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Systemic liquidity risk in the interbank market *

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* The views expressed in this presentation are ours and not necessarily those of the institutions the authors are working for.

Motivations

- Given the decline in direct interbank exposures, authorities' concerns are shifting toward systemic liquidity risk.
- But there is no work measuring the actual significance of systemic liquidity risk: Does this really matter?
- Liquidity regulations (e.g. LCR) do not consider systemic risk externalities.
- SIFIs need additional capital to contain systemic credit risk. Do they need to consider SIFIs to contain systemic liquidity risk?
- In the middle of a liquidity crisis, which bank should a central bank prioritise to rescue?



Contributions

- Measuring systemic liquidity risk ‘comprehensively’ for the first time with actual datasets.
- Extending micro-prudential liquidity monitoring incorporating systemic consequences of defaulting entities over time.
- Identifying SIFIs for systemic liquidity risk.
- Modelling dynamic contagion (contagion could occur every day).
- Modelling optimal ex-post intervention/liquidity regulations (e.g. bailout, liquidity assistance, etc.).



Literature Review

- Eisenberg and Noe (2001) have already pointed out the one period model contagion via direct bilateral links.
- Markose et al. (2010) develops a multi agent based framework to model how contagion spreads via direct and indirect counterparty exposure.
- Lenzu et al. (2012) study which network architecture can make the financial system more resilient to random shocks and how defaults spreads over time.
- Ferrara (2012) shows how to implement a linear program to take into account the clearing and propagated defaults in a dynamic financial network.



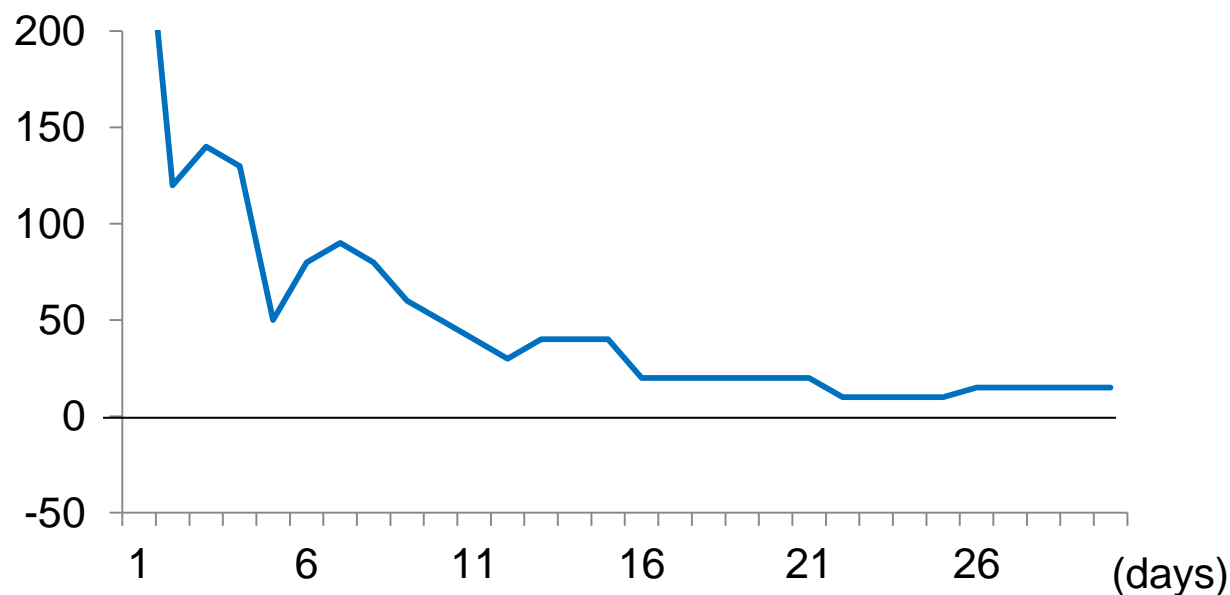
Literature Review (cont.)

- Cifuentes et al. (2005) investigate the theoretical basis for contagious failures and quantify them through simulation exercises.
- Aikman et al. (2009) demonstrate how the introduction of liability-side feedbacks affects the properties of a quantitative model of systemic risk (RAMSI).
- Haldane et al. (2011) develop a network model of interbank lending focused on unsecured claims, repo activity and shocks to the haircuts applied to collateral.



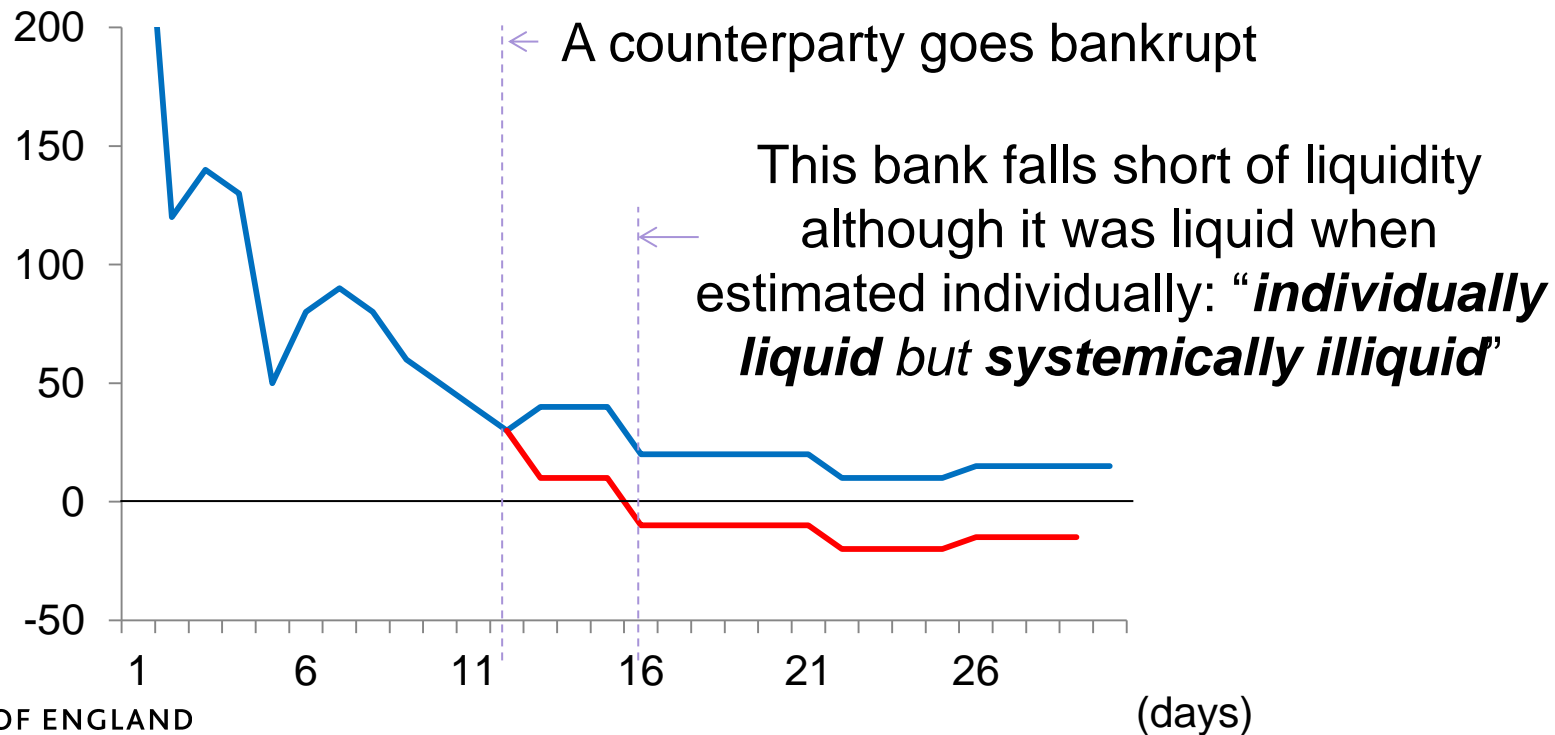
What are we going to do (1): Estimating banks' liquidity positions

- Banks hold liquid asset buffers (LAB) consisting of cash, central bank reserves and high-quality securities.
- Stress scenario: banks cannot roll-over any wholesale funding (consistent with FSA wholesale funding gap) for 30 days.
- This assumes that all counterparties repay their loans.



What are we going to do (2): Introducing externality

- If a counterparty fails to make a repayment, the scheduled cash inflow of a bank would fall, hence the bank's liquidity position decreases, which could trigger the bank's default (now or later).



Steps of the analysis

1. Estimating banks' liquidity position (over time)
2. Estimating networks
3. Testing Dynamic financial contagion model
4. Results
5. Conclusion and possible extensions



1. Estimating liquidity positions

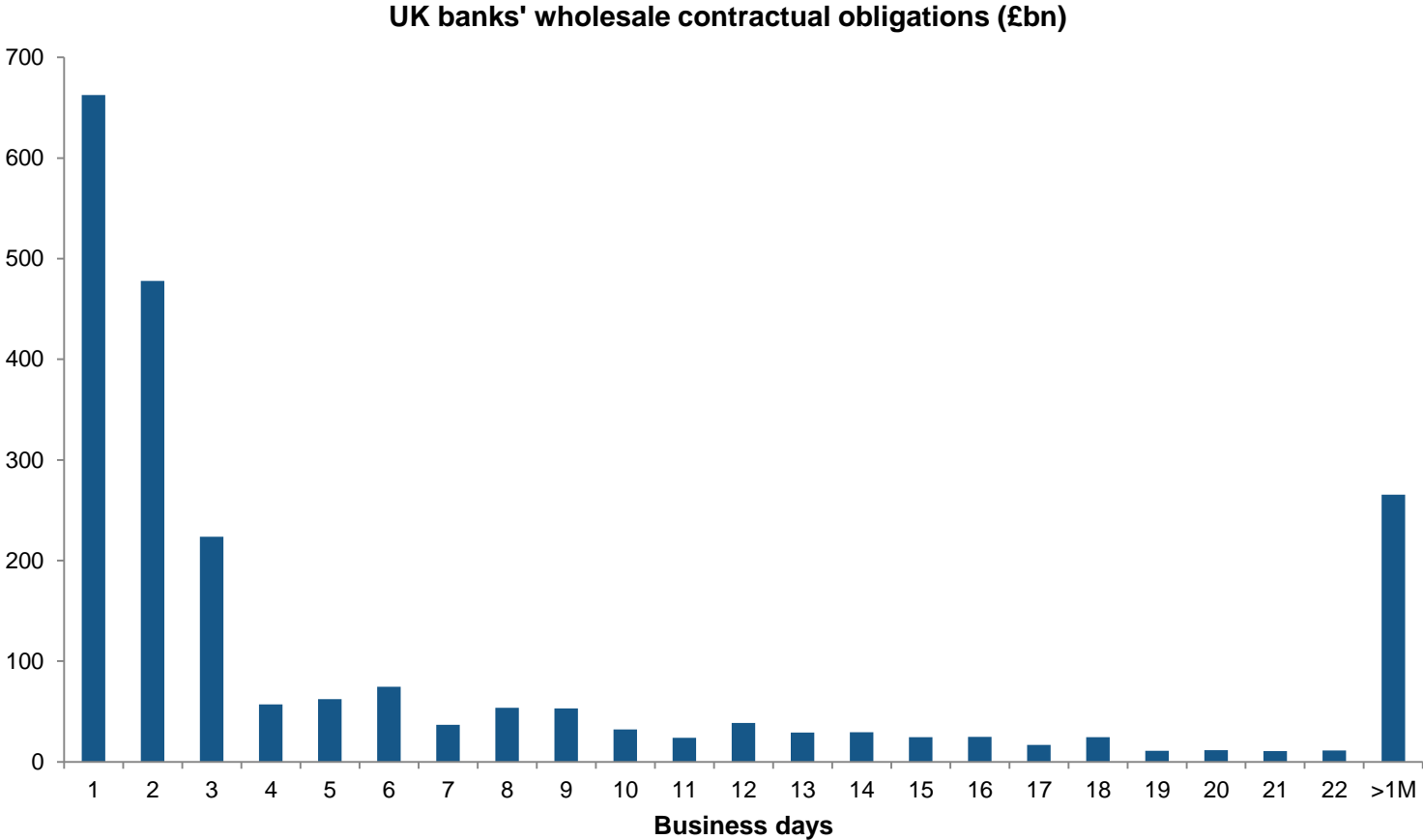
Data sources

- Regulatory data on daily cash flow (data as at end-2013):
 - FSA047 (banks' daily liquidity flows)
 - FSA048 (banks' longer maturity liquidity flows)
- Each reporting bank submits:
 - Contractual (re)payment obligations due on each day up to 3 months.
 - Contractual cash inflows the bank expects (for 3 months)
 - Broken down by instrument
 - Broken down by lenders (unsecured loans only)
 - Current cash and liquid asset holding



1. Estimating liquidity positions

UK banks' aggregate wholesale contractual obligations by expiry date



2. Estimating Networks

- Two regulatory datasets (data as at end-2013):
 - FSA051 (banks' top 30 funding providers)
 - RRP interbank exposures data
- FSA051: each reporting bank submits:
 - 30 largest wholesale lenders the bank borrows from
 - Including non banks and non financial institutions (e.g. sovereigns)
 - The bank submits weighted average maturities of the 30 liabilities
 - Broken down into 'unsecured loans' and 'repos'
- RRE LE Return: each reporting bank submits:
 - 20 largest counterparties the bank is exposed to (lending to)
 - Broken down by instrument and by maturity (O/N, <3M, >3M)



2. Estimating Networks

Coverage of the estimated networks

- We focus on the UK interbank networks
 - Transactions with foreign banks are ignored
 - Our sample captures roughly 90% of unsecured liabilities between UK banks
 - But the majority of the unsecured loans are from non-UK banks
- The coverage of repo transactions is low
 - Most likely because large cash lenders of repo transactions are from the US non-bank financial institutions
 - Approximately 25% of repo liabilities are covered in the sample
- Smaller liabilities are ignored
 - since we identify reported counterparties only



3. Testing contagion: why dynamic?

- Liquidity shortage could propagate slowly
 - A bank's failure today could trigger another bank's failure next week
- Relevant to regulations ensuring banks to be liquid 'for the time being'
 - Liquidity Coverage Ratio
 - UK ILG requirements
- Static contagion could underestimate network externality
 - Some banks could fall short of liquidity during a month but can go back to liquid at the end of the month



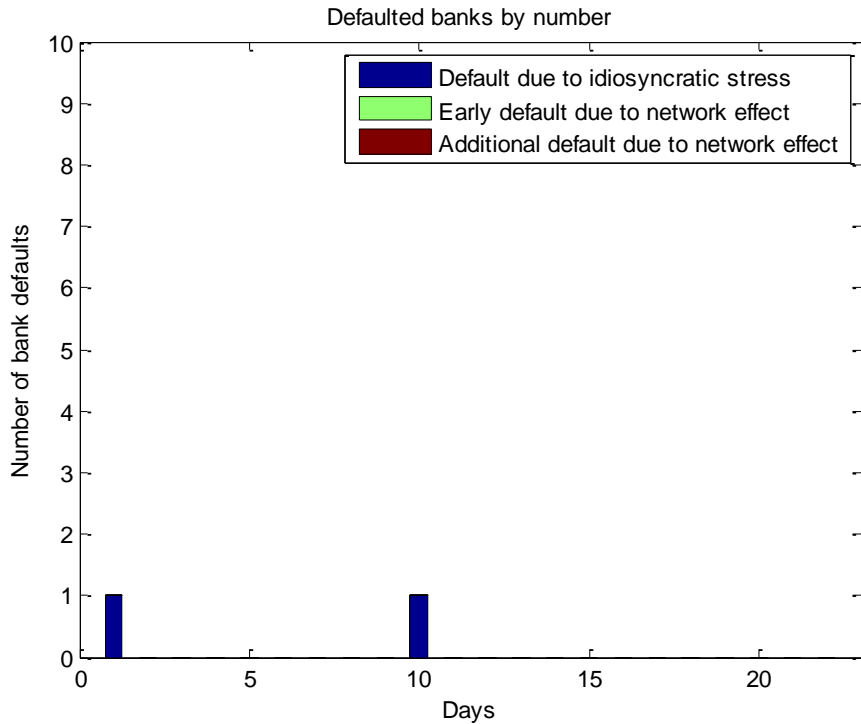
Dynamic E/N: What we assume / don't assume

- No new loans, no roll-over
 - Otherwise we need to model banks' lending behaviour
- Once a bank fails, the bank no longer pay anything
 - But surviving banks have to repay to the failed bank (unsecured)
- No fire-sales
 - The value of less liquid collateral is fixed at zero throughout the period (i.e. terrible fire-sales)
- Repos have a close-out netting clause
 - Assume borrowing banks do not have to repay to failed banks

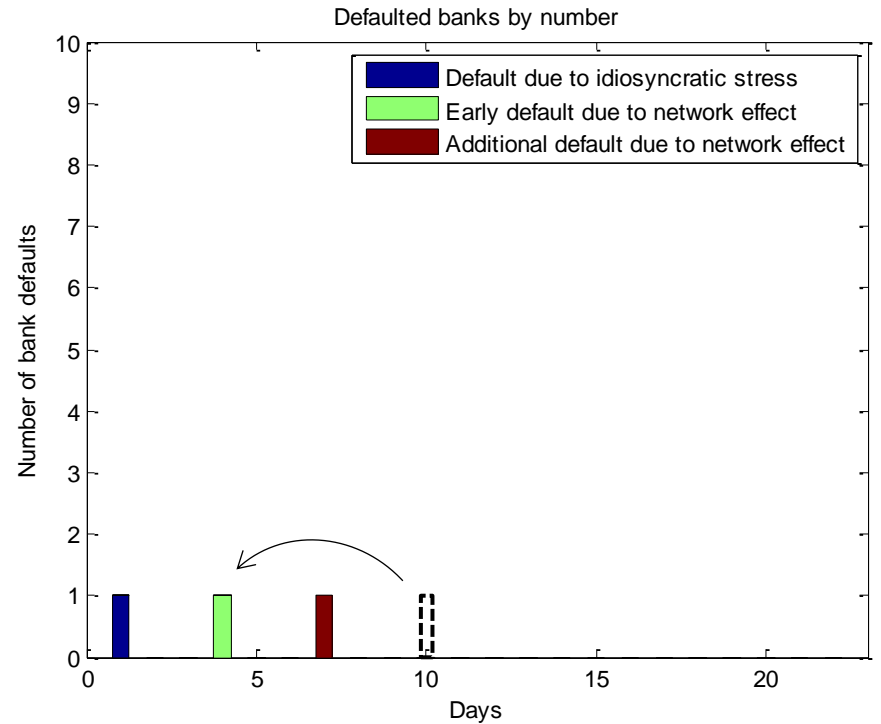


Definition of network effect

Without network effect



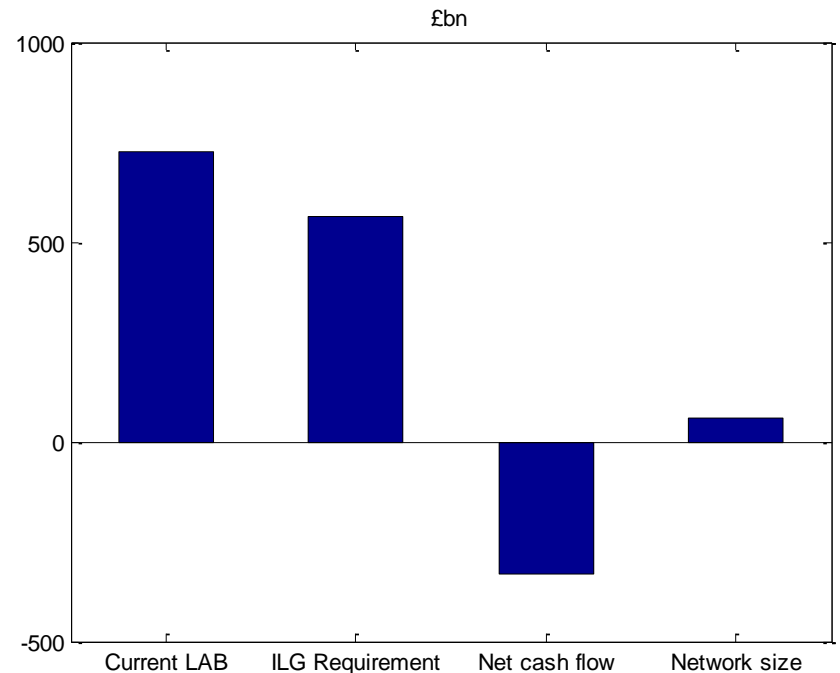
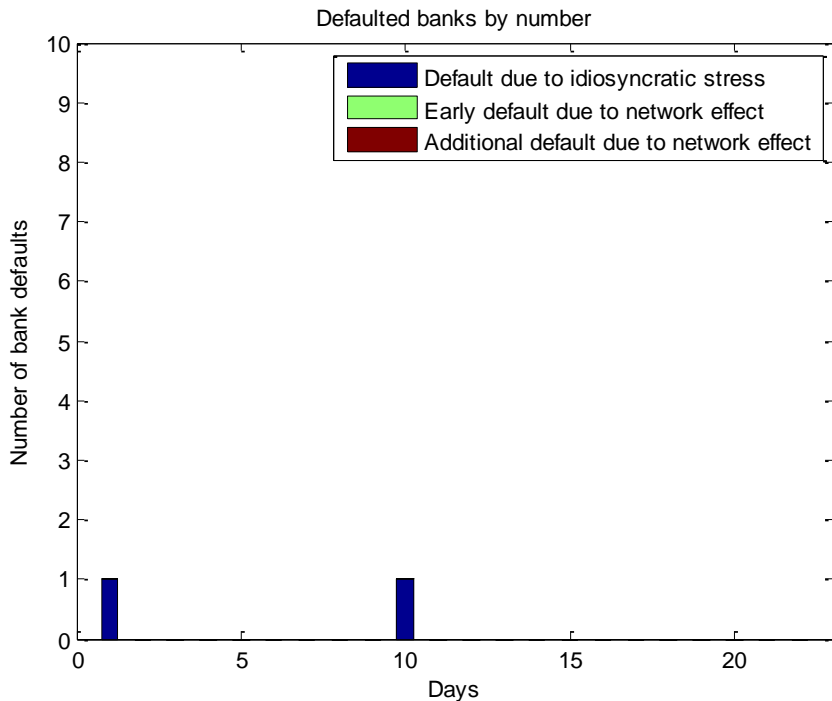
With network effect (illustrative)



Without considering network effect, two banks default due to idiosyncratic stresses.



No contagion with the current liquidity holding

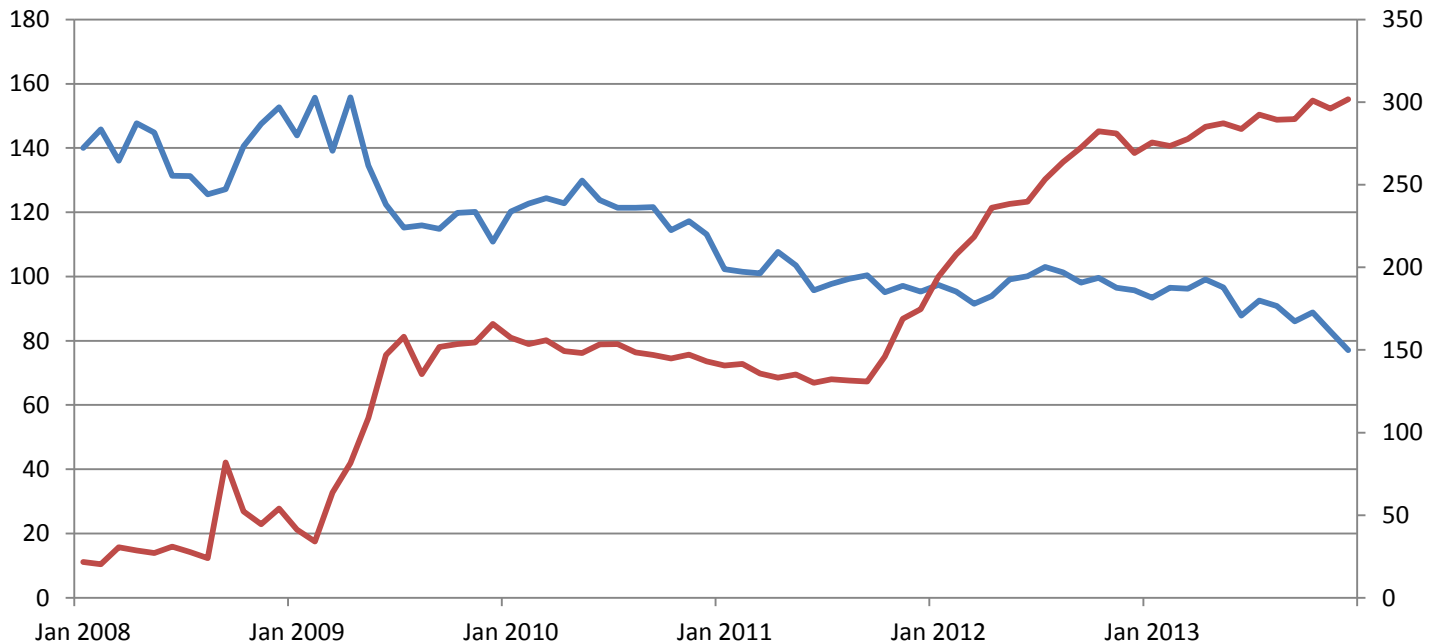


The total size of the network (sum of links between banks) is only around £70bn, much smaller than the current liquid asset buffer held by banks or the net cash outflow from banks in idiosyncratic stress scenarios.



The reasons why the networks effects are weak (1)

UK banks' unsecured loans and liquid assets (£bn)



Source: Bank of England
Note: Intra-group loans are not included.

— Unsecured interbank lending (LHS)
— Central bank balances and treasury bills (RHS)



The reasons why the networks effects are weak (3)

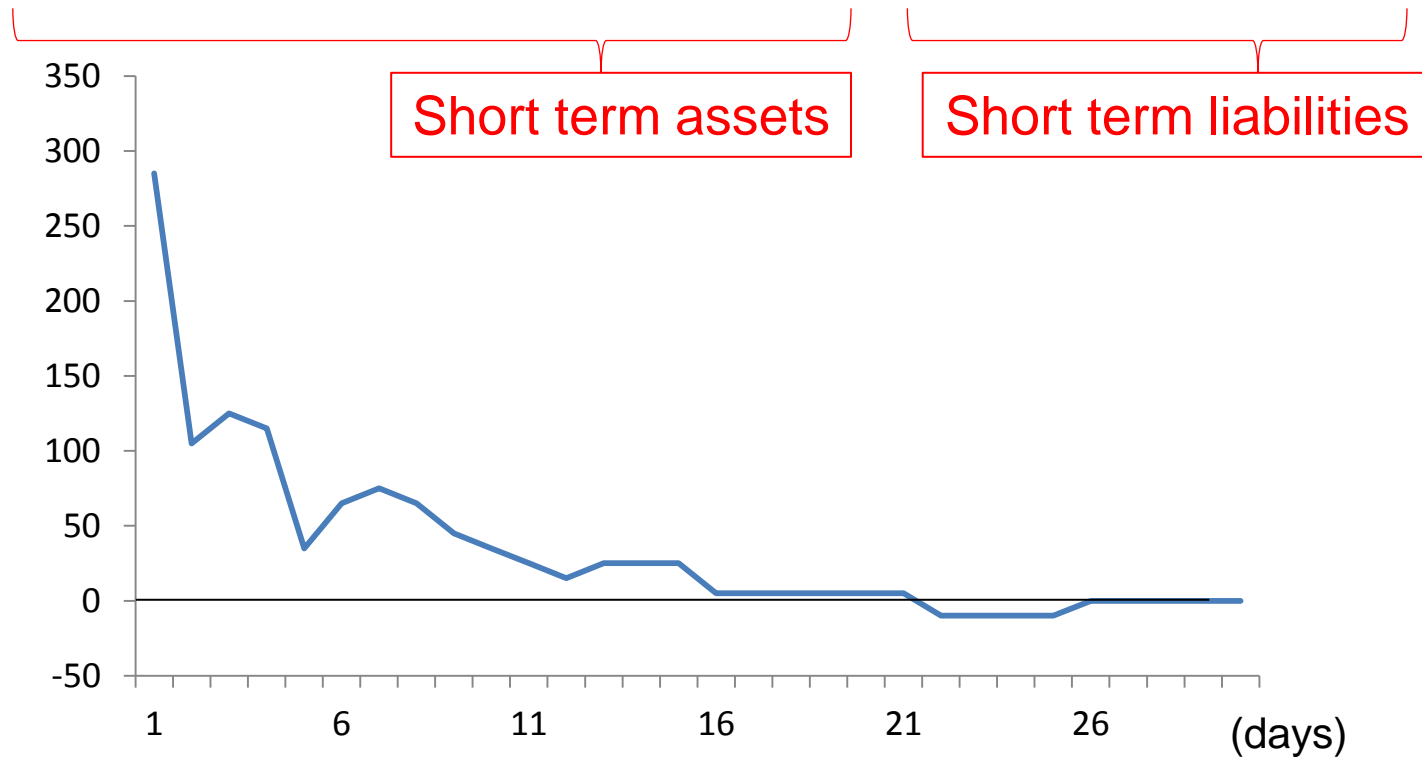
- Banks are required to hold liquidity for various different stresses
 - Wholesale market stress
 - Depositors' run
 - Large margin call following to a market turmoil
- Banks go bankrupt only when interbank shocks are larger than the whole liquidity holding
 - No problem if the other stresses never occur simultaneously
 - If several stresses are likely to occur simultaneously, we are severely underestimating the systemic risk
- A solution: stress-testing liquidity regulations:
 - Assuming that banks hold minimum liquidity buffer for wholesale market stresses



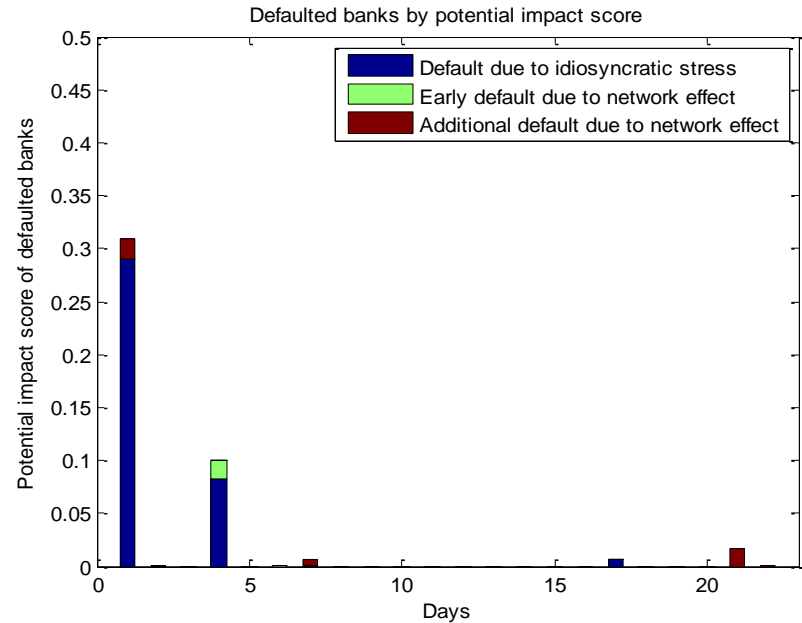
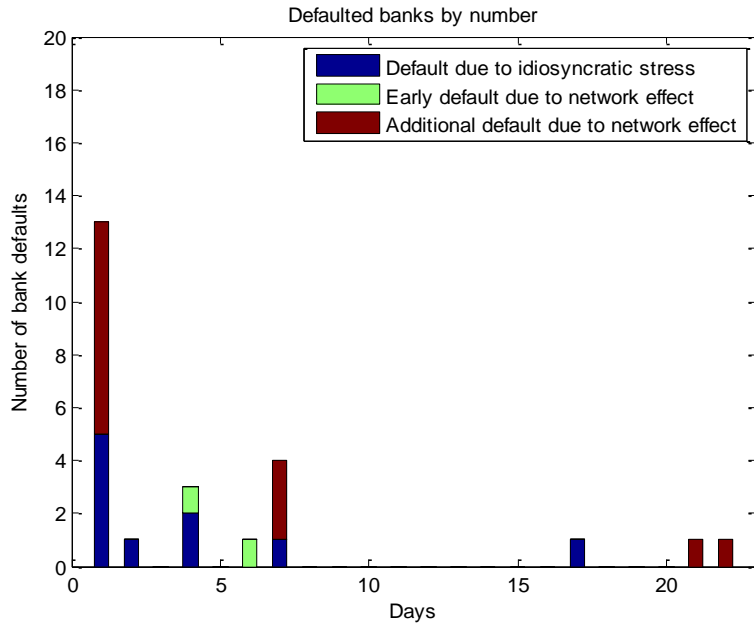
Banks hold minimum required liquidity buffer

- Banks need to have the minimum liquidity such that:

$$Liq_Holding + \sum_{t=1}^{22} Cash_in_flow_t \geq \sum_{t=1}^{22} Cash_out_flow_t$$



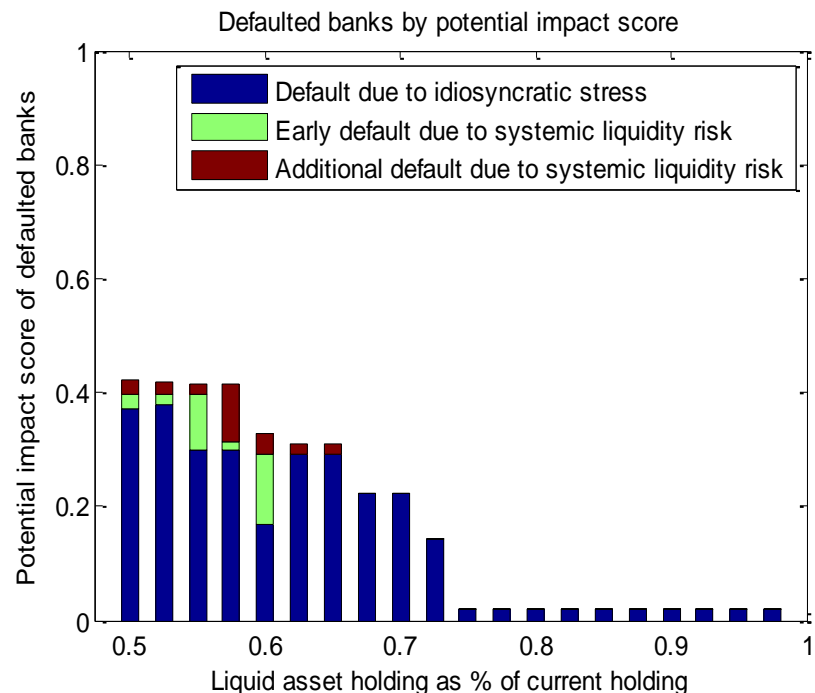
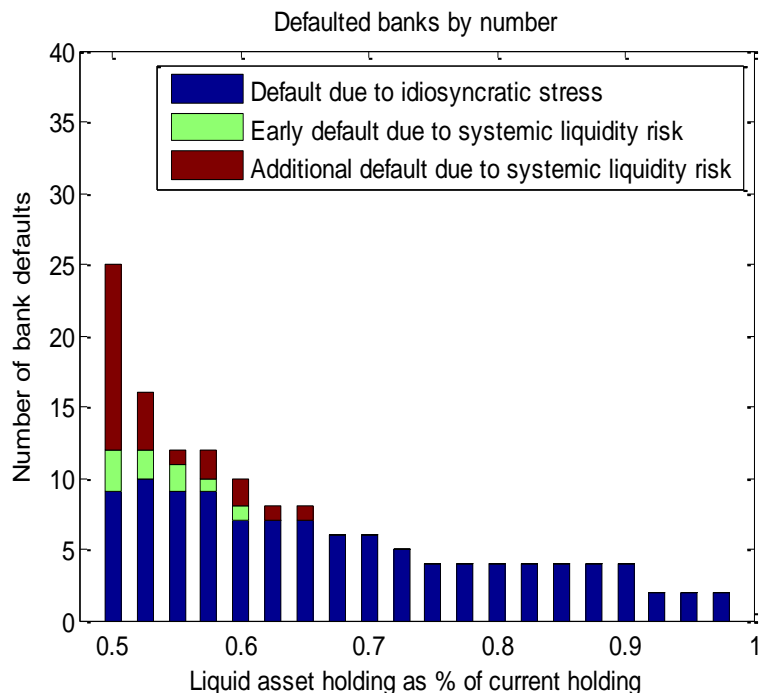
Holding LAB to cover 30-day outflow



- The above assumes that banks hold LAB to cover the net cumulative outflow on the 30th day (22nd business day).
- Many banks will default due to idiosyncratic stress within the 30-day period.
- This leads to both early defaults and additional defaults.



What if banks hold a little bit more LAB?

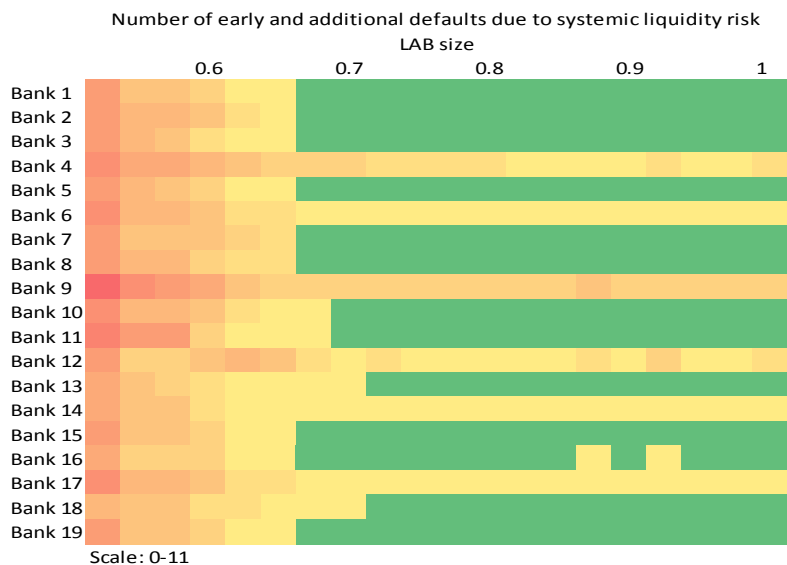


The above assumes banks hold $1+x\%$ of the minimum LAB (to cover net cumulative outflow on the 30th day).

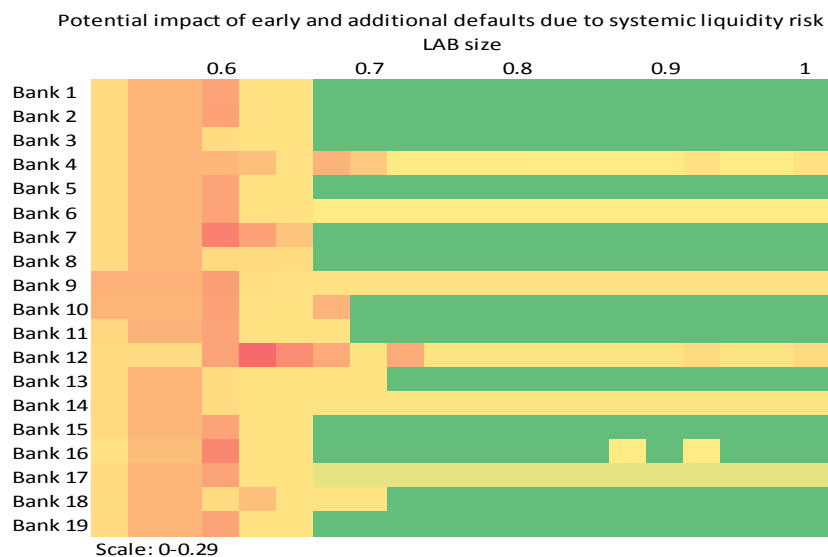


Exogenous shock to a particular bank

Number of defaults due to network effect (0-11)



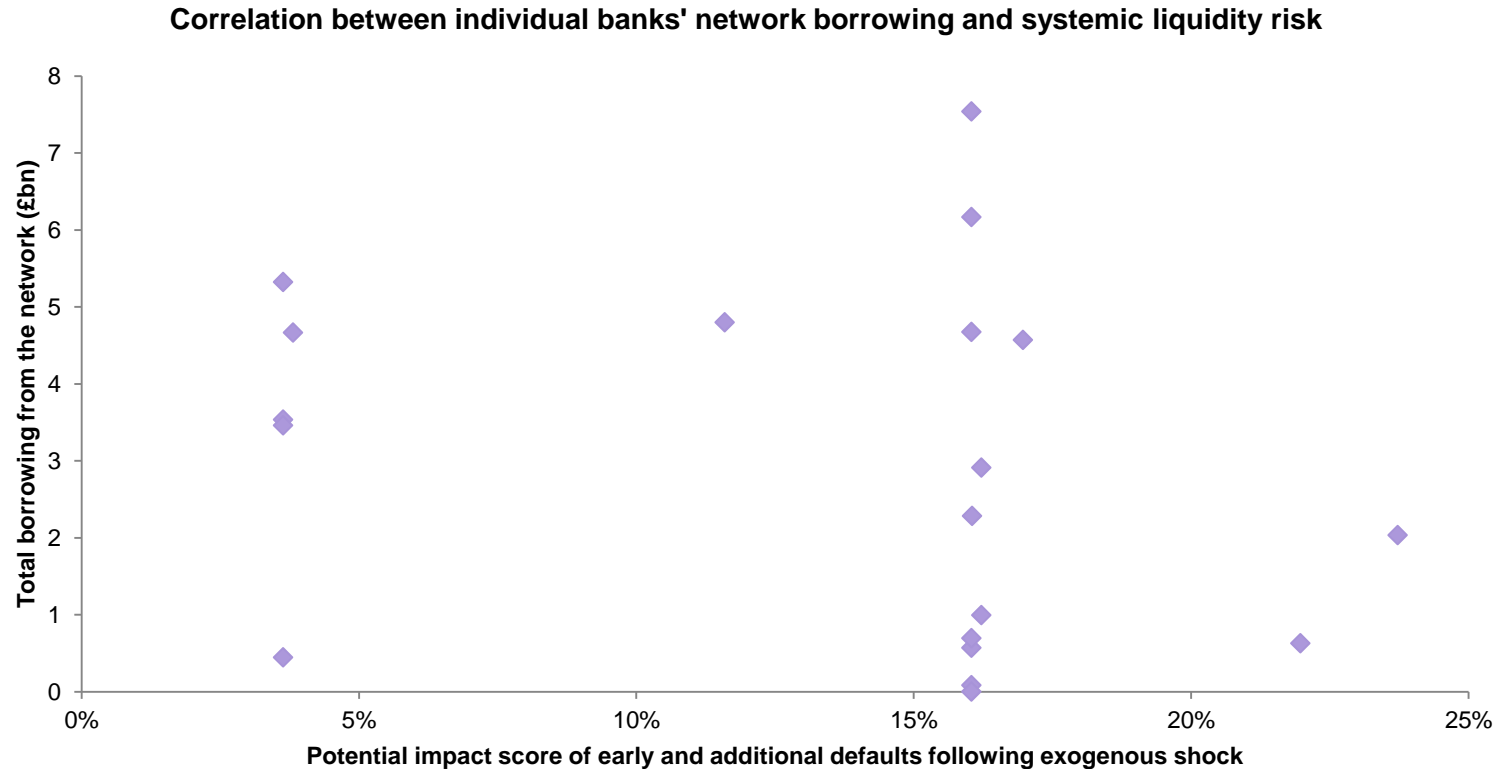
Potential impact score of defaults due to network effect



- The above assumes banks hold $1+x\%$ of the minimum LAB (to cover 30-day outflow), and a bank defaults at Day 1 due to an exogenous shock.
- The network effect is not monotonic in the size of LAB because when LAB is low, vulnerable banks are more likely to default due to idiosyncratic stresses in the first place.



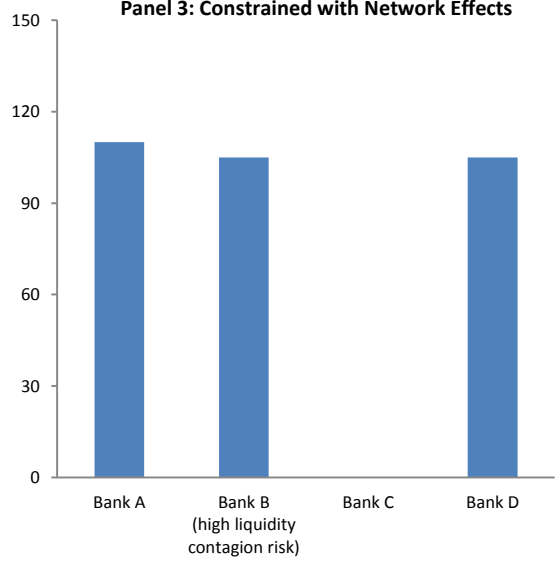
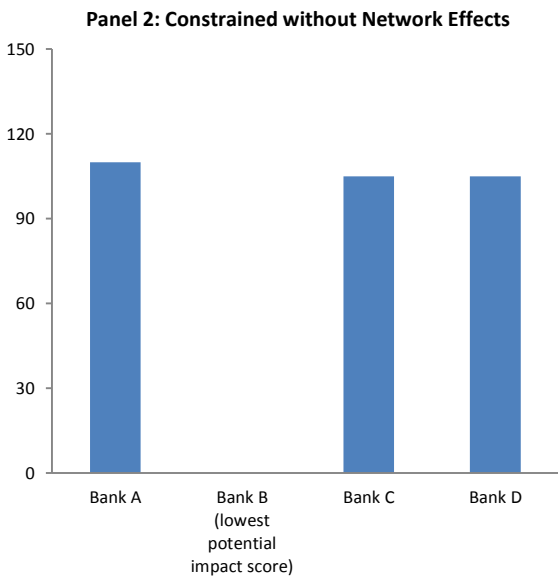
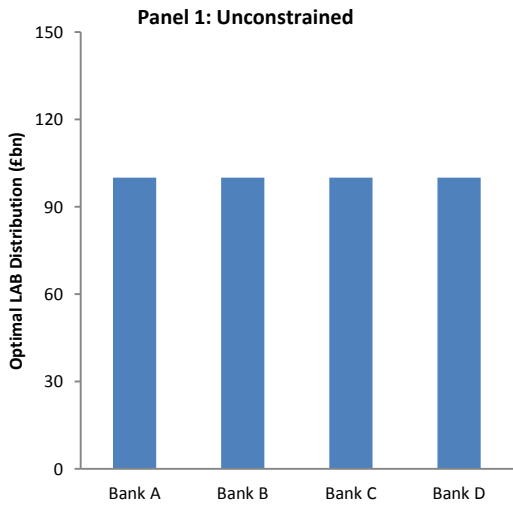
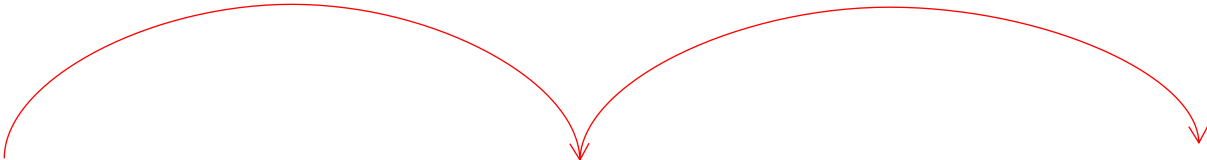
Borrowing from the network



Defaults of banks that have large number/value of borrowings from the network do not necessarily have a large impact on the network.

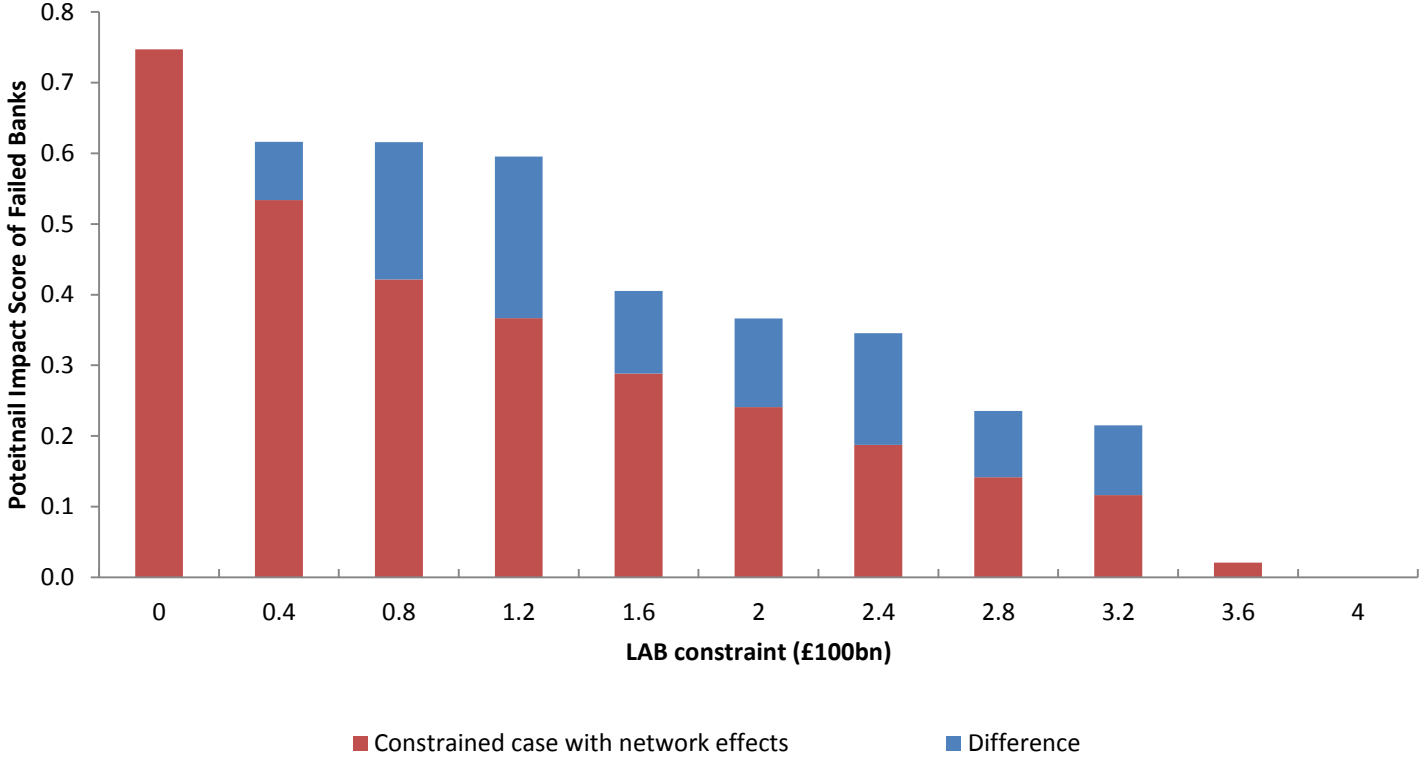


Minimise the Potential Impact of Defaulted Banks (1)



Minimise the Potential Impact of Defaulted Banks (2)

The difference between the total impact score of failed banks under the constrained case with and without network effects



Conclusion

- At current levels of liquid holdings, contagion does not occur.
- But the result underestimates the systemic risk
- There are several “SIFIs in funding liquidity system”
- These ‘liquidity SIFIs’ are not necessarily correlated with the size of the banks.
- When assuming a major bank defaults exogenously, network effect remains significant, even when banks hold more than 150% of the minimum LAB.



Potential extensions

- We could determine the optimal amount of liquidity buffer in order to maintain the network resilience and compare with the real life regulations such as ILG and LCR.
- The model can be extended to incorporate with fire-sales of illiquid assets when a bank falls short of liquidity, and with any other self-defensive behaviour banks can take to increase their liquidity buffers.
- The model can be connected with a systemic credit risk model to consider the interaction (and possible trade-offs) between systemic credit risk and systemic liquidity risk.



Questions?



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