Discussion of
"Financial Linkages, Portfolio Choice, and Systemic Risk"
by Galeotti, Ghiglino, and Goyal

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Model Overview

- A model of interconnected agents (corporations, banks) with claims on
  - some fundamental assets: both risky and riskless,
  - each other.
- Origin of the shocks (investments in risky assets) is endogenous.
- Key questions: what is the relationship of network topology, risk taking, and welfare? What would be optimal design of networks?
- Results: more interconnectivity can have non-monotonic effects.

Model – Basics

- n agents
- agent i with endowment w_i can invest in risky project with return $z_i \sim N\left(\mu_i, \sigma_i^2\right)$ or riskless r
- $\beta_i \in [0, w_i]$ is risky investment, $\beta = \{\beta_1, ..., \beta_n\}$ is the investment profile.
- Interconnectivity by a network S of cross-holdings: agent i (directly) owns a fraction of $s_{ij} \geq 0$ of agent j; $\sum_j s_{ji} < 1$; D is (diagonal) unclaimed holding matrix (outside shareholders?).
  - This creates ownership paths between any i and j.
- Main settings covered are core-peripery networks; complete graph or star.

Model – Value and utility

- Own wealth from project i is $W_i = \beta_i z_i + (w_i - \beta_i)\, r$, but also claim on others.
- Market value of agent i, V_i, is the fix point of

$$V_i = \left(1 - \sum_k s_{ki}\right) W_i + \sum_k s_{ik} V_k \tag{1}$$

- Leads to $V = \Gamma W$, with $\Gamma = D\,[I - S]^{-1}$; γ_{ij} is i's ownership of j, γ_{ii} is i's self ownership.
- Agent i has mean-variance preference

$$max_{\beta_i \in [0,w_i]}\ \mathsf{E}\left[V_i\left(\beta\right)\right] - \frac{\alpha}{2}\mathsf{Var}\left[V_i\left(\beta\right)\right] \tag{2}$$

Model – Portfolio choice

- Optimal portfolio is

$$\beta_i^* = \min\left\{w_i; \frac{\mu_i - r}{\alpha\gamma_{ii}\sigma_i^2}\right\}$$

- Investment in risky asset is inversely related to self ownership.
- Separation of ownership and decision making implies agent i optimizes mean-variance on $\gamma_{ii}W_i$ or has lower effective risk aversion $\alpha\gamma_{ii}$ – agency friction?
- Tradeoff: lower self-ownership increases expected value and variance of payoff:

$$\mathsf{E}\left[V_i\left(\beta\right)\right] = rw\sum_j \gamma_{ij} + \frac{\left(\mu - r\right)^2}{\alpha\sigma^2}\sum_j \frac{\gamma_{ij}}{\gamma_{jj}} \text{ and } \mathsf{Var}\left[V_i\left(\beta\right)\right] = \sum_j \frac{\left(\mu - r\right)^2}{\alpha^2\sigma^2}\frac{\gamma_{ij}^2}{\gamma_{jj}^2}$$

- Welfare (with identical projects)

$$W = rnw + \frac{\left(\mu - r\right)^2}{\alpha\sigma^2}\sum_{i,j}\left[\frac{\gamma_{ij}}{\gamma_{jj}} - \frac{1}{2}\frac{\gamma_{ij}^2}{\gamma_{jj}^2}\right]$$

Integration and diversification

- Integration: S' is more integrated than S if ties get stronger.
- Diversification: S' is more diversified if cross-holdings are spread out more evenly.
  – Note: definitions are more restrictive than Elliott, Golub, and Jackson (2014).
- Results: Under some conditions,
  – In thin networks, higher integration increases welfare.
  – In thin networks, higher diversification can increase or decrease welfare.
  – In a complete symmetric network, higher integration increases welfare (everybody is better off).
  – In a star network, higher integration can increase/decrease welfare (depends on the self-ownership of the central player).
- Welfare loss of decentralization is larger in more integrated networks.
- Optimal network design: first-best and second-best are the complete network with identical and maximum link strength.

Comments 1 – Interpretation and non-linearities

- Wedge between ownership and control, while values are interdependent: V_i is affected by risk-taking β_j.
- Principal/agent? Equity/debt? Those either don't match the payoff structure, or hard to interpret as cross-ownership of (commercial) banks or corporations, as the paper suggests $\rightarrow$ improved motivation?

- Linear sharing rule introduces no kink.
- w_i endowments are assumed to be large so no wealth effects in portfolio choice.
- Non-linearities surely complicate the model, but are important
  - Comparative statics w.r.t. S must take into account the endogenous number of agents in the linear region.
  - E.g. interaction of w_i and γ_{ii} drives risk-taking and hence optimal networks.
  - Cross-sectional difference in w_i is natural given the core-periphery separation.

- Analytical tractability is already compromised due to approximation of $\frac{\gamma_{ij}}{\gamma_{jj}}$.

Comments 2 – Optimization programs and welfare

- Mean-variance optimization is used to derive the results – equivalent to exponential utility in a static setting with Gaussian random variables.

- But mean-variance itself is not a utility – e.g. failure of iterated expectations, dynamic inconsistency, Basak and Chabakauri (2010) – so should not be added up for welfare.

- One could also think about the planner caring about "systemic risk," measured by covariances between V_i and V_j.

- E.g., planner could have mean-variance preference over aggregate value $V = \sum_i V_i$ that leads to

$$\sum_i \mathsf{E}\left[V_i\right] - \frac{\alpha}{2}\sum_i \mathsf{Var}\left[V_i\right] - \frac{\alpha}{2}\sum_{i,j} \mathsf{Cov}\left[V_i, V_j\right]$$

Comments 3 – Towards equilibrium asset pricing

- Suppose the n agents are investment banks who can buy riskless bonds ($r = 1$) or risky assets with random payoff $z_i \sim N\left(\mu_i, \sigma_i^2\right)$, that are in positive net supply u_i. Market-clearing prices denoted by p_i.

- Interconnectivity by a network S of cross-holdings as before $\rightarrow \Gamma$ ownership.

- Different from asset pricing papers where the network implies who you can trade with, e.g., Babus and Kondor (2016), Malamud and Rostek (2016).

- Optimal demand is

$$\beta_i = \frac{\mu_i - p_i}{\alpha \gamma_{ii} \sigma_i^2},$$

which leads to equilibrium prices

$$p_i = \mu_i - \alpha \gamma_{ii} \sigma_i^2 u_i$$

- Smaller risk premium on asset i when lower self-ownership γ_{ii}.

Comments 3 – Towards equilibrium asset pricing (cont'd)

- With identical assets, welfare becomes

$$W = nw + \alpha\sigma^2 u^2 \sum_{i,j} \left[\gamma_{ij}\gamma_{jj} - \frac{1}{2}\gamma_{ij}^2 \right]$$

- Contrast with that in the paper

$$W = rnw + \frac{(\mu - r)^2}{\alpha\sigma^2} \sum_{i,j} \left[\frac{\gamma_{ij}}{\gamma_{jj}} - \frac{1}{2}\frac{\gamma_{ij}^2}{\gamma_{jj}^2} \right]$$

- Expected value and variance parts are now increasing in self-ownership γ_{ii}*
- Integration still increases welfare in thin networks, as the quadratic (variance) term is dominated when $\gamma_{ij} \ll \gamma_{jj}$; diversification is less straightforward; have not done calculations for the rest of the paper.
- Would be interesting to check, either to see if predictions turn around, or if not, it looks like a more tractable setting with no linearization needed.

Concluding remarks

- Interesting paper, clean insights.
- Great streamlined setting, but interpretation could be improved, and a slight complication (microfoundation) would lead to further interesting predictions.
- Portfolio choice vs equilibrium pricing can be important.