Equilibrium Asset Pricing in Directed Networks
by Nicole Branger, Patrick Konermann, Christoph Meinerding and Christian Schlag

Discussant: Christian Heyerdahl-Larsen

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Firms are interconnected

- Suppliers $\rightarrow$ Firm

Hanjin Shipping bankruptcy: Samsung Electronics had about $38 million of their goods and parts on vessels
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Motivation

Firms are interconnected

- Suppliers → Firm

Hanjin Shipping bankruptcy: Samsung Electronics had about $38 million of their goods and parts on vessels

- Firm ← Customers

- Competitors ↔ Firm
Motivation

Propagation of shocks

1. Might happen with delay
2. Direction of shock might matter

Both 1 and 2 make standard processes like Brownian motion less suitable
This paper

- Introduces self-exciting and mutually exciting jump processes
  - Jumps in the cash flows of one asset can trigger higher likelihood of jumps in cash flows of other assets
  - Effects can have “directions” and happen with a delay
- When combined with EZ preferences:
  - There is a centrality premium
  - Direction matters for volatility and betas
  - Can generate flight-to-quality effect (directed ring network)
Individual firm cash flows (log cash flows) follow

$$dy_i = \mu_i dt + L_i dN_{i,t}$$

Jump intensities follow

$$d\lambda_{i,t} = \kappa_i \left( \bar{\lambda}_i - \lambda_{i,t} \right) dt + \sum_{j=1}^{n} \beta_{i,j} dN_{j,t}$$

Log aggregate consumption follows

$$dy = \mu dt + \sum_{i=1}^{n} K_i dN_{i,t}$$
Example with 2 assets:

\[ dy_1 = \mu_1 dt + L_1 dN_{1,t} \quad dy_2 = \mu_2 dt + L_2 dN_{2,t} \]

Each asset’s cash flow only depend on it’s own jump

\[ d\lambda_1 = \kappa_1 (\bar{\lambda}_1 - \lambda_{1,t}) \, dt + \beta_{1,1} dN_{1,t} \]
\[ d\lambda_2 = \kappa_2 (\bar{\lambda}_2 - \lambda_{2,t}) \, dt + \beta_{2,1} dN_{1,t} \]

**Here Firm 1 → Firm 2**
Example with 2 assets:

\[ dy_1 = \mu_1 dt + L_1 dN_{1,t} \quad dy_2 = \mu_2 dt + L_2 dN_{2,t} \]

Each asset’s cash flow only depend on it’s own jump

\[ d\lambda_1 = \kappa_1 (\bar{\lambda}_1 - \lambda_{1,t}) dt + \beta_{1,2} dN_{2,t} \]
\[ d\lambda_2 = \kappa_2 (\bar{\lambda}_2 - \lambda_{2,t}) dt + \beta_{2,2} dN_{2,t} \]

Here Firm 1 ← Firm 2
Example with 2 assets:

\[ dy_1 = \mu_1 \, dt + L_1 \, dN_{1,t} \quad dy_2 = \mu_2 \, dt + L_2 \, dN_{2,t} \]

Each asset’s cash flow only depend on it’s own jump

\[ d\lambda_1 = \kappa_1 \left( \lambda_1 - \lambda_{1,t} \right) \, dt + \beta_{1,1} \, dN_{1,t} + \beta_{1,2} \, dN_{2,t} \]
\[ d\lambda_2 = \kappa_2 \left( \lambda_2 - \lambda_{2,t} \right) \, dt + \beta_{2,1} \, dN_{1,t} + \beta_{2,2} \, dN_{2,t} \]

Here Firm 1 ↔ Firm 2
The paper contains many interesting results

Most results are stated without much explanation

Example: Centrality premium - Why is it there in the model?
Consider the dynamics of log aggregate output:

\[ dy_t = \mu dt + \sum_{i=1}^{n} K_i dN_{i,t} \]

- From above, it is unclear why EZ is important
- \( dN_{i,t} \) is not a mean zero shock!
- Instead, write in terms of the compensate Poisson process

\[ dy_t = \left( \mu + \sum_{i=1}^{n} K_i \lambda_{i,t} \right) dt + \sum_{i=1}^{n} K_i \left( dN_{i,t} - \lambda_{i,t} dt \right) \]
Suggestion:

- Write in terms of compensated jump processes
- Do a simple example to show how the drift of aggregate consumption looks like
  - 3 assets
  - 1 being central
  - Do directed and not directed
It is assumed that the risky assets are zero net supply assets

- Avoid having to aggregate dividends to get aggregate consumption
- Adds tractability

Is this assumption harmless?

- Martin (2013): Market clearing is important and there are endogenous effects!
- No role for size to matter in the network
- Free to choose dynamics of aggregate consumption?
Comments II - Zero net supply risky asset

Suggestion:

- Convince reader that this is not crucial (current justification is based on papers where it is less likely to be important)

- Tie your hands as much as possible when specifying dynamics of aggregate consumption

  - How should I set the loading on the different jumps in aggregate consumption to be “close to Lucas tree model”? 
Not much justification for the choice of parameters

Questions:

- What is the volatility of aggregate consumption?
- How about the volatility of individual dividends?
- How reasonable are the jump sizes and the frequencies of jumps?
- How reasonable are the intensities?
Comments IV - Jump direction

- Only model downward jumps (bad news)
- What about upward jumps?
- What about good news for firm 1 is bad news for firm 2?
  - Non-negativity of jump intensities makes the problem challenging
- Empirical analysis (not in the paper) has both good and bad news
Suggestion:

\[ dy_i = \mu_i dt + L_i^+ dN_{i,t}^+ + L_i^- dN_{i,t}^- \]

- One good shock and one bad shock for each stock
- Can model different directions for good and bad shocks etc.
- Drawback: Might not be much added value in terms of economics
A paper that I very much enjoyed - Made me want to work on mutually exciting jump processes

A natural application of mutually exciting jump processes

Tractable framework

Would be good with more emphasis on the mechanism and economic intuition