



# Multiple equilibrium overnight rates in a dynamic interbank market game<sup>☆</sup>

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## Abstract

We analyse a two-period model of the interbank market, i.e. the market where banks trade liquidity. We assume that banks do not take the interbank interest rate as given, but instead negotiate on interest rates and transaction volumes with each other. The solution concept applied is the Shapley value. We show that there are a multiplicity of average equilibrium interest rates of the first period so that the average interest rate in this period does not convey any information on the expected liquidity situation on the interbank market. As the banks control not only the transaction volumes, but also the interest rates, they can leave the interest rates constant and adjust the transaction volumes when, for example, a liquidity deficit becomes more likely. © 2005 Elsevier Inc. All rights reserved.

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## 1. Introduction

Central banks normally use the average overnight interbank market rate (the EONIA rate in European Monetary Union, the Fed funds rate in the US) as an indicator for the (expected) liquidity situation on the interbank market. If the rate is high, the market is assumed to expect a liquidity deficit, whereas if the rate is low, it is assumed to expect a liquidity surplus. This method of assessing the liquidity situation on the interbank market can easily be justified theoretically. Ho and Saunders (1985) and Spindt and Hoffmeister (1988), for example, discuss models of the

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Fed funds market, while Välimäki (2001), Mendizábal and Quirós (2001) and Tapking (2002) analyse models of the European interbank market. In all of these models, the more likely a liquidity deficit is, the higher the equilibrium rate. However, most of these models are general equilibrium models and are thus based on the assumption that all banks take the interbank rate as given.

At least in Europe, transactions on the interbank market are usually agreed on in direct negotiations between banks, often on the telephone. Sometimes brokers are involved to help banks find a transaction partner, but the terms of transactions, i.e. the interest rates and transaction volumes, are still a matter of negotiation between the banks.<sup>1</sup> Therefore, one may question whether a general equilibrium model with interest rate taking banks is an appropriate model of the interbank market. Consequently, one may ask whether the overnight interbank market rate is still a good indicator for the liquidity situation on the interbank market, if banks do not take interest rates as given but determine interest rates and transaction volumes in negotiations. The latter question is exactly what we are going to address in this paper.

Why may the overnight rate not be a good indicator of the liquidity situation on the interbank market if banks determine the terms of transactions in negotiations? Consider for example two banks that provisionally agree that the first will lend a certain amount of liquidity to the second at a certain interest rate. If the banks now receive new information that indicates that a liquidity deficit is more likely than previously expected, we might expect the banks to agree to adjust the terms of their transaction. But what kind of new agreement will they choose? They might agree to leave the transaction volume as it is, but raise the interest rate. However, they could also agree to leave the interest rate as it is, but adjust the transaction volume. In the latter case, changes in expectations would not lead to changes in interest rates.

To put forward this idea in a precise and consistent way, we consider a model of an interbank market with institutional characteristics similar to those of the European interbank market.<sup>2</sup> We look at only one so-called maintenance period which, lasts two days. At the beginning of the first day of the maintenance period, each bank starts with an initial endowment of liquidity (i.e. deposits on accounts with the central bank). At the beginning of the second day, banks face a random and exogenous influx or drain of liquidity. The central bank requires each bank to hold a certain amount of liquidity on a so-called minimum reserve account with the central bank. The banks are allowed to average their reserve holdings with the central bank over the maintenance period. For example, if a bank has a reserve requirement of, say, 100 per day, it does not have to hold reserves of exactly 100 with the central bank every day. It may instead hold 50 on the first and 150 on the second day, or 120 on the first and 80 on the second day. This assumption is in line with the practice of all (major) central banks that impose reserve requirements on banks. On the last day of the maintenance period, banks can lend liquidity to the central bank's deposit facility, and can borrow liquidity from the central bank's marginal lending facility. The interest rate paid for lending to the deposit facility is called the deposit rate, and the rate for borrowing from the marginal lending facility is the marginal lending rate. Both facility rates are fixed by the central bank. The marginal lending rate is higher than the deposit rate. On both days of the maintenance period, banks can borrow liquidity from and lend liquidity to other banks. Thus, each bank that has less liquidity at its disposal at the beginning of the second day than remaining reserve requirements on that day must borrow liquidity either from the central bank's marginal

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<sup>1</sup> A detailed description of the European interbank market can be found in Hartmann et al. (2001).

<sup>2</sup> A complete description of the ECB's regulatory instruments related to the interbank market can be found in European Central Bank (2003).

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