Chapter 3
Preparing Simulations in Large Value Payment Systems using Historical Data

Ronald Heijmans
De Nederlandsche Bank, The Netherlands

Richard Heuver
De Nederlandsche Bank, The Netherlands

ABSTRACT
Simulations in large value payment systems have become a common tool for stress scenario analyses, often using historical data. The reason for simulating is that disruptions in payment systems are not very common. Simulation of realistic scenarios requires adequate preparation. As part of the preparation, it is essential 1) to have a thorough understanding of the structure of the investigated market, 2) to potentially remove certain types of transactions, such as funding-related transactions (interbank loans), and 3) to understand how banks react to a shock. The financial crisis starting in the summer of 2007 caused several stressful events worldwide and provided insight into how banks behaved during these events.

INTRODUCTION
Large Value Payment Systems (LVPSs) are used worldwide by financial institutions to settle various types of payment obligations, such as payments on behalf of a customer, obligations of the bank itself, payment of the cash leg of a security transaction, pay-in of CLS (Continuous Linked Settlement) to settle foreign exchange transactions, and so on. The importance of these systems can be found in the fact that virtually all economic activity is facilitated by transfers of claims by financial institutions. A lot of these claims and in particular the large value ones are settled in LVPSs. These LVPSs can only be used by financial institutions that meet the access criteria, such as credit institutions, central banks, or treasury departments. In most industrialised countries, these LVPSs are
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Real-Time Gross Settlement (RTGS) systems; see Bech and Hobijn (2007), who studied the adoption of RTGS systems across world’s 174 central banks.

The financial crisis, which erupted in the summer of 2007, clearly showed the interdependence of the financial system on a worldwide scale. Since then several stressful events occurred, such as failures, rumours on financial soundness, decreasing activity in the interbank money market, etc. These events also became visible in payment system data. Therefore, the payment system data provide interesting study opportunities. The strength of information obtained from LVPS transaction data lies in that you do not have to rely on data provided by banks themselves (such as supervision data or statistics on payments). Furthermore, as the information is usually available at very short notice (e.g. for TARGET2, the next day), it is possible to study the latest developments. This is particularly useful in times of stress. However, the LVPS transaction data do not include all economic processes, like detailed retail transactions or large value payments settled in other systems than central bank systems. An example of the latter is EURO1: the private sector owned payment system in euro between banks in the European Union.

This chapter discusses how the payment system’s data may be used in stress scenario analyses. The chapter focuses on the following three aspects: 1) network topology, 2) interbank loans’ identification, and 3) banks’ behaviour.

1. LVPSs can be described in terms of networks. As LVPSs worldwide vary strongly in number of participants and activity of these participants, they may also vary strongly in structure. The effect of a certain disruption largely depends on the network structure of the payment system. Investigating the network structure provides insight into the vulnerability of this network. Besides, it makes for a better comparison between the simulation results of different payment systems.

2. The interbank money market is the place where banks with a liquidity shortage meet banks with a liquidity surplus. As bank are used to “liquidity shocks” arising from unexpected changes in liquidity demand, they use this market to meet their central bank’s maintenance requirements. The interbank loans are mostly settled at the central bank’s LVPS, as these payments are usually very high in value (sometimes above EUR 1 billion) and time critical. The study of interbank money markets is a research topic in its own right and will be briefly discussed in this chapter, but interbank loans are also relevant in certain stress scenario analyses. If the topic of interest is how the payment system will function if the interbank money market (partly) disappears, interbank loans have to be removed from the historical payments data in order to simulate the new banks’ liquidity position.

3. If the payment system faces a certain disruption, banks may react to this disruption. How banks react or behave depends on the type of disruption. This disruption can be an operational outage of the LVPS, a failure of a large bank, a delay of payments by one or more banks, a diminishing willingness to lend liquidity, etc. By studying the historical payment’s data during stressful events and the effects of the different shocks on the payment system’s structure, banks’ reaction patterns in a payment system can be identified. These patterns can then be translated into a set of behavioural rules, which can be used in stress scenario analyses and reality-based simulations.

The outline of this chapter is as follows. It starts with a description of the simulation literature. The section “Preparing the simulation” describes the network properties of payment systems and the

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