Risk Concentration and Interconnectedness in OTC Markets

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Overview

Question How do banks' risk concentration and the structure of the interbank market interact?

This paper Tractable framework that jointly determines interbank links and risk allocations.

Main model ingredients

- Multiple rounds of sequential bilateral trading
- Key frictions:
  - Uncontingent matching choices
  - Limited information about risk positions of other banks
- Diminishing marginal costs of bearing risk

Environment

- $N + 1$ periods

- One ling-lived risky asset a, one numeraire good x, and one dividend good d
- Continuum of banks $i \in [0, 1]$
  - Quasi linear preferences

$$\mathbb{E}\left(\sum_{t=1}^{N} x_{i,t} - \kappa_t a_{i,t}^2\right) + \mathbb{E}\left(U_{N+1}\left(d a_{i,N+1}\right)\right)$$

    where d is the random dividend payment

  - Random endowment of the asset $a_{i,0}$ + deep pockets
- Bilateral meetings each period $t = 1, ..., N$ determined at $t = 0$
  - Banks choose all bilateral partners before endowments are realized
  - Terms of trade are contingent on all possible paths: depend on all realized asset positions
- Limited information: only observe a bank's asset position after being matched

Equilibrium

- Simplifying assumption: linear post trade asset allocations

$$a_{k,t+1} = \alpha_{k,t}\left(a_{i,t} + a_{j,t}\right) + \beta_{k,t} \quad \text{for} \quad k = i, j$$

- Match structure is known but asset positions are not until after match
- Endogenous state: joint distribution of asset holdings $\boldsymbol{\pi}_t$
  - depends on matches and all past trading strategies up to t
- Equilibrium concept: Pairwise stability at each time t

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$$\mathbb{E}\left[U_{N+1}\left(da_{i,N+1}\right)|a_{i,N},a_{j,N}\right] = W_{N+1}\left(v_{i,N+1}\right)$$
where $v_{i,N+1} = \mathbb{V}ar\left[a_{i,N+1}|a_{i,N},a_{j,N}\right]$

- Quadratic holding costs $\Rightarrow$ change of state variable: $\boldsymbol{v}_t = \{v_{i,t}\}_i$

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- Quadratic holding costs $\Rightarrow$ change of state variable: $\boldsymbol{v}_t = \{v_{i,t}\}_i$
- Shape of $W_{N+1}(\cdot)$ is crucial in determining the degree of risk concentration
  - If $W_{N+1}(\cdot)$ is concave $\Rightarrow$ full risk-sharing and random matching
  - If $W_{N+1}(\cdot)$ is convex $\Rightarrow$risk concentration (positive sorting on risk)

Mechanism

- Quadratic holding costs push toward full diversification (reinforced by $W''_{N+1} < 0$)

- Convex $W_{N+1}(\cdot)$ implies diminishing marginal costs of bearing risk
  - lead to positive assortative matching in risk exposures

Mechanism

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- Convex $W_{N+1}(\cdot)$ implies diminishing marginal costs of bearing risk
  - lead to positive assortative matching in risk exposures
- All one needs to understand the relation between interconnectedness and risk concentration is W_{N+1}
  - Applications microfound W_{N+1}
  - Interesting dynamics and predictions!

Comments

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   - All decisions are made at $t = 0$
     - Uncontingent matches
     - Trading strategies are contingent on distribution of assets: in match and economy (continuation)
   - Quasi linearity and quadratic holding costs seem important

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   - General results depending on convexity or concavity of $W_{N+1}(\nu_{N+1})$

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3. Results on risk concentration and interconnectedness depend on terminal payoff
   - General results depending on convexity or concavity of $W_{N+1}(\nu_{N+1})$
4. Applications! Microfoundation to justify functional form of $W_{N+1}(\nu_{N+1})$
   - Generality of approach? Terminal value may not depend only on ν_{N+1}
     - Limited liability: wealth is given by $\max\{Ra_{i,N+1} - D, 0\}$