Chapter 5
Liquidity Management in the Large Value Payment Systems: Need for an Agent-Based Model’s Complex Approach

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ABSTRACT
With the advent of Large Value Interbank Fund Transfer Systems operating on an RTGS basis, the bank liquidity management problem has become a crucial issue in payment system analysis for its interrelations with the key monetary policy variables, namely, the short-term interbank interest rate. The analysis of the RTGS system is far from being a trivial task due—mostly—to the complexity and the endogeneity. These stem from the multiplicity of heterogeneous participants (complexity) usually joining a system, whose decisions produce a spillover effect on the rest of the system, which prevents any participant from solving its liquidity demand problem in isolation (endogeneity). Agent Based Models seem to present a few advantages in analysing the payment system in comparison to microfounded ones, as well as to standard simulations: behavioural rules can be assigned to a multiplicity of banks defining the lending or borrowing timing as well as the liquidity sources. Therefore, Agent Based Modelling seems to represent an additional instrument by which to analyse the connection between the payment system and the functioning of one of the most important liquidity sources, the interbank money market.

1. INTRODUCTION
According to a consolidated definition, “a payment system consists of a set of instruments, banking procedures and, typically, interbank funds transfer systems that ensure the circulation of money among the economic agents” (Bank for International Settlement, 2001).

Banks lie at the heart of the payment system allowing economic agents to deliver funds to their counterparts either through bilateral arrangements (i.e. correspondent banking) or through multilateral arrangements, the Interbank Fund Transfer
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Systems (IFTSs). IFTSs are formal arrangements among banks (but also comprising other eligible participants) and a settlement agent who holds settlement account on behalf of participants and provides them with the settlement asset need to comply with their reciprocal obligations. Due to their systemic importance, large value IFTSs are mainly managed by central banks, which allow participants to use cash deposited at their reserve accounts to fund their payment obligations. With a view to reducing systemic risk, central banks have been progressively adopting Real Time Gross Settlement (RTGS) systems where each payment instruction is settled individually on gross basis as soon as it enters the system, provided that the sender bank has sufficient liquidity on its account. RTGS systems, while virtually eliminating credit risk, impose participants to bear a significant liquidity cost, since they need to maintain adequate settlement asset in their accounts in order to process smoothly their payment instructions without any significant delay. Besides the balance held at their reserve accounts, banks may rely on other liquidity sources: they can condition the submission of outgoing payment to incoming payments from their counterparties; they can access the daylight credit usually granted from the central bank; they can also borrow and lend funds on the money market to manage mismatching between the incoming and outgoing payments. Thus in a RTGS environment, payment activity is likely to generate demand and supply of settlement asset by banks to both satisfy their intraday payment needs and meet the desired end-of-day balance within the planned minimum reserve fulfillment path. This renders RTGS systems and money markets intertwined with relevant implications for the conduct of the monetary policy: lack of liquidity in RTGS systems may give rise to an excess of demand in the money market either pushing the interest rates up or increase their volatility; on the other hand, weaknesses in the money market due to an increase of either credit risk or risk aversion may prevent bank from submitting their outgoing payments.

Investigating how the RTGS participants choose their liquidity mix represent a key issue for central banking, which—so far—has been basically investigated through the standard tools available at policy makers and academics: neoclassical theoretical models and simulations tools. As shown below in detail, these approaches have been proven to offer useful insights on the functioning of RTGS systems, but they do not seem fully able to cope with all the difficulties, which emerge when studying the behaviour of banks in a RTGS large value payment system: in particular, the neoclassical theoretical models face difficulties in dealing with the fact that: 1) payment flows in RTGS systems do not follow any nice distribution from the exponential family but complex dynamics for which is difficult to derive analytical solutions; 2) the spillover effects each bank’s decision produces on the rest of the system which prevent any system participant from solving its liquidity demand problem in isolation; 3) the incentives for banks to choose their liquidity mix (e.g. pay early versus late) are heavily influenced by the system design which has become increasingly complex due to the introduction of sophisticated liquidity saving features; 4) the players are affected by a high degree of heterogeneity.

On the other hand, the empirical literature based on simulation tools has not properly addressed the endogeneity issues, which arise in this context, where banks change their behaviour according to the evolution of the underlying environment. Against this background, the toolkit available at policymakers and academics for analysing the functioning of RTGS systems needs to be enhanced: as we are going to show throughout this chapter, Agent Based Modelling represents an alternative approach, which appears to be very attractive. In fact, Agent Based Modelling makes it possible to represent each economic agent, i.e. each individual element of the system by way of a set of micro-level rules governing its behaviour both