A Model of Tiered Settlement Networks

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Settlement networks typically involve various tiers of intermediation. Some banks participate and clear directly in a "first-tier" network. A subset of these direct clearers then act as clearing agents by operating a "second-tier" network and providing settlement accounts to indirect clearers downstream. In Canada, both the Large Value Transfer System (LVTS) and the Automated Clearing Settlement System (ACSS) exhibit a high degree of tiering. The efficiency and risk associated with these tiered settlement networks are of particular interest to policy-makers. For example, what are the immediate impact and long-term effects of the failure of a clearing agent in a highly tiered settlement system? How do these effects differ from those caused by the failure of an ordinary direct clearer?

This article summarizes Chapman, Chiu, and Molico (2008), in which we develop a dynamic equilibrium model of settlement networks to study these questions. We demonstrate that, in the presence of imperfect information and fixed costs of settlement system participation, a tiered structure can improve efficiency by supporting interbank monitoring and cost saving.

Methodology

While policy-makers care about the efficiency and stability of settlement systems, guidance provided by economic theory has been limited. In particular, there is little theoretical work on the tiered structure in settlement systems. This is because standard economic models abstract from the mechanism through which payments and settlement take place and thus are not suitable tools for modelling settlement systems. Our study is the first to develop a dynamic equilibrium model for studying the degree of tiering and welfare effects of clearing-agent failure.[1] Economic models of payments systems are developed to capture how the incentives and behaviour of participants will adjust in response to changes in policy or in the economic environment.[2] Moreover, since we have limited historical data on certain rare but highly significant events (e.g., failure of clearing agents), using an economic model to conduct hypothetical experiments can help us gain a better understanding of the potential causes and consequences of such extreme events.[3]

Model

Our analytically tractable model of the settlement system, in which the settlement structure is determined endogenously, is built on rational, strategic, and forward-looking agents. In the model, the economy consists of two sectors: a trading sector and a settlement sector. In the trading sector, agents meet bilaterally to trade consumption goods financed by private liabilities. In the settlement sector, agents interact to clear and settle these payment instruments. Underlying transactions in the trading sector generate the bilateral payment flows in a settlement network. In this environment, the mode of settlement (i.e., real-time vs. deferred) and the structure of settlement networks (i.e., direct or indirect participation) are endogenously determined by agents, subject to the fundamental cost structure and information structure.

The choice of settlement mode between real-time and deferred settlement involves the fundamental trade-off between liquidity costs and

1. Related literature includes Kahn and Roberds (2002), Lai, Chande, and O'Connor (2006), and Chapman and Martin (2007).
2. Much of the literature on payments system design is based on payments system simulators such as that developed by the Bank of Finland (BoF-PSS2). Because they do not model the behaviour of system participants, these tools are not appropriate for studying the endogenous formation of tiered networks.
3. See Chiu and Lai (2007) for a more detailed discussion of the microfoundations of payment economics.

default risk. On the one hand, since real-time settlement imposes a higher liquidity cost (for example, the need to hold low-return liquid assets as collateral), payment senders (debtors) may prefer deferred settlement. On the other hand, because of the settlement risk involved, payment recipients are willing to accept deferred settlement only from creditworthy payment senders. Therefore, the choice of settlement mode depends critically on whether creditors possess reliable information about debtors' credit history. This informational constraint is particularly binding for trades involving debtors whose creditworthiness is not well known to other agents and debtors who trade with other agents only infrequently. We label these "small" agents. As a result, some of these small but safe debtors with no public history will be forced to use real-time settlement. This is inefficient, because the unnecessary liquidity cost incurred by these safe debtors leads to a suboptimal allocation of resources.

This allocative inefficiency can be resolved by having some financial institutions act as clearing agents for these small agents. Typically, these clearing agents are "large" in the sense that they have frequent transactions with a significant set of debtors and creditors. These large agents can improve the efficiency of settlement by providing information and cost saving. Through their frequent dealings with creditors, they can establish a reputation and make their own creditworthiness public information. Through their frequent dealings with debtors, they can monitor debtors' credit history and choose the optimal settlement mode for each of them. This is their information role. When there are fixed costs associated with participation in the settlement system, clearing agents can also enjoy economies of scale and thus play a cost-saving role in a settlement network.

Main Findings

Our main findings can be summarized as follows. First, we demonstrate that a tiered structure can improve efficiency by supporting cost saving and interbank monitoring. In a tiered settlement system, large agents work as clearing agents who participate directly in a settlement system. Small agents become indirect clearers who settle their debt through their clearing agent's internal second-tier network.

This arrangement allows clearing agents to monitor the credit histories of the indirect clearers that they serve and to then use this private information to choose the best mode of settlement for their clients. Clearing agents have incentives to appropriately monitor their clients because they will be held responsible if their clients default. Furthermore, a tiered structure can improve efficiency by economizing on the fixed cost of settlement system participation.

Second, the degree of tiering is decreasing in the fixed cost of operating the second-tier network and the availability of public credit history. As the fixed cost of being a clearing agent increases, each clearing agent requires a larger number of the small agents as clients to be profitable. Therefore, there will be fewer larger clearing agents.

If a clearing agent's provision of information is its primary motivation, then more public information regarding the creditworthiness of indirect clearers will lead to fewer clearing agents. For example, an increase in the number of agents with credit ratings will reduce the equilibrium degree of tiering.[4] In the extreme case, in a world where agents' credit histories are perfectly observable, clearing agents have no informational role.

Third, the failure of a clearing agent leads to social costs, which can be decomposed into: (i) default loss; (ii) participant loss; (iii) information loss; and (iv) operational inefficiency. The loss to default and the loss of participants are transitory in nature and represent straightforward losses as a result of the clearing agent's failure to perform its contracted role. The information loss and operational inefficiency are of interest, since they can have persistent welfare implications and are closely related to the clearing agent's unique role. The failure of a clearing agent leads to the loss of private information regarding the trading history of its indirect clearers, which took time to accumulate. In addition, if there are economies of scale in the operation of the clearing agent's second-tier network, then, unless that agent is immediately replaced, its failure will lead to operational inefficiency because the remaining clearing agents will need

4. In Canada, while all the direct clearers and clearing agents have credit ratings, many indirect clearers do not.

to serve too many indirect clearers and will be operating above their efficient capacity.

Conclusion

Our study highlights that, in the presence of imperfect information and fixed costs, the tiered structure can, indeed, improve efficiency by supporting interbank monitoring and cost saving.[5] One policy implication of this finding is that restricting the degree of tiering in payments systems such as the LVTS or ACSS may distort the efficient monitoring structure of the system.[6] Moreover, we identify the social costs resulting from the failure of a clearing agent. Since such a failure may generate negative spillovers on other participants, the market-determined concentration and degree of tiering may not optimally diversify the risk of such failure. In conclusion, this framework can be expanded for future analysis of specific payments system policies and their welfare implications.

5. Potentially, a tiered structure may also help to mitigate the impact of systemic liquidity shocks (such as the recent market events) on the indirect participants.
6. There is a volume restriction imposed on ACSS participation. There is no similar restriction to access in the LVTS.

References

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