations
- Analyze results

[2] The terms 'institutions', 'participants' and 'banks' all refer to the institutions participating in TARGET2 aggregated to the level of institution.

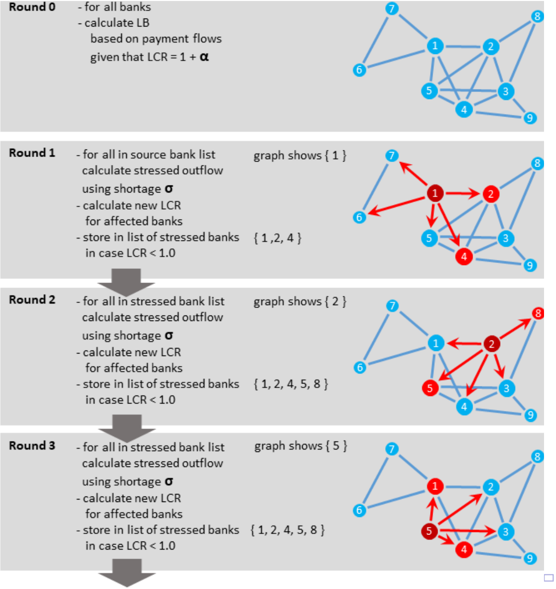
Calculation of initial Liquidity Buffers using Payment Flows

- The LCR requires a detailed runoff calculation using many balance sheet items
- $LCR = \frac{LiquidityBuffer}{NetOutflow} = \frac{LiquidityBuffer}{Outflow - Inflow} > 1$
- Important restriction;
  - Inflow may not exceed 0.75 of $Outflow$
- Rewrite to: $LCR = \frac{LiquidityBuffer}{(Outflow - 0.75 Outflow)}$

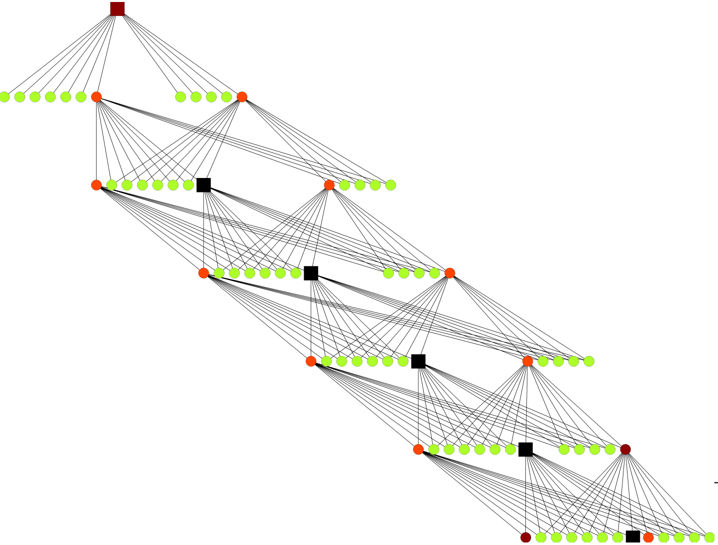
  $LiquidityBuffer = LCR\, 0.25\, Outflow$
- Generate different Liquidity Buffers at LCR $= 1 + \alpha$,

  e.g. $1 + 0.05$, $1 + 0.10$, $1 + 0.20$, ...

Generating a Stress Cascade in a payments network



Example of an unfolding Stress Cascade



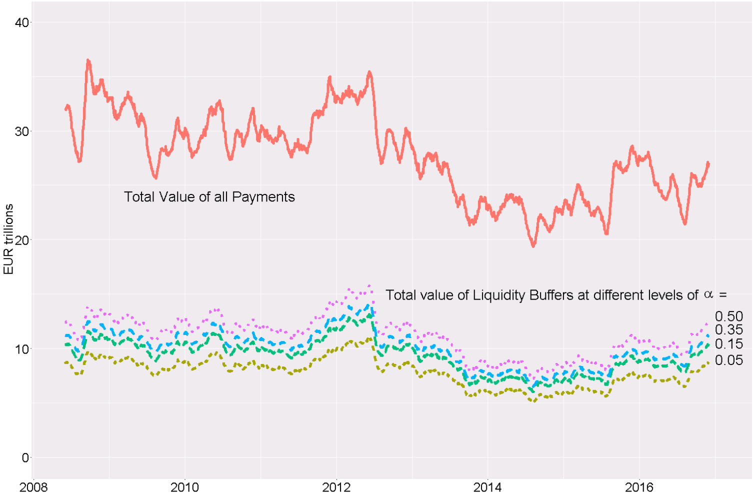
- Each level in the graph represents a round in the cascade,
  starting at the top with level 0, and ending at the bottom with round $\rho = 6$
- The stressed bank is represented by a square
- Darkening of colors of nodes reflects *LCR* deterioration[a]
- Parameters: $\alpha = 0.05$, $\sigma = 0.50$, $\rho = 6$.

[a] Colors: green, orange, brown and black were assigned using LCR border values of 1.0, 0.70 and 0.50.

Storage of Cascade Results

- Initially: day , bank , inflow , outflow , liquidity buffer
- Cascades: day , Source bank , round , Stressed bank , Affected bank
  Actual inflow , - outflow , - LCR
- Versions for levels of liquidity addition (α) and liquidity shortage (σ)
- Enables generation of several statistics
- Enables generation of a "Network of LCR Deterioration"

First results - Buffer size through time



- Linear relationship between Total Value and calculated Buffers, which follows from

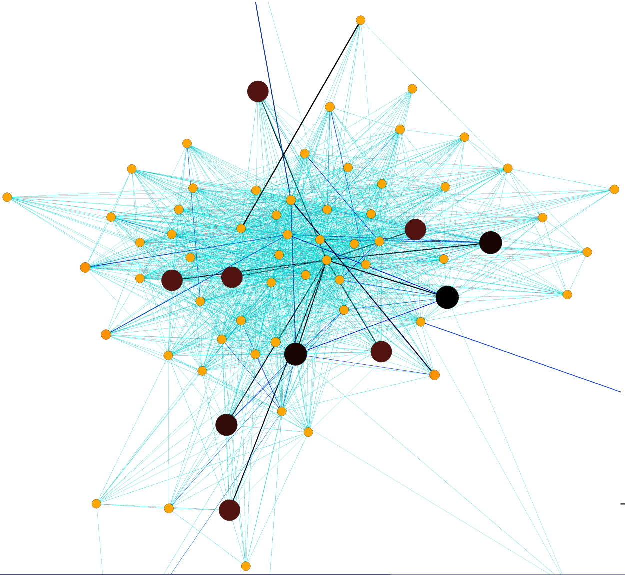
$$LCR = \frac{Buffer}{NetOutflow} \text{ i.e.}$$

$$LCR = \frac{Buffer}{(Outflow - 0.75\,Outflow)}$$

$$Buffer = LCR\,0.25\;Outflow$$

$$Buffer = (1+\alpha)\,0.25\;Outflow$$

First results - Example of an LCR Deterioration Network

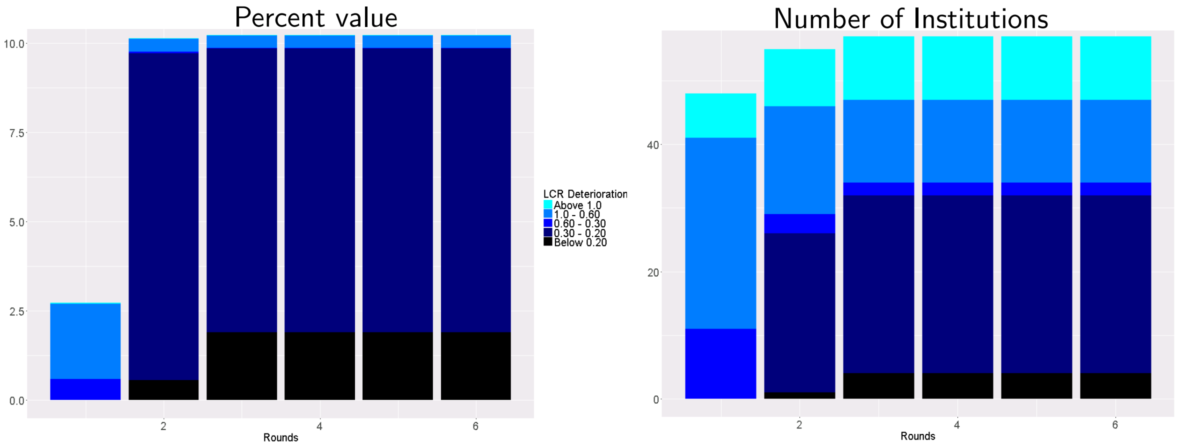


- Nodes:
  Size and darkening of colors reflect banks' outgoing strength [a]
  i.e. the power to cause damage

- Edges:
  Size and darkening of colors reflect value of damage
  i.e. path of destruction

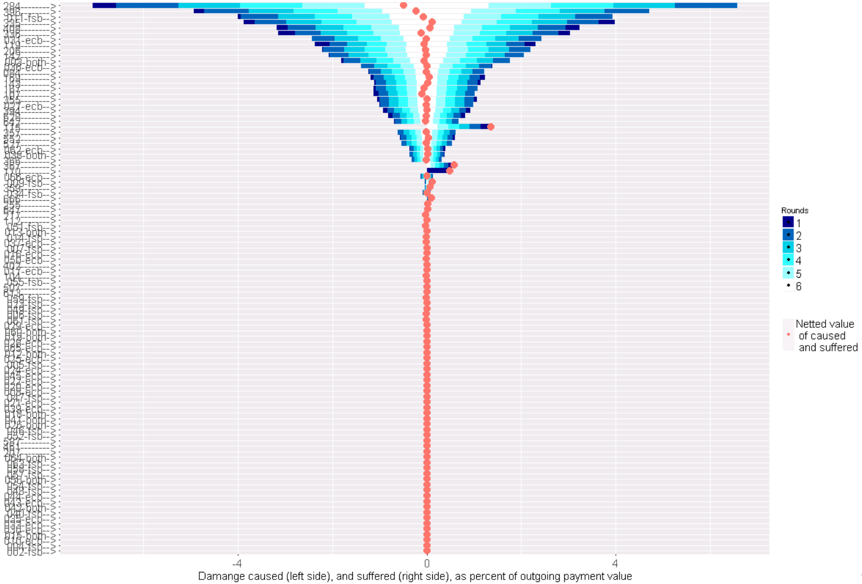
[a] Kleinberg's hub centrality measure has been applied, which highly ranks nodes that have outgoing links to most central nodes.

First Results - LCR Deterioration per round[3]

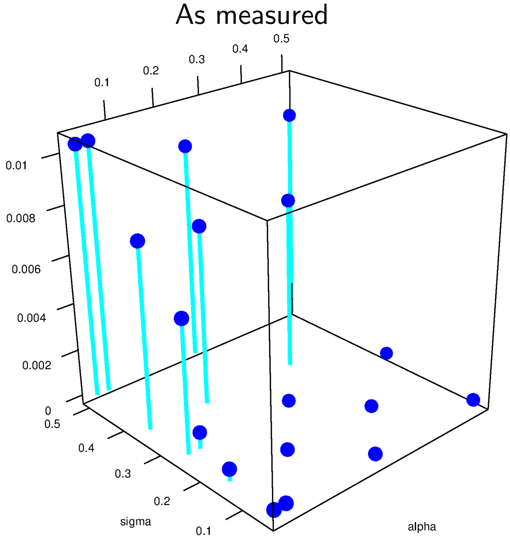


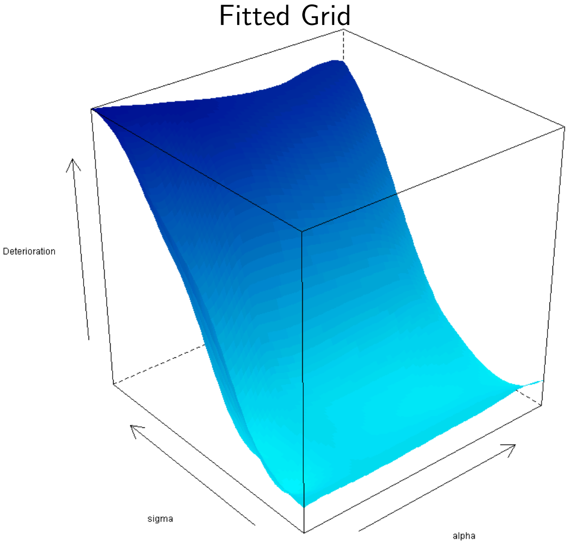
[3] Parameters used: addition $\alpha = 0.05$, shortage $\sigma = 0.50$, nr of rounds $\rho = 6$.

First Results - LCR Deterioration Caused and Suffered



First Results - Relation between shortage and addition





(Very) Preliminary Conclusions

- Liquidity Shortage σ seems to be the most important driver
- Liquidity Addition α quickly lost, in the first rounds
- Large institutions cause most damage
- Small institutions on suffering side
- LCR benefits from an added network dimension,
  at damaging side as well as at suffering side
- ...

Challenges faced

- Large amount of transactions (786 mln)
- Aggregation from BIC code (2,500) to institution level (1,200) not present
- Data Warehouse approach is necessary and time consuming
- Storage of cascade results (566k) also needs database solution
- Performance and storage of the environment has reached its limits

Further Work

- Data validation
- Daily cascades on whole period (2008-2016)
- Analysis of relation between addition α , shortage σ and rounds ρ
- Analysis of deterioration network
- ...

Thanks for your attention