An analysis of liquidity and systemic risk in alternative settlement architectures

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ABSTRACT

One of the challenges faced by European Central Banks arising from the single market is the harmonization of clearing and settlement (SCS) infrastructure. Clearing and settlement are the processes by which securities market transactions are finalized. After two parties have concluded a security transaction the securities have to be transferred from the seller to the buyer and the related payment has to be transferred from the buyer to the seller. These days, thanks to technological advances in telecommunications and computers, assets are transfered electronically by account entries. Both the buyer and the seller have a cash account and a security account with some institutions. Most industrialized countries have established so called Central Securities Depository that act as custodians of investors securities account. Central bank money is the preferred settlement asset for important interbank settlement.

Central banks are concerned about the security and soundness of clearing and settlement arrangements not only because because the final settlement of transaction among financial institutions takes place through the transfer of central bank funds but also because central banks, as lender of last resort, are the ultimate source of liquidity to the financial system.

The measures envisaged to harmonize the different national systems (for example in respect of access condition and provision of credit lines), should aim to reduce risks and avoid competitive disadvantages in the single market. Controlling liquidity and systemic risk in the process of clearing and settling financial market transactions is a crucial public policy objective when designing clearing and settlement systems The failure of one institution to settle any one leg of the transaction at the time the obligation is due, or at any later time, can have 'knock on' effects on the balance sheet of other institutions, leading to a contagion of failures throughout the system. Speed and efficiency are also basic customer requirements that current CSS have difficulties in providing. Delivery times of $t + 3$ and $t + 5$ are still common and even the $t + 1$ target has proven difficult to reach.

The Bank of International Settlement has recommended delivery versus payment (DVP) to reduce or eliminate principal risk (i.e. the risk that the buyer does not receive the asset after payment, or that the seller does not receive the payment after delivery). One of the commonly implemented procedure to protect participants in a common SCS system, in case of failure of a financial institution, is to unwind the transactions involving the failed institution. Achievement of DVP through unwinding eliminates principal risk but does not eliminate liquidity or replacement cost risks. A well designed SCS system that handles large-value payments should be able to guarantee that once a transaction has been accepted by the system that transaction will settle no matter what happen. Unwinding a transaction if an instituton fails does not seem to be a reasonable solution as unwinds may expose the counterpart to significant liquidity and credit risk.

Although it is commonly agreed that large-value payment systems should be safe and efficient, debate continues on what is the optimal design that allow to achieve these objectives. A major point of discussion is whether payments should be settled individually or if net positions should be settled at some specified period of time.

Three alternative models have been suggested and implemented for for achieving DVP

- Securities and funds both transfered on a gross basis.
- Gross settlement of securities transfer followed by net settlement of funds transfer.
- Securities and funds both transfered on a net basis.

The difference between gross and net arrangements is in that in real time gross system (RTGS) payments are executed continuously via transfers of central bank funds from the account of the paying bank to the account of the receiving bank. In contrast, under a multilateral net settlement system, participants' net positions viis-a-vis all other participants are settled on a periodic basis, usually at the close of business. The primary motivation of RTGS is to reduce systemic risk. Nonetheless in a pure RTGS where, for a given volume of transactions, banks need to hold on average more reserves and gridlocks may occur if the flow of payments is disrupted because participants are waiting to receive payments before sending them.

Liquidity and intraday credit requirements concern mainly the payments and not the security leg of the transaction. Custodian cannot make transfers resulting in negative balances, because this would imply increase the amount of security via unauthorized issuing. If short selling cannot be accepted, banks are forced to keep all their assets in the custodian account and the custodian never face liquidity shortage for securities. On the contrary, banks have generally more customer deposits than available central banks funds and bad cash management can create liquidity shortages. Liquidity risk becomes particularly important if settlement is done in real time, whether immediately after the trade or by netting the end of day positions, because in this case the incoming and outcoming flows of payments are not known in advance by the cash managers. To limit the need of money balance, central banks provide intraday credit to participating banks by allowing them to overdraft their funds accounts. Netting systems implicitly allow for funds overdraft given that running balances are permitted to be net debit balances. If credit extensions reduces liquidity risk however exposes counterparts to credit risk and for this reason collateral of various types are often required before credit is granted. To avoid principal risk, payments in netting systems are usually secured by a guarantor who protects itself against credit risk requiring collaterals. Additional protections are introduced to reduce the risk that the guarantor itself may default such as as caps on net debt funding positions of participants that can be supported by a single guarantor. CHIP, the largest private net settlement system (used primarily to settle the US dollar component of foreign exchange transaction and cross-border transaction) also implement loss-sharing arrangements.

The objective of the first this paper is to compare liquidity requirements in multilateral netting and RTGS architectures by formulating a reserve optimization problem in the presence of stochastic order flows.

In the second part of the paper we focus on systemic risk, and in particular on the role of interbank lending on the stability of payment systems. By borrowing from banks with surplus liquidity, banks which face a temporary shortfall can survive as a result of interbank credit. This risk sharing, in and of itself, must help keep down the incidence of failures in the system. Of course, in the event of one bank's failure, an interbank credit market could very well exhibit the symptoms of contagion.

Using our model, we show that interbank credit contributes to an overall lower incidence of bank failures but occasionally leads the system to display avalanches, *i.e.* episodes of multiple bank collapse. Avalanches indicate the presence of contagion, *i.e* the tendency for the failure of one bank to have knock-on effects on other banks. We compare the dynamics of the system under various scenarios concerning the degree to which banks lend to other banks which face liquidity shortfalls. These strategies are imposed exogenously and the choice between them is not derived from first principles. The focus is instead on the characteristics of the system and of its individual components; in particular, the heterogeneous nature of banks and the extent of credit linkage between them.

In particular the topology of this network may be a crucial ingredient in the emergence of contagion. Research in random networks (Newmann (2003), Vespignanii (2002)) has recently revealed that epidemic models are strongly affected by the connectivity patterns characterizing the population in which the infective agent spreads. In particular it has been shown that in some network architectures (so called scale-free networks) the epidemic process does not possess any epidemic threshold below which the infection cannot produce a major epidemic outbreak or an endemic state. This feature affects also the choice of immunization strategies. Contrary to standard models, it is found that scale-free networks do not acquire global immunity from major epidemic outbreaks even in the presence of unrealistically high densities of randomly immunized individuals. Successful immunization strategies can be developed only by taking advantage of the inhomogeneous connectivity properties of the scale-free connectivity patterns. If this is case the criteria for Central Bank intervention could become *too connected to fail* instead of *too big to fail*[1].

[1] This his could have been in fact one of the reason the Federal Reserve Bank intervened to save Long Term Capital Management