Galbiati / Soramäki: An agent-based model of payment systems

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BoE / ECB Conference, 13 November 2007

Analysis of liquidity provision in RTGS systems

- RTGS systems require high degree of liquidity (if not: delay, gridlock)
- Probability of banks to face delay in payments depends on aggregate liquidity in the system
- Model determines this aggregate level
  - Banks make payments to each other during a day
  - May need to delay payments if funds are not sufficient
  - Delays are costly
  - Banks decide on liquidity input at beginning of day in non-cooperative fashion

The payoff function

- Banks' decision variable: how much liquidity to place into the system at the beginning of day $l_i(0)$
- $l_i(0)$ minimizes total cost
  = cost of placing liquidity
  + expected cost of facing payment delay
- The more liquidity a bank commits,
  - the higher the liquidity cost (fully internalized)
  - the lower the expected cost of delay (partially internalized)
- The more liquidity other banks commit
  - the lower the expected cost of delay

Liquidity demand and equilibrium

- Once $l_i(0)$ is determined, actions are automated
  - Rule: send payment when liquidity balance is positive
- "Ficticious play": repetition of daily game to learn behavior of others
- Results:
  - Higher cost of delay → higher liquidity input
  - Higher liquidity input → shorter average delay
  - Comparison with collective-cost-minimization: Non-cooperative game performs worse only for high levels of delay cost

Further results

- Network size
  - Result: fewer system participants → higher efficiency (netting ratio = liquidity needed per payment increases)
  - Reason: higher share of delay costs is internalized
- Operational incidents (liquidity sink)
  - Result: only for very high delay costs bank reduce liquidity
  - How does liquidity provision depend on number of banks in system?

Further comments and suggestions

- Price of delay excessive? Should not exceed 100% of payment (i.e. be <2)
- Economic intuition sometimes difficult to grasp
  - Be explicit about objective function / choice variables
  - Solve model for T=small?
- Collective cost-minimization: how does optimality depend on network size?
  - intuition: more internalization of cost of delay

Further comments and suggestions

- Endogenous liquidity supply
  - what if liquidity input could be altered during the day?
  - intraday credit / withholding of liquidity
- Policy implications
  - How to avoid insufficient liquidity provision / gridlock
  - limit network size?
  - generous provision of intraday credit?
  - monitoring and information dissemination about liquidity sink?