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Discussion of
Modelling, simulation and optimization of interbank
settlements
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Outline

- ◆ Summary
- ◆ Discussion of the cost structure
- ◆ Other observations

The presentation in nutshell

- ◆ Stochastic generation of transactions with distributions estimated from real data
- ◆ Cost structure for the liquidity management of an intermediary in payment system
- ◆ Algorithm for stochastic optimization of liquidity management costs:
 - Adaptive Monte Carlo estimator for cost function gradient
- ◆ All this integrated in to a Java class library

Cost structure revisited

- ◆ The cost structure of agents in the model is essential:
 - It includes most of the assumptions made
 - It gives the incentives to the agents
 - should be transparent, intuitive and, if possible, calibrated with real data.

$$D_i = RE_i + F_i + B_i + TT_i + AC_i$$

where:

D_i – total costs of i -th agent;

RE_i – premium of satisfaction of reserve requirements;

F_i – penalty of violation of reserve requirements;

B_i – costs of short time loans;

TT_i – losses due to freeze of finance;

AC_i – operational costs.

Cost structure revisited, the easy terms

RE_i – premium of satisfaction of reserve requirements;

F_i – penalty of violation of reserve requirements;

- ◆ Interest with average refinancing rate
- ◆ Penalty, if account balance is below given level
 - The penalty in the model is calculated for individual periods not based on an average balance over number of periods.

AC_i – operational costs.

- ◆ Fixed unit cost of a transaction
 - Here increase in operational costs vs. volume is linear. With ICT you could expect strong economies of scale instead.

Cost structure revisited, more tricky terms

$$B_i = -STL \cdot \sum_{l=1}^T \min\left(0, \underbrace{K_i^{l-1} + \delta_i^l + G_i^l}_{\text{End of day balance}}\right) \quad \text{— costs of short time loans;}$$

Overnight interest rate

⇒ B_i is the cost of overnight loan from central bank (?)

$$TT_i = IBR \cdot \sum_{t=0}^T G_i^t \quad \text{— losses due to freeze of finance;}$$

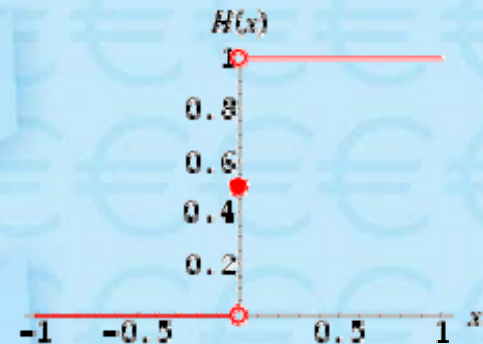
Interbank rate

Realised deposit or withdraw

⇒ TT_i is the actual cost of short term loans from interbank market (?)

"probability of system liquidity"

- ◆ defined as
$$P_{likv} = \frac{\sum_{l=1}^T \sum_{i=1}^J H\left(\min\left(0, K_i^{l-1} + \delta_i^l + G_i^l\right)\right)}{T}$$
 - ◆ used as a constraint in the optimization
$$P_{likv} \leq \alpha$$
- ⇒ describes the average probability for banks to end up in negative end of day balance (?) i.e.



source: <http://mathworld.wolfram.com>

Likelihood of overnight lending from CB

- ◆ Shouldn't it have also J in the nominator?
- ◆ and record the negative values of EOD balance?
- ◆ Is this additional constraint needed?
Penalty cost of overnight lending is already included in the model.

$$P_{likv} = \frac{\sum_{l=1}^T \sum_{i=1}^J H(f(t, i))}{TJ}$$

$$\begin{aligned} f(t, i) &= -EODbalance = \\ &= -\left(K_i^{l-1} + \delta_i^l + G_i^l\right) \end{aligned}$$

Other observations

- ◆ Game theory aspect
 - How is it included in the cost structure?
 - Is it a one shot game solved with iterative process?
- ◆ Indirect costs?
 - Delaying of payments, reputation risk etc. Are these considered?
- ◆ Estimated Poisson-Lognormal model for transactions
 - How well do these distributions fit?
 - Were any others tested?
- ◆ Stochastic optimisation:
 - Could it benefit from a more sophisticated method for nonlinear programming? (SQP, IP-methods, heuristics)
- ◆ Policy implications for CB or rules of thumb for the banks?

Additional notes

- ◆ Is the estimated matrix of interdependencies in paper (table 1) incomplete?
 - Participants 0, 2 and 6 seem to be liquidity sinks (outwards interdependencies zero, inwards >0)
- ◆ Some proposals for terminology (in the paper mainly)
 - Application ~ transaction?
 - Balances of settlement day (δ) ~ net value of transactions?
 - The cost terms as discussed above
- ◆ Proposals for the notation
 - simplify!
 - Eg operational costs – are these needed if all the payments are anyway settled? (Are they?)
 - Definitions of the variables
 - in the paper eg "K" is used since eq. 9 without a definition, "N" in eq. 3 lacks definition, Φ on slide 11 similarly...
- ◆ Increased comparison and references to literature of payment system modelling would benefit the reader.