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Interbank market liquidity and central bank intervention ☆

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ABSTRACT

We develop a simple model of the interbank market where banks trade a long term, safe asset. When there is a lack of opportunities for banks to hedge idiosyncratic and aggregate liquidity shocks, the interbank market is characterized by excessive price volatility. In such a situation, a central bank can implement the constrained efficient allocation by using open market operations to fix the short term interest rate. It can be constrained efficient for banks to hoard liquidity and stop trading with each other if there is sufficient uncertainty about aggregate liquidity demand compared to idiosyncratic liquidity demand.

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1. Introduction

Interbank markets are among the most important in the financial system. They allow liquidity to be readily transferred from banks with a surplus to banks with a deficit. They are the focus of central banks' implementation of monetary policy and have a significant effect on the whole economy. Under normal circumstances the interbank markets, especially the short term ones, work rather well. On occasion, however, such as in the crisis that started in the summer of 2007, interbank markets stop functioning well inducing central banks to intervene massively in order to try to restore normal conditions.

Despite their apparent importance, interbank markets have received relatively little attention in the academic literature. The purpose of this paper is to develop a simple theoretical framework for analyzing interbank markets and how the central bank should intervene. Our analysis is based on a standard banking model developed in Allen and Gale (2004a, b) and Allen and Carletti (2006, 2008). There are two periods in the usual way. Banks can hold one-period liquid assets or two-

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period long term assets with a higher return. All assets are risk free in the sense that their promised payoffs are always paid. Banks face uncertain liquidity demands from their customers at the end of the first period. We distinguish between two types of uncertainty concerning banks' liquidity needs. The first is *idiosyncratic uncertainty* that arises from the fact that for any given level of aggregate demand for liquidity there is uncertainty about which banks will face the demand. The basic role of interbank markets is to allow reallocations of liquidity from banks with an excess to banks with a deficit. The second is the *aggregate uncertainty* that is due to the fact that the overall level of the demand for liquidity that banks face is stochastic.

We start with the analysis of the optimal portfolio of assets and payments that a planner who can transfer liquidity costlessly would implement. The planner is constrained in the same way as banks to offer deposit contracts where the payment at the end of the first period cannot be made contingent on the aggregate demand for liquidity in the banking system or the bank's individual liquidity demand. The resulting optimal allocation is termed the *constrained efficient allocation* because of this constraint to use deposit contracts.

We next consider the operation of an interbank market where banks can buy and sell the long term asset at the end of the first period. Since all assets are risk free in our model, there is no difference between selling the long asset and using it as collateral in a repurchase agreement. For ease of exposition, we consider outright sales of assets. The interbank market allows reallocations of liquidity between banks that depend on the realizations of the idiosyncratic and aggregate liquidity shocks. We focus on situations where the uncertainty concerning liquidity demand is not sufficient to cause banks to fail. In other words, banks find it optimal to keep enough liquidity to insure themselves against the high aggregate liquidity shock. The aggregate uncertainty about liquidity demand leads to volatile equilibrium prices for the long asset at the end of the first period, or equivalently interest rates. The intuition hinges on the simple fact that prices in the interbank market have to adjust to satisfy the market-clearing condition and to provide banks with the appropriate incentives to keep the necessary liquidity initially. When the aggregate liquidity demand turns out to be low (that is, in the good state), there is an excess supply of aggregate liquidity at the end of the first period. The price of the long term asset is bid up to the level where the return during the second period is the same for both assets so that banks will be willing to hold both of them. The high price in the good state implies that prices have to fall in the bad state, that is when the high aggregate liquidity shock is realized, in order for banks to be willing to hold both the short and the long term assets initially. If this was not the case, the long asset would dominate the short asset and banks would not hold any liquidity to start with. Given that consumers are risk averse, this price volatility is inefficient because it leads to consumption volatility thus preventing the implementation of the constrained efficient allocation.

The main result of the paper is to show that the introduction of a central bank that engages in open market operations to fix the price of the long asset at the end of the first period (or equivalently fix the short term interest rate) removes the inefficiency associated with a lack of hedging opportunities. This intervention allows the banks to implement the constrained efficient allocation.

To see how this occurs it is helpful to consider two special cases. The first is where there is just idiosyncratic liquidity risk and no aggregate risk. Provided the central bank engages in the right open market operations and fixes the price in the interbank market at the end of the first period at the appropriate level, banks with a high liquidity demand will be able to sell their holdings of the long term asset to raise liquidity. The banks with low liquidity demand at the end of the first period are happy to buy the long asset and provide liquidity to the market because they need payoffs at the end of the second period to meet their needs then. The second special case is where there is no idiosyncratic uncertainty but there is aggregate uncertainty about liquidity demand. Here the central bank must fix the price by engaging in open market operations. In particular, it needs to remove excess liquidity from the banks by selling the long asset when aggregate liquidity demand is low. It can do this by selling government securities that replicate the long asset that are funded through lump sum taxes on late consumers at the final date. The optimal intervention by the central bank when there is both idiosyncratic and aggregate uncertainty combines the two policies in the special cases. The central bank must fix the price at the appropriate level that allows banks to reallocate liquidity from those with low idiosyncratic shocks to those with high ones. At the same time it must use open market operations to control the aggregate liquidity in the market to fix the price. We show that achieving both objectives simultaneously is possible and the constrained efficient allocation can be implemented. This result is in line with the argument of [Goodfriend and King \(1988\)](#) that open market operations are sufficient to address pure liquidity risk on the interbank market.

One of the implications of our model is that even when the constrained efficient allocation is being implemented by the policies of the central bank, an increase in aggregate uncertainty can cause banks to stop using the interbank markets to trade with each other. The banks hoard liquidity because they may need it to meet high aggregate demand. When aggregate demand is low, however, they have enough liquidity to deal with variations in idiosyncratic demand and as a result the banks stop trading with each other. At least in the context of the model considered here, this cessation of trade does not have consequences on the banks' ability to remain active. There is no need for central banks to intervene since the liquidity hoarding is consistent with constrained efficiency.

The basic problem in our model that leads to a need for central bank intervention is that financial markets are incomplete. In particular, banks are unable to hedge the idiosyncratic and aggregate liquidity shocks that they face. We consider how complete markets would operate and allow these risks to be hedged. There are many forms that such complete markets could take. We consider how markets for Arrow securities where all trades are made at the initial date allow the constrained efficient allocation to be implemented. This involves a large number of securities being issued and

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