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Payment obligations, reserve requirements, and the demand for central bank balances ☆

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Abstract

We develop a model in which a bank's demand for reserves depends on the joint distribution of transactions, reserve requirements, and the interest rate. By devoting resources to its liquidity management, a bank can save on costly reserves required to settle its payments on time. We test the model with data from the largest banks in the Swiss Interbank Clearing system. We find that the turnover ratio (the speed with which a bank turns over its reserves in the payment system) depends largely on the aggregate value of its payments. We also find that reserve requirements impose a highly uneven burden on the banks.

JEL classification: G21; G28

Keywords: Payment systems; Reserve requirements; Bank behavior

1. Introduction

In most countries, commercial banks have two reasons to hold central bank balances. First, banks can use these balances to meet their obligations in the interbank payment system. The second reason is that banks are obliged by law to maintain a certain minimum amount of reserves. The literature that explains the demand for cash balances with payments or transactions motives was initiated by

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Baumol and by Tobin and has been expanding prolificly ever since. By adding uncertainty over the cash flows to a Baumol–Tobin framework, Miller and Orr (1966) show that the demand for money depends not only on the interest rate and transaction costs, but also on the variance of the cash flows. In Baltensperger (1974), banks have the ability to influence uncertainty over net withdrawals. By investing in what he calls *planning*, the banks can reduce the variance of the withdrawals, which enables them to hold fewer central bank balances. Planning is a substitute for reserves. In these early models, only Poole (1968) explicitly incorporates both reserve requirements and stochastic payment flows into a demand function for reserves.

Empirically, it is commonly observed that the turnover ratio, defined as the average value of a bank's payments divided by its average overnight reserves, varies greatly across banks. Data from the Swiss Interbank Clearing System (SIC), for instance, reveal that some banks' turnover ratios are consistently above 100, while other banks have turnovers that never exceed 20. Based on the predictions of our model we argue that the reason for these large differences is twofold.

First, following Baltensperger (1974) and more recently Furfine and Stehm (1998), we assume that liquidity management is a substitute for reserves. In other words, a bank can reduce holding the (costly) central bank balances that it needs to fulfill its payment obligations by investing in its cash or liquidity management. We model this function in such a way that there are increasing returns to scale. The more payments a bank has to make, the more investment in liquidity management pays off. In a modern payment system in which payment instructions are settled continuously and individually, factors such as clever bundling, sequencing, and timing of payments are important determinants of the balances needed to settle all obligations when due. In addition, active participation in the money market—be it by borrowing or lending—also influences the amount of reserves kept overnight in the central bank accounts. Of course, all of these activities are costly and a bank has to weigh these costs against the benefits of being able to reduce its end-of-day balances with the central bank.

Second, we assume that the presence of legal reserve requirements can considerably influence a bank's demand for central bank balances. Reserve requirements impose an upper bound on the turnover ratios, and since the relationship between transaction value and reserve requirements can vary across banks, so can the turnover ratio. The reserve requirement being a function of the short-term liabilities of a bank is itself a random variable. Solving this more complex optimization problem, we find that the optimal turnover ratio of a bank is a function of the whole joint distribution of transactions, reserve requirements, and interest rates. Such joint distributions naturally depend on the business sectors in which a bank is active, thus contributing to the heterogenous turnover ratios we observe empirically.

In this paper, we derive an exact solution to an individual bank's optimization problem, subject to uncertainty and stochastic reserve requirements. We test this model with data from the 40 largest participants in the Swiss Interbank Clearing system (SIC) for the period from 1992 to 1998. We find that the value of payments is the most important factor in determining the turnover ratio. We also find that the