



Using synthetic data to evaluate the impact of RTGS on systemic risk in the Australian payments system

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ABSTRACT

This paper develops a new methodology for allowing researchers outside central banks to test the extent of payment system risk, and applies this methodology to an investigation of the impact that the introduction of real time gross settlement (RTGS) had on systemic risk in the Australian payments system. System-specific ratios are first developed to extract bilateral payment obligations from aggregate payments data in the Australian RTGS system. This synthetic data is then used to generate a deferred net settlement (DNS) system of similar dimensions to those the Australian system would have had, had RTGS not been introduced. Standard default simulation methodology is then applied to test the levels of systemic risk in both this system and the corresponding RTGS system to ascertain the degree to which the introduction of RTGS is likely to have reduced the level of risk. We find that while the level of systemic risk is likely to have been reduced in the Australian case, the size of the effect is small, a finding consistent with the results of payments system studies in other countries.

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1. Introduction

The possibility of financial crises and the public policy objective of crisis prevention have underpinned a number of significant developments in financial systems around the world over the last twenty years. The importance of these measures has been further underscored by the failure of a number of large banks in the United States as a result of sub-prime mortgage defaults and the onset of the Global Financial Crisis. One development has been the introduction of real time gross settlement (RTGS) systems for the clearing of payments obligations between banks. The aim of this development has been to reduce the possibility of problems at one bank spreading to other banks via a series of defaults on payments system obligations (see, for example, Flannery, 1996, 804; and Campbell, 1998, 54). In Australia, large value payments were moved over to RTGS in 1998 although small value payments continue to be processed on a deferred net settlement (DNS) basis. Given that this measure was designed to reduce systemic payments system risk, the post-1998 Australian payments system should have been characterised by less risk than the pre-1998 system.

The cost of implementing RTGS, both in Australia and around the world, has been considerable and the case for incurring this cost has been called into question by a number of studies which have found that systemic risk in pre-RTGS systems was smaller than had previously been thought. The methodology employed by these studies examines the size of losses when institution failure is simulated within a pre-RTGS, DNS system or in some cases within a system with an RTGS component. No study has compared the degree of risk before and after the introduction of RTGS within a single system. The methodology of these studies also uses data which is only available to central bank economists due to its commercially sensitive nature, so that verification has emerged from application of the methodology to data sets for different countries rather than from within-country application by economists outside central banks. To date no study has been published for the Australian payments system.

The contribution of this paper is threefold. Firstly, it develops a new methodology which facilitates verification of central bank studies by economists without access to confidential central bank data. This is done by using synthetically generated data sets with characteristics similar to those of data from the actual system being examined. Secondly, the paper focuses on a comparison of systemic risk before and after the introduction of RTGS. In this way the extent to which RTGS may have reduced systemic risk in a particular coun-

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try can be evaluated. Thirdly, it examines these issues with respect to the Australian system. Synthetic data is used to compare a purely DNS system with similar dimensions and composition to those the Australian system could have been expected to have had without the introduction of RTGS, to one with RTGS and DNS components similar to those the Australian payments system actually did have given the introduction of RTGS in 1998. A comparison of risk in these two systems should provide some insight into the impact that the introduction of RTGS has had in Australia since the synthetic data used in the study was generated from the broad parameters of the actual Australian system.

The paper proceeds as follows. Section 2 reviews the literature on payments system risk and Section 3 provides a brief description of the Australian financial system. Section 4 outlines the synthetic data construction methodology and Section 5 describes the characteristics of the data generated for the Australian system. Section 6 summarises the simulation methodology used and reports the results of applying this methodology to the Australian data set. Section 7 summarises the paper and draws some conclusions.

2. Literature review

The possibility that financial contagion may spread from bank to bank through the payments system has been the focus of payments system research for some time now. Flannery (1988, 263–268), for example, analyses growth in the size of daylight overdrafts between banks in DNS systems (especially in the United States) across the course of the 1970s and 80s, and discusses the potential for defaults on those credit exposures to cause a chain reaction of flow-on defaults and insolvencies through the whole financial system. Rochet and Tirole (1996, 835ff) carefully outline the dimensions of systemic payments risk and emphasise the importance of monitoring interbank credit exposures as part of an effective systemic risk management policy. A number of studies point to the rapid expansion of transactions volumes processed by payments systems in the major economies, the consequent expansion of interbank credit exposures and the associated increase in systemic risk (see Flannery, 1988, 264; Rochet and Tirole, 1996, 832; Schmiedel, Malkamaki and Tarkka, 2006, 1784). This expansion has been due especially to increased volumes of financial transactions. Hasan, Malkamaki and Schmiedel (2003) use evidence from European stock markets to explain this trend in terms of transactions cost reductions resulting from investment in improved settlement technology that has boosted investment returns and thus the volume of securities trading. Humphrey, Pulley and Vesala (1996) and Amromin and Chakravorti (2007) examine the forces underpinning a more general long term substitution of cash for non-cash payment instruments that has increased the importance of interbank settlement processes and potentially increased the risk associated with DNS systems.

Berger, Hancock and Marquardt (1996, 699ff) provide a useful framework for analyzing the policy issues associated with the management of payments system risk. They draw particular attention to the fact that reductions in systemic risk can usually only be obtained at greater cost. The implication of this analysis is that risk reductions from migrating DNS systems to an RTGS basis need to be large if such migrations are to be justified given the substantial associated costs. These costs arise largely from the capital intensive nature of the more complex processing and communications structures used in RTGS systems as well as their more advanced operational protocols. One might expect the average cost of such capital intensive systems to fall as the trend in the volume of transactions described above continues, and a large

amount of research on the cost structure of electronic payments systems indicates that this is likely to be the case. Schmiedel, Malkamaki and Tarkka (2006) provide evidence from a range of countries across Europe, Asia and the United States for the period 1993–2000 that demonstrates substantial economies of scale in depository and settlement industries. Bolt and Humphrey (2007) employ data from 1987 to 2004 for Norway, the Netherlands and Belgium to show potential economies from cross-border merging of electronic transactions processing networks. Beijnen and Bolt (2009) similarly show the existence of economies across eight European payments processors over a fifteen-year period ending in 2005.

However, even in the presence of economies of scale in electronic payments processing, additional costs are only worth incurring if reasonable reductions in systemic risk are obtained from more expensive RTGS systems. On this question, Benston and Kaufman (1995) challenge the proposition that financial contagion is spread via defaults on payments system obligations. In particular, they suggest that daylight overdrafts are likely to be overused if supported by implicit government guarantees and that correct pricing of such overdrafts represents one means of controlling this source of risk, an observation echoed by Flannery (1988, 273–275).

A number of studies have also explicitly modeled the degree of risk in DNS systems. Humphrey (1986) demonstrates the extent of DNS risk by simulating the failure of a single participant in the CHIPS¹ system for a randomly selected business day in January 1983. All payments to and from this participant were unwound and new net multilateral settlement positions calculated for each participant in the system. These revisions had the potential to change the initial exposures of other institutions from net credit positions to net debit positions, with the possibility that liabilities associated with such position deteriorations might not be covered by the capital bases of affected institutions. Humphrey (1986, 104) assumes that such additional failures ensue when two conditions are met:

- An institution's revised multilateral net position to the system is negative; and
- the institution's increased system obligation exceeds or equals its available capital.

Additional failures, of course, require further revisions to the multilateral positions of surviving institutions and the reapplication of the above tests. Humphrey repeats this process until all remaining participants are able to settle their net multilateral obligations.

He finds that 50 institutions failed in this simulated crisis, representing 38.6% of the total dollar value of daily payment instructions in the system. Six sets of failure iterations were required before no additional participant met Humphrey's two knock-on failure criteria. If only 10% of bank capital is assumed available to absorb losses from position deteriorations (rather than 100%), the number of failures increases to 73 representing 76.1% of the total dollar value of daily payment instructions. Humphrey tests the robustness of this result by repeating the failure simulation of the same large institution on a different randomly selected day in January 1983, and by simulating the failure of a large associated participant for two randomly selected days in the same sample period.

He concluded that a significant level of systemic risk was present in the then DNS-based U.S. payments system (Humphrey, 1986,

¹ Clearing House Inter-bank Payments System (CHIPS) is a privately operated U.S. dollar clearing system owned by banks located in New York City. CHIPS is more than 30 years old and operated as a DNS system until 2001 when it was upgraded to CHIPS Finality, a continuous netting settlement (CNS) system.

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