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The intraday liquidity management game

Morten L. Bech^{a,b} and Rod Garratt^{c,*}

^a *Federal Reserve Bank of New York, USA*

^b *Danmarks Nationalbank, Denmark*

^c *Department of Economics, University of California, Santa Barbara, CA 93106, USA*

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Abstract

We use a game theoretical framework to analyze the intraday behavior of banks with respect to settlement of interbank claims in a real-time gross settlement setting. The game played by banks depends upon the intraday credit policy of the central bank and it encompasses two well-known game theoretical paradigms: the prisoner's dilemma and the stag hunt. The former arises in a collateralized credit regime where banks have an incentive to postpone payments when daylight liquidity is costly, an outcome that is socially inefficient. The latter arises in a priced credit regime where the postponement of payments can be socially efficient. Banks are risk neutral, but we show that most of the results are unaffected by risk aversion.

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1. Introduction

Most transactions between agents are settled using payment instruments such as cash, check, or electronic money transfer. The system through which these payments flow is supplied in collaboration between the commercial banks and the central bank and is referred to as the payment system. A prerequisite for a well functioning economy is a well functioning payment system.

*Corresponding author.

E-mail address: garratt@econ.ucsb.edu (R. Garratt).

The *raison d'être* of central banks is partly the promotion of smooth operations of the payment system.¹ The extent to which the central bank is involved in the payment system varies, however across countries.² Almost always, the central bank provides the medium to settle the smallest payments (cash) and the means to settle the largest payments, which typically are wholesale payments between banks. For the latter purpose the central bank usually operates a system through which banks can settle payments in central bank money. Besides a role in the operational part of the payment system the central bank often has a regulatory role as overseer of private payment system arrangements.

The volume of interbank payments increased dramatically throughout the 1980s and 1990s as a result of rapid financial innovation and the integration and globalization of financial markets. Historically, interbank payments have been settled via (end-of-day) netting systems. As volume increased central banks became worried about the risks inherent in netting systems. Most central banks opted for the implementation of a real-time gross settlement (RTGS) system.³ A RTGS system processes payments individually, immediately and with finality throughout the day. The system avoids the situation where the failure of one participant may cause the failure of others due to the exposures that are accumulated over the day, as in a net settlement system without proper risk controls. However, this elimination of risk comes at the cost of an increased need for intraday liquidity to smooth the non-synchronized payment flows. Central banks are almost unanimous in the opinion that the provision of free intraday liquidity is not a viable option. It implies that the central bank (i.e., the tax payers) as guarantor of the finality of a payment assumes a credit risk and it creates an incentive for overuse as is often the case when something of value is available for free.⁴ Thus, central banks typically provide intraday liquidity for a fee or require shortfalls to be backed by collateral. Liquidity is thus costly either in form of an explicit fee or implicitly as the opportunity cost of the pledged collateral. Banks try to manage their liquidity throughout the day in order to minimize the cost of settling customer obligations and their own proprietary operations. Intraday liquidity management has become an important competitive parameter in commercial banking and a policy concern of central banks.⁵

Incentives in RTGS systems are studied in [1,18,19]. Angelini [1] and Kobayakawa [18] use a setup derived from earlier literature on precautionary demand for reserves. Angelini [1] shows that in a RTGS system, where banks are charged for intraday liquidity, payments will tend to be delayed and that the equilibrium outcome is not socially optimal. Kobayakawa [18] models the intraday liquidity management

¹ See e.g. Chapter 2, Article 3 of [7]. For discussion of payment systems and the historical and current role of central banks see [20].

² See [5] for a discussion of a minimalistic approach preferred in the Nordic countries.

³ An exception is Canada where the large value transfer system (LVTS) is a net settlement system. See [17] for a discussion of the relative merits of net versus gross settlement.

⁴ See [8,16].

⁵ A recent discussion of the timing issues and risks associated with payment systems in connection with foreign exchange (FX) settlement is contained in an article entitled "The long, dark shadow of Herstatt," which appeared in the April 14–20, 2001 issue of Economist magazine.

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