Equilibrium Asset Pricing in Directed Networks

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Motivation

Firms are interconnected

- Suppliers $\rightarrow$ Firm

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

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

- Firm $\leftarrow$ Customers

- Competitors $\leftrightarrow$ 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)

Model

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

$$dy = \mu dt + \sum_{i=1}^{n} K_i dN_{i,t}$$

Model

Example with 2 assets:

$$dy_1 = \mu_1 dt + L_1 dN_{1,t} \qquad dy_2 = \mu_2 dt + L_2 dN_{2,t}$$

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

$$\begin{aligned} d\lambda_1 &= \kappa_1 \left(\bar{\lambda}_1 - \lambda_{1,t}\right) dt + \beta_{1,1} dN_{1,t} \\ d\lambda_2 &= \kappa_2 \left(\bar{\lambda}_2 - \lambda_{2,t}\right) dt + \beta_{2,1} dN_{1,t} \end{aligned}$$

Here Firm 1 $\rightarrow$ Firm 2

Model

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Here Firm 1 $\leftrightarrow$ Firm 2

Comments I - Mechanism

- The paper contains many interesting results
- Most results are stated without much explanation
- Example: Centrality premium - Why is it there in the model?

Comments I - Mechanism

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

$$dy_t = \left(\mu + \overbrace{\sum_{i=1}^{n} K_i \lambda_{i,t}}^{\text{“LRR”}} \right) dt + \sum_{i=1}^{n} K_i \overbrace{(dN_{i,t} - \lambda_{i,t} dt)}^{\text{Martingale}}$$

Comments I - Mechanism

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

Comments II - Zero net supply risky assets

- 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"?

Comments III - Parameters

- 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

Comments IV - Jump direction

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

Summary

- 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