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Inventory management effects, isolated: Evidence from the federal funds market

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ABSTRACT

The federal funds market is highly competitive, has uniform information, and does not have most order-processing cost components of equity markets. Hence, it provides an opportunity to study the effect of inventory management on the bid-ask spread in an isolated fashion. Using a unique data set of daily borrowing and lending federal funds quotes posted by a large commercial bank, we find that the bank maintains a fairly constant bid-ask spread throughout a two-week reserve maintenance period. It acts similarly to a market maker facilitating flow of funds between depository institutions throughout the reserve maintenance period. The bank becomes more active toward the end of the period. In particular, on settlement Wednesday it increases the bid and ask quotes relative to the effective federal funds rate in an apparent attempt to manage its reserve inventory and satisfy its own reserve requirements.

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1. Introduction

Determinants of the bid-ask spread in financial markets discussed in the literature fall into four major categories: inventory management, informational asymmetry, order-processing costs, and competition among market makers.¹ The federal funds market, where depository institutions trade their reserve balances, has some similarities to exchange markets. However, there are also significant differences. First of all, this market is highly efficient and information is largely uniform. Second, most of the components of order-processing costs in exchange markets, such as an exchange seat price, floor space rent, and informational service cost are not present in the federal funds market. Third, the competitive factor is relatively uniform across the entire market since many institutions engage in facilitation of short-term lending and borrowing between depositories. At the same time, depository institutions in the U.S. must satisfy reserve requirements imposed by the Federal Reserve, which creates the need to manage inventories of reserves. Spindt and Hoffmeister (1988) and Griffiths and Winters (1995) both suggest that the main explanation of the behavior of the federal funds rate is reserve

management by depository institutions. Overall, the federal funds market provides a unique environment where the effect of inventory management on the bid-ask spread could be studied in an isolated fashion.

Using a unique data set of daily borrowing (bid) and lending (ask) quotes posted by a large Midwestern U.S. bank trading federal funds for its own account, we study how the quotes and the spread between them evolve throughout the reserve maintenance period. In particular, we examine if and how inventory management necessitated by the federal funds market structure affects the bid-ask spread. To our knowledge, this is the first study that directly investigates the bid-ask spread in the federal funds market.

We find that the bank maintains a relatively stable bid-ask spread throughout the two-week reserve maintenance period, with the bid and ask quotes mimicking a brokered transaction-weighted market rate. The bank increases both bid and asks relative to the effective federal funds rate as settlement approaches. This behavior is consistent with the bank maximizing profits and helping to facilitate orderly flow of funds between depository institutions throughout most of the two-week reserve maintenance period while focusing more on its own reserve inventory management through additional borrowing toward the end of the period.

The paper proceeds as follows. The next section provides essential details of the federal funds market and discusses inventory management in the federal funds market. The following section describes data and methods, Section 4 reports and discusses empirical results, and the last section concludes.

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¹ Inventory management deals with inventory control cost or inventory-holding cost. Informational asymmetry is costly because it can lead to adverse selection.

2. Inventory management in the federal funds market

The U.S. federal funds market is the market for short-term interbank loans, most of which are unsecured.² Its primary purpose is to trade funds to satisfy depository institutions' reserve requirements (set by Regulation D of the Federal Reserve). Depository institutions can satisfy the requirements either by holding balances at the Federal Reserve Bank or by vault cash. A *reserve maintenance period* starts on Thursday and ends on Wednesday two weeks later (settlement Wednesday). On settlement Wednesday, depositories compare their actual reserves to total required reserves. Depository institutions must satisfy their reserve requirement each period; however, a small amount of excess or deficiency may be carried over to the next period. No institution can carry over a deficiency two maintenance periods in a row. Toward the end of the maintenance period some institutions may face pressure to adjust the amount of their reserves based on the required level; they achieve it by borrowing funds from other institutions or lending excess reserves. Reserve balances also count for weekends and holidays when the market is closed.³

When funds are transmitted, the lending bank's account with the Federal Reserve Bank is debited, thus reducing the amount of reserves, and the borrowing bank's account is credited, increasing the amount of reserves. The opposite happens when the loan is repaid. Transactions in the federal funds market may be carried in three ways. First, funds may be transacted directly between institutions that have pre-approved lines of credit with each other. Second, fed funds may be traded through brokers, non-banks that facilitate trades but do not take positions. The brokers' market is only available to banks that trade in volume; a round lot is \$5 million, and transactions involving hundreds of millions of dollars are not uncommon (Stigum & Crescenzi, 2007). Third, banks may transact through correspondent banks. Correspondent banks are often thought to upstream funds from small banks, but they trade on both sides of the market. Smaller banks often prefer to act through correspondents because they are unable to trade in the brokered market. Quoting Stigum and Crescenzi (2007, pp. 511–512), "To cultivate correspondents that will sell funds to them, large banks stand ready to buy whatever sums these banks offer, whether they need all these funds or not. If they get more funds than they need, they sell off the surplus in the brokers' market. Also, they will sell to their correspondents if the correspondents need funds, but that occurs infrequently." To indicate at what rates they are ready to borrow from or lend to other institutions, larger banks quote borrowing (bid) and lending (ask) rates. By regularly trading federal funds, these institutions facilitate the flow of funds between depositories. Each time such an institution transacts with a client by borrowing (lending) funds, its inventory of funds and its reserves increase (decrease). Therefore, it always trades for its own account and has to constantly monitor and manage its inventory of funds and reserves. It may do so by adjusting the bid and ask quotes. The main data utilized in this study are daily bid and ask quotes of a large Midwestern U.S. bank that trades federal funds for its own account and

serves as a correspondent institution for many smaller banks in its region.

Of the major determinants of the bid-ask spread in financial markets – inventory management, informational asymmetry, order-processing cost, and competition among market makers – only inventory management plays an important role in the federal funds market because periodic settlement with the Fed requires a certain degree of inventory management by depository institutions. The Spindt and Hoffmeister (1988) model predicts that (1) the variance of the federal funds rate increases on days before non-trading days and peaks on settlement days and (2) the intraday variance peaks at the end of the day. Griffiths and Winters (1995) confirm predictions of Spindt and Hoffmeister (1988) and show that profit-maximizing institutions tend to build a reserve deficiency rather than a surplus throughout most of the reserve maintenance period.⁴ They also provide evidence of lending pressure before non-trading days and suggest that this is a result of the federal funds market structure. Both Spindt and Hoffmeister (1988) and Griffiths and Winters (1995) suggest that inventory control (reserve management) by depository institutions is the explanation for the behavior of the federal funds rate's level and variance. Cyree and Winters (2001) conclude that the reverse-J intraday pattern in the federal funds rate is caused by inventory management necessitated by end-of-day trading stoppages, consistent with the model of Brock and Kleidon (1992). Clouse and Dow (2002) use dynamic programming to model bank demand for reserves throughout the maintenance period. Their model predicts an upward trend in demand for reserves throughout the maintenance period, lower demand on Fridays, and a spike in demand on settlement Wednesday. Carpenter and Demiralp (2006) find that the liquidity effect of the Fed's open market operations is highest on settlement Wednesday. This result is expected because reserve deficiencies cannot be shifted (except for a small carryover provision) to the next maintenance period; it is consistent with the model of Clouse and Dow (2002). In this study, we expect the bid quote to increase and the bid-ask spread either to narrow or stay unchanged as settlement approaches and the bank attempts to cover its own reserve shortages by borrowing at a higher rate.

3. Data and methods

3.1. Data

The data comprise the daily lending (ask) and borrowing (bid) quotes of an institution trading federal funds for its own account (a large Midwestern U.S. commercial bank). The daily quotes are available for the period from February 2, 2001 through September 10, 2001. The total number of trading days is 154. There are 16 settlement Wednesdays as well as Tuesdays before settlement Wednesdays (second Tuesdays hereafter), 33 days preceding non-trading days (32 Fridays and one Tuesday), and 33 days following non-trading days (29 Mondays, three Tuesdays, and one Thursday) in our sample period. While the sample period is short, this is the only data of this type that is available. To our knowledge, this is the first study that uses a bid-ask spread in the federal funds market.

We also collect the effective federal funds rate series (EFFR hereafter) from the Federal Reserve H15 report. The EFFR is a weighted average of rates on brokered trades reported by the federal funds brokers to the Federal Reserve. It is calculated by the Federal Reserve Bank of New York.

² Some federal funds loans are explicitly secured. In a secured transaction, the borrower places government securities in a custody account for the lender as collateral to support the loan. The borrower retains title to the securities (which is different from a repurchase agreement in which pledged securities change ownership). Lending institutions sometimes request secured transactions (Goodfriend & Whelpley, 1993). The bid and ask quotes employed in this study are for unsecured transactions.

³ Having insufficient reserves entails pecuniary and, more importantly, non-pecuniary penalties in the form of regulators' scrutiny. Having excess reserves involved an opportunity loss since (required and excess) reserve balances did not earn interest during our sample period.

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