Discussion of
“Asset Pricing Implications of Systemic Risk in Network Economies”
Buraschi and Tebaldi (2019)

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Growing literature on how network linkages between firms, banks, industries can

(i) function as a mechanism for propagation and amplification of shocks.
(ii) translate micro shocks into aggregate fluctuations.

Applications:

▶ potential explanation for the source of macroeconomic fluctuations
▶ a theory of systemic risk in the banking system

This paper: asset pricing implications of network interactions
This Paper

- **Framework**: endowment economy of \( n \) firms with interlinked dividend streams
  - network \( \Delta \) capturing the likelihood of distress spillovers (reduction in dividends)
  - study whether the distress can persist for a long time due to spillovers
  - **subcritical regime**: idiosyncratic shocks die out very rapidly
  - **supercritical regime**: the distress can persist in the long run in a large economy

- **Main Takeaways**:
  - the threshold between the two phases depends on the network \( \Delta \)
  - higher \( \Delta_{ij} \) results in more spillovers and faster transition to the supercritical regime
  - all this has to be priced ex ante: a model of endogenous long-run risk
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  ▶ the threshold between the two phases depends on the network $\Delta$
  ▶ higher $\Delta_{ij}$ results in more spillovers and faster transition to the supercritical regime
  ▶ all this has to be priced ex ante: a model of *endogenous long-run risk*
• Economy consisting of $n$ firms with dividend streams

$$d_{it} = (a_i - \epsilon_i H_{it}) Y_t$$

- $Y_t$: common systematic shock (following $dY_t / Y_t = \mu dt + \sigma dW_t$)
- $a_i$: payout in the normal state
- $\epsilon_i$: reduction in the distress state
- $H_{it} \in \{0, 1\}$: binary variable indicating the distress state

• $H_{it}$ transitions between 0 and 1 following independent jump processes:
  - $\lambda_i$: transition rate to distress ($0 \rightarrow 1$)
  - $\eta_i$: transition rate out of distress ($1 \rightarrow 0$)
Model

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Model: Network Interdependence

- While transitions occur independently, transition rates are intertwined. Distress at some firm $j$ increases the likelihood of distress at other firms:

$$\lambda_i(H) = \lambda_i + \lambda \sum_{j=1}^{n} \Delta_{ij} H_j$$

- Network of distress spillovers: $\Delta$

- Recovery rates not subject to spillovers: $\eta_i(H) = \eta$
  
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- Recovery rates not subject to spillovers: \( \eta_i(H) = \eta \)
  - extreme asymmetry in how negative and positive shocks propagate!
• A Markovian model of transitions in and out of distress:

\[ d_{it} = (a_i - \epsilon_i H_{it})Y_t \]
\[ \lambda_i = \lambda \sum_{j=1}^{n} \Delta_{ij} H_j \]
\[ \eta_i = \eta. \]

• **Key question:** suppose we start from a no distress state \((H = 0)\) and push one firm to distress \((H_i = 0 \rightarrow H_i = 1)\). How long does it take for the system to get back to the full no distress state?

• **Solution:** use standard results for Markov chain convergence times to quantify this time as a function of \(\Delta\).
Cascades

Definition
A sequence of economies experiences a cascade if expected time to mixing of the Markov chain grows exponentially in $n$.

$$\lim_{n \to \infty} \frac{1}{n} \log E[T_{\text{mix}}] > 0.$$ 

- Cascade: distress can persist for a very long time.

Theorem
There exists a critical threshold $\kappa(\Delta)$ such that a cascade can occur with positive probability if and only if $\lambda/\eta > \kappa(\Delta)$.

- Two very different regimes:
  - subcritical: the effect of shocks die out in a large economy in the long run
  - supercritical: the effect of shocks last for a long time even in a large economy
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Intuition

- A network where each agent has $m$ neighbors:

$$\begin{cases} 
\text{subcritical:} & m\lambda < \eta \\
\text{supercritical:} & m\lambda > \eta 
\end{cases}$$

- If $m$ is large relative to the recovery rate, one distressed firm can infect many others. But if $m$ is small, the infection dies out.
Asset Pricing Implications

- If initial shocks do not dissipate away in the long run, then they should be priced.
- A model of generating long-run risks endogenously.
- Long term risk premium:

\[ \mu^i_\infty = \gamma \sigma^2 + \left( h_{i\infty} \epsilon / a \right) \ast \text{(network-dependent terms)} \]

- In the supercritical regime \((h_{i\infty} > 0)\), we no longer have a single-factor model.
- Therefore, CAPM \(\beta\) no longer captures priced risk exposure.
Comment

- Modeling assumptions indispensable to the creating long-lasting effects:
  (i) asymmetric propagation between positive and negative shocks
  (ii) epidemic-like propagation mechanism (“neighborhood independence”)

- No reason to think the assumptions are unreasonable in principle
- Question: what environment the model is approximating?
  - in general, macro predictions of network models are highly sensitive to the assumptions made on micro interactions (Acemoglu et al., 2016)
The model has two key features:

1. **out-neighborhood independence:**
   likelihood that $j$ infects $i$ is independent of how many others $j$ can infect

2. **in-neighborhood independence:**
   likelihood that $j$ infects $i$ is independent of how many others can infect $i$.

Both forces imply more connections can only intensify the likelihood of cascades.

Reasonable assumptions for epidemics and pandemics
- You cannot diversify the risk of getting sick by hanging out with more people!
Comment

- More questionable for spillovers via economic interactions or financial markets: holding the exposure of $i$ to $j$ constant, changing $i$ or $j$’s other connections can still change the propagation intensity.

  ▶ production networks:
  unless inputs are perfect complements, having more suppliers reduces the likelihood of spillover from a given supplier (in-neighborhood dependence)

  ▶ interbank networks:
  the likelihood of spillover of losses from debtor $j$ to creditor $i$ depends not only on $i$’s exposure to $j$, but also on how much $j$ owes others (out-neighborhood dependence)

- How important is this very strong propagation mechanism for the existence of a supercritical regime?
Summary

- Nice and innovative paper aimed at studying the asset pricing implications of network economies
- Analytical results on how firm-level shocks can persist for a very long time
  - phase transition and sub- vs. supercritical regimes
  - risk premia
  - characterization in terms of network centralities (see the paper)

- Comments/Wishlist: like any other model, results are sensitive to the specific propagation mechanism assumed in the model
  - holding interaction levels constant, shocks to neighbors cannot be diversified away
  - key in generating long-lasting effects
  - important to argue for contexts/applications where such assumptions are good approximations