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Liquidity risk and policy options

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ABSTRACT

On the basis of a liquidity management model, liquidity risks, defined as the probability of payment failures in a real-time gross settlement (RTGS) payment system, may either stem from liquidity management inefficiencies or insufficient cash balances. I will show that penalties charged on the amount of payment failures minimise liquidity risks without interfering with the bank's technology preferences. I will instead show that liquidity requirements, although as effective as penalties to contain the risk of liquidity shortage, may distort the bank's technology preferences and cannot stem liquidity management inefficiencies. I will also show that liquidity risks within RTGS payment systems are potentially smaller because they depend more on the liquidity management efficiency than on the randomness of cash inflows and outflows.

1. Introduction

This study addresses liquidity risks, in the sense of the probability of not settling some outgoing payments in a real-time gross settlement (RTGS) payment system.[1] Given the bank's liquidity management strategies and incentives to misbehave, I analyse the interaction between the regulator and a 'representative bank' or, if the reader wishes, the banking system as a whole and compare penalty rates charged on payment failures with liquidity requirements as policy instruments to stem banks' liquidity risks, in terms of effectiveness and efficiency.

The capacity of managing liquidity is regarded as the main constraint on the amount of outgoing payments the bank settles on a daily basis in the same way as the technology stock constrains the output amount producible by an ordinary manufacturing firm in the short run. Since I emphasise the technical framework within which banks manage their own liquidity (a dimension usually overlooked by the traditional approach to liquidity risks) and evaluate policy tools accordingly, the work also tries to bridge the gap between the traditional literature on liquidity risks and most recent studies on banks' liquidity management strategies when settling transfers within an RTGS payment system. For a review of the literature, the reader is referred to the next section.

Liquidity management can be described as a problem of managing cash inventories and inventory management models are usually adapted to cash management, as shown by Miller and Orr (1966). Likewise, I will develop a bank's liquidity management model, whose cost function resembles the one in Heller and Lengwiler (2003). While Heller and Lengwiler, with formally questionable results, only focus on the bank's long-term decisions about technology investments and eventually on the effect of a minimum reserve requirement on banks' preferences under uncertainty, I differently define the bank's cost function and the related minimisation problem; I add a *payments production function* representing the organisation, policies, procedures and technology infrastructure through which banks settle outgoing payments in an RTGS payment system; I discuss the effects of the bank's (in)efficiency and liquidity strategies on payments settlement and liquidity risks, also in the short run. The model's underlying intuition is that as holding liquidity for settlement purposes is costly in terms of forgone returns so is managing liquidity and

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[1] RTGS systems, which were developed in the 1990s, settle payments individually and, as long as the payer has enough cash, they allow for payments' settlement finality within the business day. On the other hand, RTGS payment systems require that participants in the system timely provide sufficient intraday liquidity balances, also in the form of secured and unsecured credit, both in the system and in the funding markets to finalise outgoing payments.

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settling outgoing payments in terms of human and technical resources. Of course, a bank is willing to set up this organisation machinery as long as it can economise on the cash it holds at the central bank accounts and on the eligible assets collateralising the loans the bank is extended. Maddaloni and Marcelli (2006) tested this liquidity management model for the period 2001–2005 and the Italian RTGS payment system's data support the idea that banks actually trade off the opportunity cost and the liquidity management cost.[2]

The bank's long-run problem is to formulate a production plan, i.e. an input combination of liquidity and technology capital, which minimises the cost of producing a pre-defined outputl level, i.e. a certain daily amount of outgoing payments, over a certain time horizon. In the short run the liquidity management efficiency is constrained by the technology capital invested at the previous stage. The best liquidity management performance requires some effort in the form of soft variables, say, the liquidity management organisation, procedures, operations and labour processes, to provide the bank with the necessary liquidity to settle outstanding payments. Because holding liquidity and its management are costly, the bank may misbehave and refrain from exerting the required effort and/or from holding the necessary cash so that payment failures occur.

In this framework, information on the effort and the liquidity required to settle all the bank's payment requests is private. Information on payment requests is also private as the regulator can only observe them as payment failures at the end of the business day. Nonetheless, the regulator is assumed to observe, through statistical and other confidential supervisory information, the bank's production capacity, its marginal products and marginal costs and I will show that the regulator can exploit this information, in the form of penalties charged on payment failures or liquidity requirements, to correctly incentivise the bank and minimise liquidity risks.

While most studies consider liquidity risks as only a matter of liquidity shortage, my definition includes the risk stemming from the bank's liquidity management inefficiency. Banks' liquidity management efficiency is apparently supported by many studies that show how banks strategically postpone the settlement of queuing payments to the end of the business day. My interpretation of settlement delays is that banks try to replicate, through informal agreements and established market practices, the settlement outcome typical of deferred net settlement (DNS) payment systems.[3] This behaviour reflects the banks' desire for more efficient ways of managing liquidity and settling outgoing payments, which economise on the liquidity held along the business day and attain high values for the efficiency measure I suggest, as also shown by Maddaloni and Marcelli (2006). Because of the efficiency factor I add to the model, which takes into account the RTGS payment system's framework within which banks operate, my approach can be seen as a generalisation of more traditional settings, like Freixas and Rochet (2008).

The paper is organised as follows. After introducing the model in Section 2, I will present the regulator's problem and the optimal contract, in the form of a penalty charged on payment failures, in Section 3. In Section 4, I will discuss liquidity requirements in general and, after defining the optimal liquidity requirement, I will show that penalty rates and liquidity requirements are equivalent policies, in the sense that they both represent the regulator's best response to minimise the risk of liquidity shortage. However, I will show that only penalty rates can address liquidity risks stemming from the bank's liquidity management inefficiency while liquidity requirements are clearly ineffective. On the efficiency side, in terms of technical distortions, penalty rates are shown to be technology neutral whereas liquidity requirements may interfere with the bank's technology preferences.

As I will show in Section 5, within RTGS payment systems liquidity risks are potentially smaller because they depend more on the bank's liquidity management efficiency than on the randomness of cash inflows and outflows. If the bank adequately and efficiently allows for additional liquidity under adverse conditions, the liquidity manager will promptly find other sources to fund its daily cash outflows and timely meet its payment obligations, with a positive net effect on the liquidity risk over DNS payment systems.

1.1. Literature's review

Following the definition given by Freixas and Rochet (2008), liquidity risks occur when a bank must make unexpected cash payments. These risks usually relate to the demand of deposits which, differently from other claims, can be withdrawn by depositors at any time, possibly causing problems to the bank if the amount of the liquidity requested is very big. At the aggregate level, the problem can propagate from one bank to others, potentially affecting the efficiency of the financial system and the whole economy.

Traditionally, most studies are concerned with both liquidity and solvency risks. Their approach is usually broad, including the bank's portfolio choices on risky assets and the balance-sheet's financial duration affecting depositors' claims and eventually causing, as shown by Diamond and Dybvig (1983), bank runs and bankruptcy. Liquidity makes possible to reimburse creditors when the debt becomes due without early termination of long-term and still profitable investment projects. In a world of perfect information and complete markets, refinancing is not a concern because firms can borrow against the future returns of their current investment. Because of imperfect information and incomplete markets, in reality the full value of ongoing investment projects cannot be pledged and firms need to hold extra cash to withstand exogenous shocks and obtain additional funding (see, for instance, Holmström and Tirole, 1998, 2000). Consequently, as pointed out, for example, by Morris and Shin (2008, 2010), liquidity requirements may reduce liquidity risks because they make debtor banks more robust to withdrawals and creditor banks less prone to triggering the run (see also Rochet and Tirole, 1996b). More recently, Brunnermeier and Pedersen (2009) have modelled liquidity risks as the spiral of mutually reinforcing drops in market liquidity (i.e. how easy assets are traded in the market) and funding liquidity (i.e. how easy traders can obtain funding), when traders face rising capital and margin requirements and market liquidity across all asset classes abruptly dries up. If a central bank is better at distinguishing liquidity shocks from fundamental shocks, it can provide emergency funding at times of crisis and alleviate margin requirements so that both market liquidity and funding liquidity improve. The point is shared, for example, by Rochet and Vives (2004) that, modelling a positive probability that a solvent bank cannot borrow liquidity, propose the central bank's intervention in the form of open market operations or discount window lending at a low interest rate (see also Repullo, 2005). Those views can be traced back to the classical doctrine of the lender of last resort elaborated by

[2] A review of Maddaloni and Marcelli (2006) can be found in the Appendix.

[3] DNS systems, which were the prevailing large-value payment system's model of the 1980s, usually pile up financial institutions' payment orders along the business day and settle participants' net balances only once, typically at the end of the day. Netting the values of financial institutions' overall incoming and outgoing payments, a DNS system reduces the usage of central bank money. On the other hand, DNS payment systems entail higher financial risks because the finality of payments' settlement is assured at the end of the business cycle and there is no certainty that payments will be settled until that time. For more detailed descriptions of how DNS and RTGS payment systems work, see Rochet and Tirole (1996a), Bank for International Settlements (1989, 1997).