Interbank Network Disruptions and The Real Economy

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Motivation

- Recent empirical evidence on the structure of interbank markets implies that interbank networks:
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$\Rightarrow$ Questions:

  - **How do disruptions in the interbank market effect the real sector?**
  - **What is the role for the central bank in this context?**

Environment

Banking sector:

- large number of banks
- allocate portfolio between cash (reserves) and loans to firms
- face **stochastic withdrawals (+ or -)**
- can borrow from each other – **if connected via network**
- face demand for lending from firms

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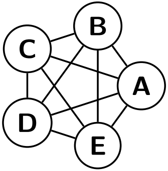
Central bank:

- provides last-resort loans to banks
- serves as a storage facility for banks' cash
- sets capital requirements and reserve requirements

Interbank Network

steady state: (a) market freeze: (b) partial disruption:



Interbank Network

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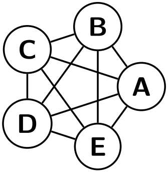
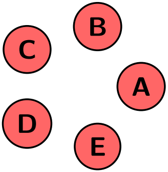


(a) market freeze:



(b) partial disruption:

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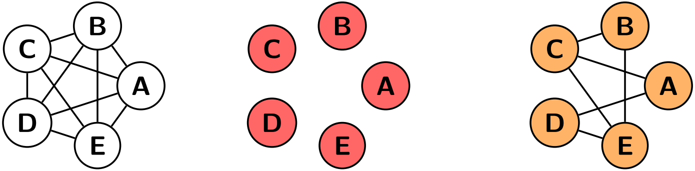

Model. Timing (banks)

start t:
some equity

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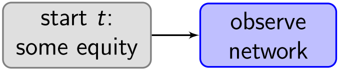

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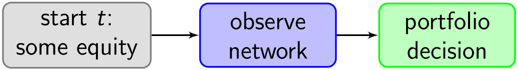

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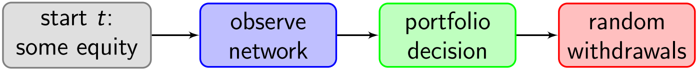

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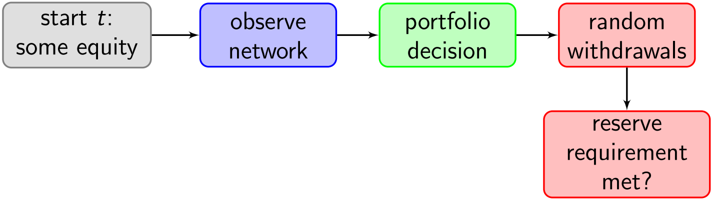

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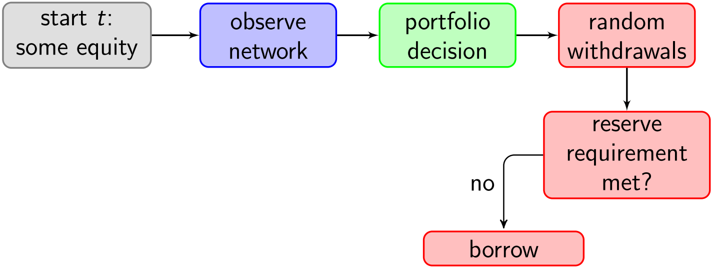

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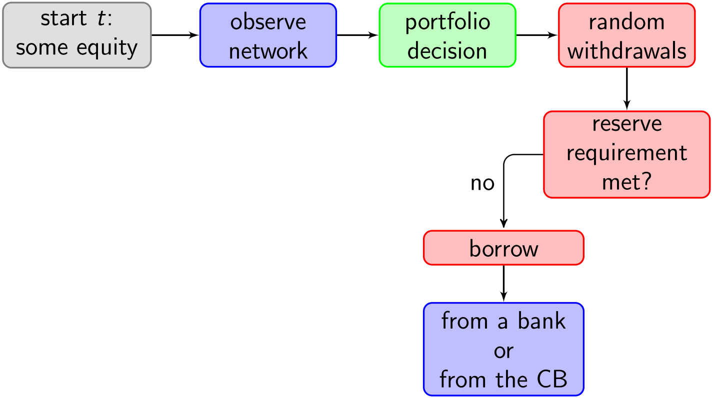

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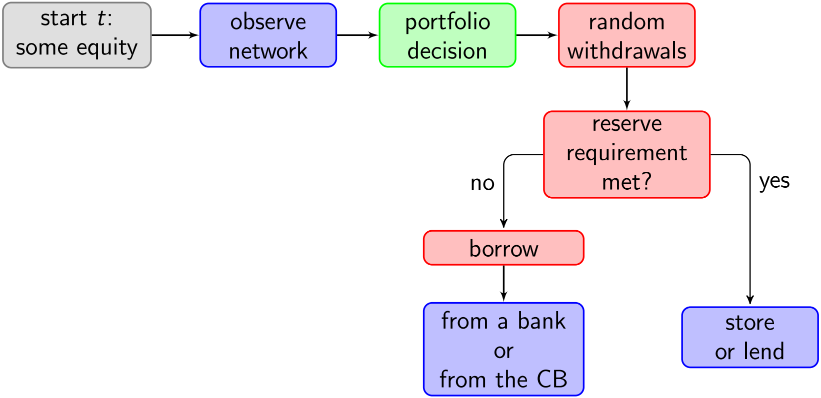

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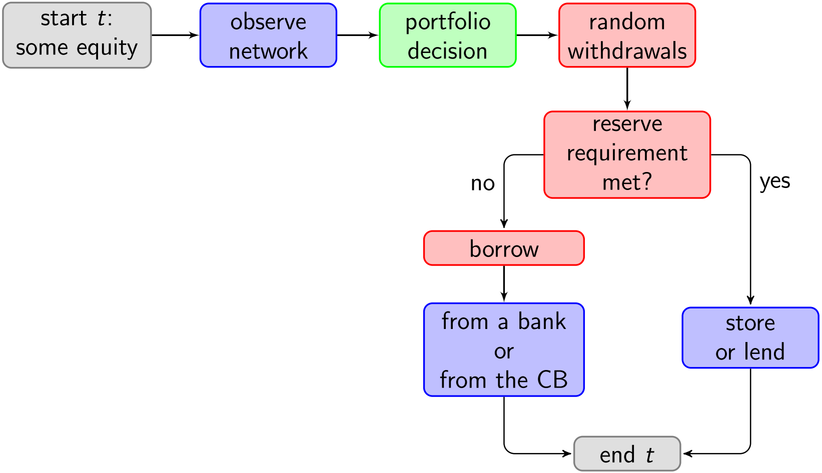

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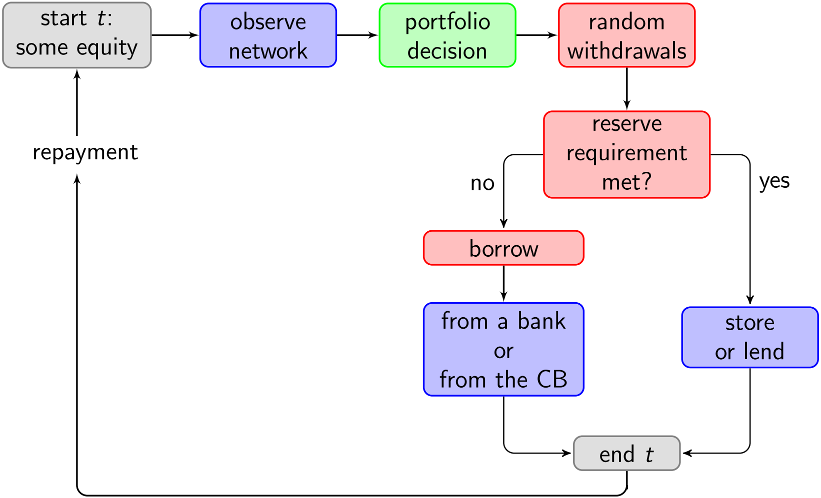

Mechanism

1. If a bank has a reserve deficit, its options for meeting reserve requirements are:
   - *central bank (high cost of borrowing)*
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$\Rightarrow$ Decrease in lending to firms*

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* **Important: After the total number of connections decreases, does a bank have more/less connections relative to others?**

Bank's Portfolio Evolution

- Bank i starts a period with equity E_{it} and chooses its portfolio:

Assets		Liabilities and Equity	
Loans	B_{it}	Deposits	D_{it}
Cash assets	C_{it}	Equity	E_{it}

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- Deposits are limited by the **capital requirement**:

$$D_{it} \leq \kappa_t E_{it}$$

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- Assumption:

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- Reserve deficit:

$$X_{it} = \rho_t D_{it}^{end} - C_{it}^{end}$$

Portfolio Return

The realized return on the portfolio is:

$$E_{it+1} = R^b_{it} B_{it} + C^{end}_{it} - R^d D^{end}_{it} - R^x(X_{it}, G_t) X_{it}$$

where

$$R^x(X_{it}, G_t) = \begin{cases} R_t^{IB} & \text{if borrow/lend in the interbank market} \\ R_t^{DW} & \text{if borrow from the CB} \\ R_t^{ER} & \text{if store excess reserves at the CB} \end{cases}$$

- G_t is the interbank network
- R_t^{ER} and R_t^{DW} are CB's gross policy rates
- R_t^{IB} is the interbank rate set as in Atkeson et al. (2012):

$$R_t^{IB} = \xi R_t^{ER} + (1 - \xi) R_t^{DW}$$

where ξ is the bargaining power of a borrowing order

Loan Supply

$$r_{it}^{b} = r_t^{DW} - \left(r_t^{DW} - r_t^{ER}\right)\left[\underbrace{P(X_{it} \leq 0)\left(1-(1-\xi)\,p_{it}^{LB}\right)}_{\substack{\text{prob. of a surplus } \times \\ f(\text{prob. of a match if surplus})}} + \xi\underbrace{\left(1-P(X_{it} \leq 0)\right)p_{it}^{BL}}_{\substack{\text{prob. of a deficit } \times \\ \text{prob. of a match if deficit}}}\right]$$

- p_{it}^{LB} is the probability that a lending order finds a borrowing order
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- these probabilities are general equilibrium objects which depend on the **bank's position in the interbank network**

Probabilities of Finding a Trading Partner

$$p_{it}^{LB} = \min\left\{1, \frac{\Gamma^{B}\left(\mathcal{N}_{it}, \Theta_t^{j}\right)}{\Gamma^{L}\left(\mathcal{N}_{it}, \mathcal{N}_{it}^{N}, \Theta_t^{k}\right)}\right\}$$

$$p_{it}^{BL} = \min\left\{1, \frac{\Upsilon^{L}\left(\mathcal{N}_{it}, \Theta_t^{j}\right)}{\Upsilon^{B}\left(\mathcal{N}_{it}, \mathcal{N}_{it}^{N}, \Theta_t^{k}\right)}\right\}$$

- $\mathcal{N}_{it}$ is the set of i's neighbors
- $\mathcal{N}_{it}^{N}$ is the set of banks that are connected to i's neighbors
- Θ_t^{j} and Θ_t^{k} are vectors of bank characteristics in sets $\mathcal{N}_{it}$ and $\mathcal{N}_{it}^{N}$ respectively

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- **Empty network:** $p_{it}^{LB} = p_{it}^{BL} = 0$

$$r_{t}^{b,E} = r_{t}^{DW} - \left(r_{t}^{DW} - r_{t}^{ER}\right) P(X_{it} \leq 0)$$

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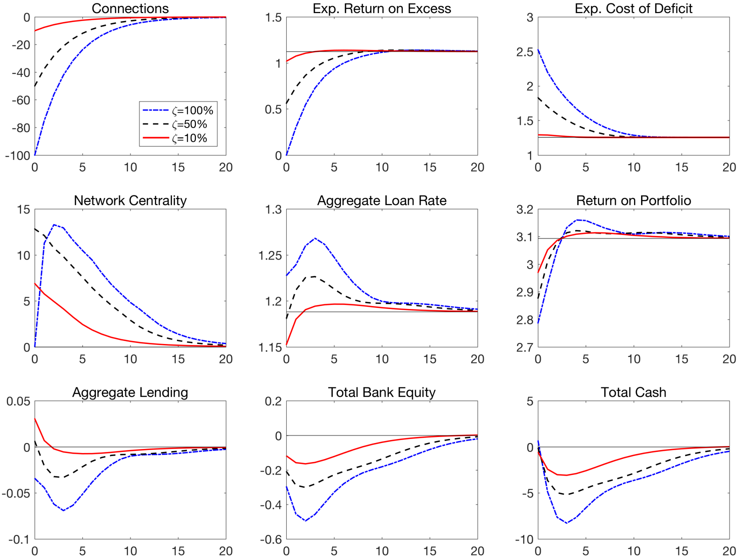
- **Complete network:** $p_{it}^{BL} = 1$ and $p_{it}^{LB} < 1$

$$r_t^{b,C} = r_t^{DW} - \left(r_t^{DW} - r_t^{ER}\right)\left[P(X_{it} \leq 0)\,(1-\xi)\left(1 - p_t^{LB}\right) + \xi\right]$$

Numerical Analysis. Complete Network

Partial Network Destruction (100 banks, 100 simulations)



Summary

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  - an *interbank market freeze* leads to an increase in the aggregate loan rate and decrease in aggregate lending
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  ** steady-state network topology is an important determinant

Summary

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  - an *interbank market freeze* leads to an increase in the aggregate loan rate and decrease in aggregate lending
  - a *partial network destruction*, however, may lead to qualitatively different responses
  - ** steady-state network topology is an important determinant
- **What is the role for the central bank in this context?**
  - if $r_t^{DW} - r_t^{ER} = 0$, the network does not matter for the real sector
  - as the corridor widens, network state becomes more important