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

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Fourth Economic Networks and Finance Conference
LSE, Dec 2016
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 $z_i \sim N(\mu_i, \sigma_i^2)$ 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-periphery networks; complete graph or star.
□ 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

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

(1)

□ Leads to $V = \Gamma W$, with $\Gamma = D \left[I - S\right]^{-1}$; $\gamma_{ij}$ is $i$’s ownership of $j$, $\gamma_{ii}$ is $i$’s self ownership.

□ Agent $i$ has mean-variance preference

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

(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:

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

- Welfare (with identical projects)

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

- 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 $\gamma_{ii}$ 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 $\frac{\gamma_{ij}}{\gamma_{jj}}$. 
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

$$\sum_i \mathbb{E}[V_i] - \frac{\alpha}{2} \sum_i \text{Var}[V_i] - \frac{\alpha}{2} \sum_{i,j} \text{Cov}[V_i, V_j]$$
Suppose the $n$ agents are investment banks who can buy riskless bonds ($r = 1$) or risky assets with random payoff $z_i \sim N(\mu_i, \sigma^2_i)$, 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
\[ \beta_i = \frac{\mu_i - p_i}{\alpha \gamma_{ii} \sigma^2_i}, \]
which leads to equilibrium prices
\[ p_i = \mu_i - \alpha \gamma_{ii} \sigma^2_i u_i \]

Smaller risk premium on asset $i$ when lower self-ownership $\gamma_{ii}$. 
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 \( \gamma_{ii} \).

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.