Modelling Contagion in a Core-Periphery Financial Network

Marion Deichmann[1], Laurenz Kaiser[2], Timo Schäfer[3]

Proposal for Modelling and Simulating Social Systems with MATLAB

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General Introduction

Especially after the collapse of Lehman in 2008 researchers and policy makers have shifted their focus towards the interconnectedness of financial intermediaries regarding interbank lending. It has been shown that the default of a bank can trigger other banks' failure via the network structure (Nier, Yang, Yorulmazer, and Alentorn, 2007).[4] Since then global discussions regarding capital requirements and banking regulations have emerged, i.e. Basel III, Volcker Rule, Liikanen report, UK Whitebook. All these measures aim to decrease the probability of default of banks and hence, to reduce contagion w.r.t. financial distress.

[1]mariond@student.ethz.ch

[2]laukaise@student.ethz.ch

[3]schatimo@student.ethz.ch

[4]They analyse various key structural parameters affecting the likelihood of knock-on defaults such as capitalization, connectivity, size of interbank liabilities, concentration of the network and tiering.

Fundamental Questions

In our seminar paper, we aim to determine how regulatory policies on banks can lower contagion risks. First, we examine the impact of increased capital buffers. Second, we simulate whether bail-out strategies can impede contagion, i.e. randomly choosing which bank to save or more specifically, target the most central bank. Furthermore, it would be interesting to conduct a counterfactual analysis comparing saving or not saving banks.

Model and Research Methods

Our analysis is based on a random graph exhibiting stylized facts of the actual European financial network. For this purpose, we will use a Erdős and Rényi (1959) random graph model with core-periphery structure. Georg and Gabrieli (2014) finds that the joint European interbank market can best described as a network of connected core-periphery networks since the latter can be found on a national bank level.

Let us assume that the total assets of each bank i consist of interbank assets, A_i^{IB}, and illiquid external assets (i.e. mortgages), A_i^M. Further, the total interbank assets are equally distributed across all incoming links. Bank i's total liabilities consist of interbank liabilities, L_i^{IB}, that are endogenously determined and of exogenous customer deposits, D_i. Using these notations, one can define the necessary condition for bank i to be solvent (Gai and Kapadia, 2010):

$$(1-\alpha)A_i^{IB} + qA_i^M - L_i^{IB} - D_i > 0 \tag{1}$$

with α being the fraction of bank i's counterparties with obligations to i that have defaulted assuming a recovery rate of zero, and q is the resale price of the illiquid asset that is <1 in the case of 'fire sales'. First, we build random graph model as described above. Second, we run a Monte Carlo simulation on the random variables A_i^{IB} and A_i^M respectively to get the numerical results. By construction, the means for the random variables for core and periphery banks differ significantly. Third, using this methodology we hope to be able to infer policy implications.

Expected Results

We expect that for increased capital buffers the frequency of contagion is more significantly reduced for core banks relative to periphery banks. Similarly, we expect that saving a core bank reduces the extent of contagion more effectively than saving a periphery bank.

References

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