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The topology of the federal funds market

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ABSTRACT

We explore the network topology of the federal funds market. This market is important for distributing liquidity throughout the financial system and for the implementation of monetary policy. The recent turmoil in global financial markets underscores its importance. We find that the network is sparse, exhibits the small-world phenomenon, and is disassortative. Centrality measures are useful predictors of the interest rate of a loan.

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1. Introduction

The recent turmoil in global financial markets underscores the continuing importance of the federal funds market. Its smooth functioning is of utmost importance for distributing liquidity throughout the financial system and for the practical implementation of monetary policy. Banks rely heavily on the federal funds market to offset liquidity shocks and manage their reserve positions over the two-week reserve maintenance period. In formulating monetary policy, the Federal Open Market Committee (FOMC) sets a target for the effective federal funds rate and directs the Federal Reserve Bank of New York to "create conditions in reserve markets" that will encourage federal funds to trade near the target. Creating such conditions became a significant challenge beginning in August 2007. Massive amounts of liquidity were injected into the market on several occasions. Nevertheless, the federal funds rate deviated from its target considerably more than usual both within and across days.

In this paper, we take an in-depth look at the structure of the federal funds market from the vantage point of network topology. Networks have proved useful in analyzing a wide array of structures and interactions across a multitude of fields. In recent years, the physics community has made significant progress toward understanding the structure and functioning of complex networks. The literature has focused on characterizing the structure of networked systems and how the properties of the observed topologies relate to stability, resiliency, and efficiency in the case of perturbations and disturbances. Recently, economists have started to show renewed interest in networks.

We represent the federal funds market as a network, in which financial institutions are nodes and loans are directed links, weighted by the value of the loans between the counterparties. Using a unique transaction-level data set spanning 1997–2006, we are able to analyze in unprecedented detail the characteristics of the overnight federal funds network and its evolution over the past decade. We find that the value sent between banks has increased even though the number of participants in the network has decreased. Like other complex networks, the federal funds network is sparse, exhibits the small-world phenomenon, and is disassortative. The number of counterparties per bank (degree) follows a fat-tailed

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distribution, with most banks having few counterparties and a small number having many. However, unlike other networks, the degree distribution is not necessarily best represented by a power law distribution. Using network-specific measures, we are able to shed new light on the small-bank–large-bank dichotomy of the federal funds market, whereby small banks generally lend funds to larger banks. Finally, we provide preliminary evidence that centrality measures, which determine the relative importance of banks in the network, are useful predictors of the interest charged between banks.

In Section 2, we begin with a quick overview of some of the institutional details of the federal funds market. In the subsequent section we review the literature on the federal funds market and network theory. Section 4 describes the data used in our study. Section 5 outlines some network terminology. Section 6 presents different ways to visualize the federal funds network. Section 7 contains the analysis and results of the paper. Section 8 concludes.

2. Federal funds market

The federal funds market is the market for immediately available reserve balances at the Federal Reserve. Depository institutions that maintain accounts at the Federal Reserve can borrow (buy) or lend (sell) reserve balances. Federal funds, or fed funds, are unsecured loans, and the rate at which these transactions occur is called the fed funds rate. Most trades are delivered on the same day, and the duration is typically overnight; but trades for longer terms (called term fed funds) also take place. In this paper, we consider only overnight fed funds.

Depository institutions hold reserve balances at the Federal Reserve Banks to meet reserve requirements – a minimum average balance over a two-week period – and to prevent any overnight overdrafts that may arise from their payment activities with other depository institutions.[2] The day-to-day flows of business to and from a bank are unlikely to leave it with the desired level of reserves. The federal funds market is one option for adjusting the level of reserves. A bank with a shortfall may buy federal funds. Like bank deposits, borrowed federal funds are bank liabilities. From a regulatory point of view borrowed fed funds are treated differently and are not subject to reserve requirements.[3]

To buy and sell federal funds, depository institutions can either trade directly with each other or use the services of a broker. Federal funds brokers do not take positions themselves but rather bring buyers and sellers together anonymously. In the direct trading segment, transactions commonly consist of sales by small-to-medium-sized banks to larger banks and often take place on a recurring basis. The rate is set in reference to the prevailing rate in the brokered market. In the brokered segment, participation is confined mostly to larger banks acting on their own or a customer's behalf. Trade sizes are generally larger than in the direct trading segment [1].

Participants can settle federal funds trades in two ways: (1) they can use the Fedwire Funds Service to transfer reserves from one depository institution's account to another; or (2) they can use correspondent rebookings, in which (mostly smaller) banks without accounts at the Federal Reserve may have their deposits at larger correspondents rebooked as overnight loans to those correspondents. The rebooking segment does not involve wire transfers between accounts at the Federal Reserve. The individual loans are typically smaller, and the interest rates tend to be one quarter of a percentage point below the rates in the brokered market [2].

By facilitating the transfer of the most liquid funds among depository institutions, the fed funds market plays a major role in the execution of monetary policy. In fact, the directive for implementation of US monetary policy from the FOMC to the Federal Reserve Bank of New York states that the trading desk should "create conditions in reserve markets" that will encourage fed funds to trade at a particular level. Using open market operations the desk can change the supply of reserve balances and thus create upward or downward pressure on the fed funds rate.

3. Literature review

The importance of the federal funds market has not escaped the notice of academic research. Ho and Saunders [3] develop a model in which banks have a target reserve balance that they achieve through participation in the federal funds market. Banks that are risk averse to having a deficient balance will have interest-rate–elastic-demand functions for purchasing federal funds. Since large banks have more options for obtaining necessary reserves, they are less risk averse. Large banks therefore end up as net borrowers, while small banks are net lenders in the federal funds market. Allen and Saunders [4] provide a second explanation for the large-bank–small-bank dichotomy. Since federal funds loans are uncollateralized, banks face a risk when lending. In addition, large banks may not be able to judge correctly the risk of lending to small, rural banks. Because of this information asymmetry, small banks are either rationed out of the federal funds market or are forced to pay higher interest rates. Allen et al. [5] empirically confirm these results. They find that banks with an asset size greater than $2.5 billion (in 1989 dollars) are more likely to be net borrowers in the federal funds market and that banks that are located away from the major banking centers are more likely to be net lenders than banks in New York, Chicago, or San Francisco. In the collateralized repo market, banks' size and location do not have the same constraining effects. Furfine [6] uses transaction-level data to describe the market microstructure of the federal funds market by categorizing banks by asset

[2] The Federal Reserve's Regulation D requires banks operating in the United States to hold reserves, either in the form of balances in deposit accounts at the Federal Reserve or as cash in their vaults, in a fixed proportion to some of their deposit liabilities.

[3] Regulation D exempts from the definition of a "deposit", and hence from reserve requirements, bank liabilities arising from borrowings from other banks, from various government agencies, and, under certain conditions, from securities dealers.

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