



The federal funds market, excess reserves, and unconventional monetary policy



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ABSTRACT

Following the bankruptcy of Lehman Brothers, interbank borrowing and lending dropped, whereas reserve holdings of depository institutions skyrocketed, as the Fed injected liquidity into the U.S. banking sector. This paper introduces bank liquidity risk and limited market participation into a real business cycle model with ex ante identical financial intermediaries and shows, in an analytically tractable way, how interbank trade and excess reserves emerge in general equilibrium. Investigating the role of the federal funds market and unconventional monetary policy for the propagation of aggregate real and financial shocks, I find that federal funds market participation is irrelevant in response to standard supply and demand shocks, whereas it matters for “uncertainty shocks”, i.e. mean-preserving spreads in the cross-section of liquidity risk. Liquidity injections by the central bank can absorb the effects of financial shocks on the real economy, although excess reserves might increase and federal funds might be crowded out, as a side effect.

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1. Introduction

Following the bankruptcy of Lehman Brothers, the Federal Reserve injected substantial amounts of liquidity into the U.S. banking sector in order to contain tensions in the federal funds market. As a result, the reserve holdings of depository institutions skyrocketed. Pundits have taken this as a signal of ineffectiveness of the Fed's liquidity facilities in promoting the supply of credit to the economy (compare Keister and McAndrews, 2009). Fig. 1 illustrates that excess reserves used to play only a negligible role in the balance sheets of financial intermediaries throughout the post-war period, averaging less than 0.05% of total deposits before September 2008.¹ After Lehman, excess reserves increased from virtually zero to almost 20%, whereas interbank lending, i.e. federal funds and reverse repurchase agreements of U.S. commercial banks with other banks, dropped from 5.5% to less than 1.5% as a fraction of total deposits.²

Identifying federal funds transactions based on Fedwire data, Ashcraft et al. (2011) document a dramatic increase in banks' liquidity risk in August 2007, due to looming intraday payments for asset-backed commercial paper liquidity lines,

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¹ Aggregate excess reserves are defined as total minus required reserves of depository institutions in the U.S.

² Throughout the paper, I use the terms “federal funds” and “interbank loans” interchangeably, when referring to unsecured short-term credit between financial intermediaries.

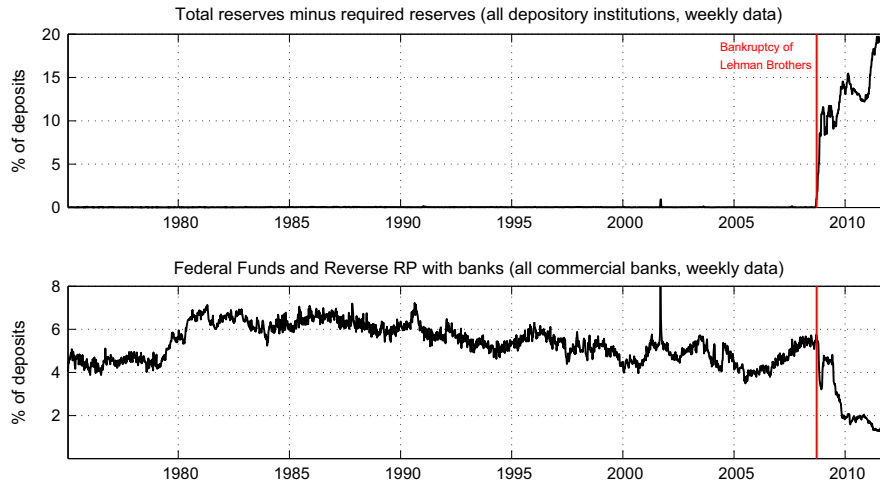


Fig. 1. Excess reserves and federal funds transactions of banks in the U.S. as a fraction of total deposits; weekly data from January 1975 to December 2011. Sources: H.3 and H.8 Statistical Releases of the Board of Governors of the Federal Reserve System.

whereas concerns about increased counterparty risk in interbank transactions were largely irrelevant until October 2008. Likewise, [Afonso and Lagos \(2012\)](#) show that the average number of daily trades and counterparties dropped from above 860 to about 240 and from 4.5 to 3, respectively, whereas average loan size doubled during the financial crisis of 2007–2009. Hence, the drop in the total volume of federal funds since 2008 was driven by a reduction in trade frequency rather than in trade size.

The aim of this paper is to show, in an analytically tractable way, how interbank lending and excess reserves can emerge in a general equilibrium. For this purpose, I introduce liquidity risk in the spirit of [Rochet and Tirole \(1996\)](#) and [Holmström and Tirole \(1998\)](#) and limited federal funds market participation in an otherwise frictionless real business cycle (RBC) model with financial intermediation. The model can thus capture the prevalence of interbank credit before as well as the rise in reserves during the “Great Recession” and is used to investigate the role of the federal funds market and unconventional monetary policy for the propagation of aggregate real and financial shocks.

In the model, interbank borrowing and lending arises from idiosyncratic uncertainty of ex ante identical financial intermediaries. Building on [Dib \(2010\)](#), banks extend commercial loans to goods-producing firms according to a Leontief technology, i.e., they must simultaneously fulfill a non-negativity constraint on liquidity and a minimum capital requirement, as in the Basel accords. Deposits are stochastic at the bank level and realize only after a bank has chosen its desired volume of loans and bank capital. Each individual bank is thus subject to liquidity risk and an occasionally binding liquidity constraint. Institutions with low (high) deposit realizations relative to their bank capital stock can engage in interbank borrowing (lending). Yet, whether a given bank participates in the federal funds market is exogenous. I abstract from pro-cyclical balance sheet constraints in financial intermediation. Hence, my model represents a complement rather than a substitute for the well-known “financial accelerator.”

Extending the approach in [Wen \(2011\)](#), I aggregate the occasionally binding liquidity constraints of individual banks by assuming a suitable distribution function of their idiosyncratic deposit realizations. Thus, the model accommodates microeconomic uncertainty at the bank level even in a loglinear approximation around the steady state.

With full participation in the federal funds market, interbank borrowing and lending provides perfect insurance against liquidity risk. Accordingly, the banking sector is “self-sufficient” in the sense of [Holmström and Tirole \(1998\)](#), attaining an optimal equilibrium allocation of liquidity. Limited participation induces banks to hold excess reserves, raises the interest rate spread in financial intermediation, and impairs thus steady-state real economic activity through a credit cost channel (compare [Kiyotaki and Moore, 2008](#)).

Given a symmetric distribution function of deposit realizations and an exogenous, in particular acyclical, participation in the federal funds market, the latter is irrelevant for the propagation of standard supply and demand shocks. On the contrary, the federal funds market is crucial for attenuating “uncertainty shocks”, i.e. changes in the variance of banks’ deposit realizations. An exogenous decrease in market participation triggers a simultaneous increase in excess reserves and an economic recession.

Unconventional monetary policy, modeled here as a liquidity injection by the central bank, can reduce banks’ liquidity risk and stabilize real economic activity in response to financial shocks. Depending on its implementation, however, it might lead to an even more pronounced increase in excess reserves and a crowding out of interbank credit.

My work is most closely related to [Gertler and Kiyotaki \(2011\)](#). In their model, a continuum of financial intermediaries is located on a continuum of islands. Each period, a fraction of firms is randomly assigned the possibility to invest (compare also [Kiyotaki and Moore, 2008](#)). Financial intermediaries can only lend to firms on the same island but to intermediaries on

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