

The Swedish market for balancing liquidity between the banks overnight 2007-2010

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This article uses transaction data from the Riksbank's payment system RIX to study the functionality of the overnight market and to determine whether monetary policy is being implemented efficiently. The study shows that, both before and during the crisis, the overnight rate for the banks varied within the band deemed by the Riksbank to represent efficiently implemented monetary policy. At the same time, the result shows that the deviation of the overnight rate from the repo rate and the level of volatility in the overnight rate have both increased since the outbreak of the financial crisis.

In addition, the study shows that the level of activity on the overnight market was low during the financial crisis. The level of activity did not increase until October 2010, when the Riksbank's last fixed-interest rate loan with a one-year maturity fell due. However, the banks' liquidity planning seems to have changed slightly after the crisis. For example, banks that previously systematically financed large deficits on the overnight market have done this to a significantly lesser degree since October 2010.

Introduction

To explain the determination of interest rates, from the repo rate to long-term market rates, it is important to understand how the markets for loans with short maturities function. It is particularly important to study the market that the Riksbank has the greatest ability to steer, which is to say the Swedish market for balancing liquidity between the banks overnight – the overnight market.

Long-term market rates are mainly determined by expectations of future overnight rates and the risk premiums associated with each maturity. An operational framework in which the overnight rate is stable and predictable thus contributes towards stabilising the development of long-term interest rates. So that the overnight rate may provide a stable anchor for the determination of interest rates with longer maturities, the Riksbank strives to hold the overnight rate stable and close to the repo rate. The indicator that the Riksbank currently uses to assess if monetary policy is being implemented efficiently specifies that the overnight rate should not deviate by more than 10 basis points above or below the repo

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rate. To monitor continuously how the overnight rate is developing in comparison with the repo rate thus forms an important part of an assessment of how efficiently the Riksbank is implementing monetary policy.

Even if a stable overnight rate forms an important precondition for the efficient implementation of monetary policy, it is not the only criterion. An equally important criterion is the influence of the overnight rate on interest rates with longer maturities. Frictions or limitations that prevent the overnight rate from being reflected in long-term interest rates may be a sign of inefficiency. However, this study focuses solely on the overnight market.

To assess the functionality of the overnight market and whether monetary policy is being implemented efficiently, it is however not enough to just study pricing. It is also important to study activity on the overnight market in terms of turnover and the number of transactions. Frictions in the overnight balancing of liquidity between banks should certainly be noticeable through their effect on the overnight rate, but this gives no information on what may lie behind them. By monitoring the level of activity and the banks' behaviour on the overnight market, the Riksbank can gain a better understanding of the distribution of liquidity among the banks. This will also provide the Riksbank with an understanding of the extent to which individual banks are motivated to adopt strategies that promote their own interests at the cost of impairing the functionality of the overnight market.¹

In this article, we use transaction data from the Riksbank's payment system RIX to assess the functionality of the overnight market and to map the overnight balancing of liquidity between the banks. We use the same data to establish measures of how efficiently monetary policy is being implemented by examining the extent to which the overnight rate on the market for balancing liquidity deviates from the repo rate. The Riksbank has not previously used transaction data in its current analysis and, consequently, a section of this article describes the data being used.²

This article has five sections. The first section includes a short description of the Swedish market for balancing liquidity overnight, that is to say the overnight market. Section two describes the statistics that form the basis of the study. The third section analyses the average overnight rate and its deviation from the repo rate. The fourth section includes an analysis of the microstructure of the Swedish overnight market. In this section we look at transaction volumes, turnover and the significance that the behaviour of the various participants has for the balancing of liquidity. Section five includes a concluding discussion.

1 Henckel et al. (1992) discuss the manner in which the mutual negotiating strength of the banks can influence the interest rates for overnight loans and the central bank's role in maintaining an efficient overnight market.

2 Eklund (2009) uses transaction data from the payment system RIX to analyse the Swedish overnight market. Particular focus is placed on contagion risks between the banks resulting from their mutual exposure in the form of overnight loans in Swedish kronor.

1. The market for balancing liquidity overnight and the Riksbank's policy rate

The market for balancing liquidity overnight – also known as the overnight market – is the market in which banks manage temporary surpluses and deficits in their liquidity in Swedish kronor. The need for an overnight market arises due to the payments in Swedish kronor handled by the banks every day, on their own behalf or on behalf of their customers. Payments in Swedish kronor between banks are made via transfers between their accounts in the Riksbank's payment system RIX. The Riksbank provides the means of payment in Swedish kronor and determines the conditions for deposits and borrowing by the banks in and from their accounts in RIX. This forms the core of the Riksbank's ability to steer the interest rate.³

The banks make forecasts of their payment flows and plan their liquidity over a longer period. However, as incoming and outgoing payments made during the day do not entirely match, there arises a surplus or deficit of liquidity that the banks must manage. During the day, those banks that are members of RIX may finance deficits through interest-free Swedish krona loans from the Riksbank, so called intra-day credit (under the condition that they provide eligible collateral). Before the payment system closes for the day, the banks' accounts in RIX must be balanced. This means that those banks having a liquidity deficit at the end of the day must somehow finance this deficit overnight. In turn, those banks with a liquidity surplus must deposit it. The banks can either even out their surplus or deficit between themselves on the overnight market via what are known as overnight loans, or they can deposit or borrow kronor from the Riksbank's standing facilities. Which of these two alternatives the banks choose depends on the relative costs of the alternatives.

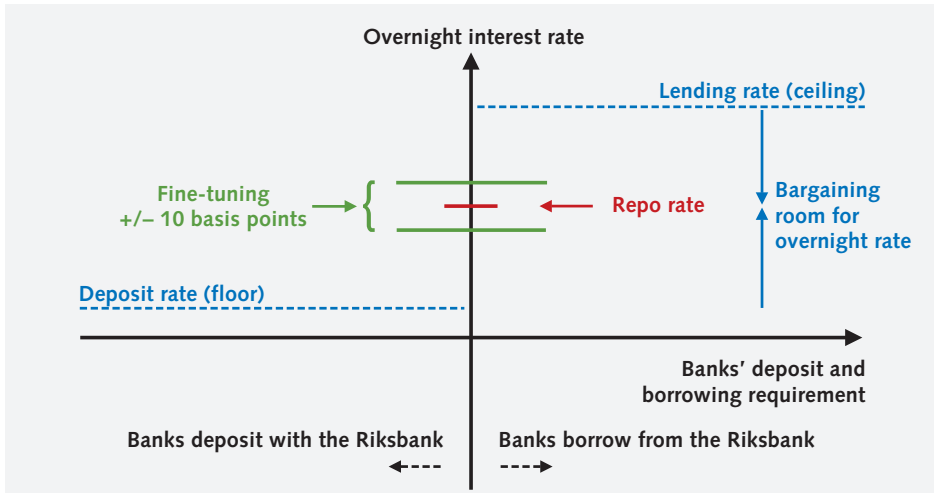
With the standing facilities the Riksbank provides an opportunity to deposit money overnight at a deposit rate corresponding to the repo rate minus 0.75 percentage points or to borrow money at a lending rate corresponding to the repo rate plus 0.75 percentage points. Banks that participate in RIX and that have agreed with the Riksbank to be monetary policy counterparties always have the possibility of borrowing or depositing liquidity overnight in the Riksbank's standing facilities. Thus, the banks never need to borrow on the overnight market at a rate above the Riksbank's lending rate or to lend on the overnight market at a rate below the Riksbank's deposit rate. In this manner, the Riksbank's deposit and lending rates create a corridor within which the overnight rate will lie.

As the Riksbank sets the rates for deposits and lending far apart in the standing facilities, the banks are encouraged to lend to and deposit with one another at an interest rate lying between the deposit and lending rates in the facilities (see Chart 1). The more precise level of the overnight rate is however a matter for negotiation between the banks on the overnight market. The difference between the deposit rate and the lending rate in the Riksbank's standing facilities, known as the interest rate corridor, is currently 150 basis

³ See Nessen et al. (2011) for a more detailed review of the Riksbank's operational framework.

points, divided symmetrically around the repo rate. This corridor can be seen as a trade-off between, on one side, a narrow corridor limiting fluctuations in the overnight interest rate and, on the other, a broad corridor motivating an active overnight market in which the banks have strong incentives to mutually even out their liquidity. Historically, the balancing of liquidity between the banks in RIX has taken place at the end of the day, with very limited use being made of the standing facilities.

Chart 1. The Riksbank's operational framework



During the financial crisis, the width of the interest rate corridor was reduced from 150 to 100 basis points as the Riksbank lowered the repo rate to 0.50 per cent in April 2009. The aim of this was to avoid having a negative deposit rate in the Riksbank's standing facilities. When the repo rate was lowered to 0.25 per cent in July 2009, the Riksbank deemed that a further narrowing of the interest rate corridor would weaken the banks' incentive to mutually even out their liquidity positions. The width of the corridor was thus held unchanged at 100 basis points. When the repo rate was raised to 0.50 per cent in July 2010, the corridor was widened to 150 basis points again. This is the historically normal width of the Riksbank's corridor, which has applied since the present operational framework was introduced in 1994. The Riksbank thus considered this widening as part of the normalisation of monetary policy.⁴

While the Riksbank's standing facilities certainly form an outer framework for the pricing of the overnight market, they are not sufficient to guarantee that the overnight rate will remain stable and close to the repo rate. If the banking system as a whole has a residual liquidity deficit vis-à-vis the Riksbank, and if the Riksbank then takes no action, the banking system will need to borrow from the Riksbank's lending facility. The interest rate on the overnight market will thus be close to the Riksbank's lending rate. Conversely, the overnight

4 See the supporting material for the repo rate decision published on 1 July 2010 http://www.riksbank.se/upload/Dokument_riksbank/Kat_publicerat/Pressmeddelanden/2010/nr30_beslutsunderlag.pdf.

rate will be close to the Riksbank's deposit rate if the banking system as a whole has a liquidity surplus. Consequently, in order to stabilise the overnight rate, the Riksbank tries to ensure that the banking system as a whole is always in balance towards the Riksbank.

In order to be able to regulate the balance of the banking system, the Riksbank makes current forecasts of the banking system's liquidity requirements over the coming week. If the banking system (as at present) has a structural surplus of liquidity towards the Riksbank, the Riksbank sells certificates to the banks to draw in this surplus liquidity. Previously, when the banking system had a liquidity deficit, the Riksbank instead carried out monetary policy repos to provide the banking system with the liquidity it needed. Both Riksbank certificates and the monetary policy repos have maturities of seven days and are implemented at a fixed interest rate corresponding with the repo rate.

The Riksbank's forecast of the banking system's liquidity requirements reflects the liquidity requirement for one week, but the banking system's actual daily liquidity position towards the Riksbank can vary from day to day. This can be due to daily variations in the banks' liquidity or to errors in the Riksbank's forecast. Furthermore, the banks can choose not to purchase Riksbank certificates or not to borrow via the monetary policy repos for a week, resulting in the banking system becoming unbalanced in relation to the Riksbank on a daily basis. The Riksbank meets any deficit or a surplus of liquidity in the banking system towards the Riksbank on any particular day through what are known as its fine-tuning operations.

In the fine-tuning operations, deposits and lending take place at an interest rate 10 basis points below or above the repo rate, respectively. The aim of these operations is to prevent variations arising in the overnight rate as a result of the deviation, on certain days, of the banking system's borrowing requirement from the Riksbank's forecast. The forecast is used as a basis by the Riksbank for its weekly repo transactions and certificate issues which the banking system is assumed to mainly use to cover its structural liquidity deficit or surplus with the Riksbank. Up to October 2008, only the Riksbank's primary monetary policy counterparties were allowed to participate in the fine-tuning operations. However, during the financial crisis, the group of banks allowed to participate was widened to include all monetary policy counterparties.⁵

In addition to a number of commercial banks, the Swedish National Debt Office also participates on the overnight market. Unlike in a number of other countries, the Swedish National Debt Office turns to the banks, rather than the central bank, to manage its daily liquidity. The Swedish National Debt Office thus acts on the overnight market under the same conditions as the banks, with the difference that it may only deposit in the Riksbank's standing facilities, and then at an interest rate of 0 per cent. The Swedish National Debt Office does not have the right to borrow from the Riksbank, as this could be considered to be monetary financing of the central government debt. This means that the Swedish

⁵ A primary monetary policy counterparty is a credit institution that participates in RIX. They are allowed to participate in the Riksbank's repos and to purchase Riksbank certificates, and have access to the Riksbank's credit facilities.

National Debt Office's balance in the RIX system, that is whether the Swedish National Debt Office has a lending or deposit requirement, does not affect the Riksbank's position towards the banking system.

2. Overnight data

The analysis in this article is based on transaction data from the Riksbank's payment system RIX dating from October 2007 to the end of December 2010. The analysis thus covers both the financial crisis of 2008 and 2009 as well as part of the period before the crisis. It also covers a brief period after the crisis, when the Riksbank had withdrawn the extraordinary measures adopted during the crisis, as well as when the last of the three extraordinary monetary policy fixed-rate loans with maturities of one year had matured (6 October 2010).

The average interest rate on the Swedish overnight market has been calculated using the payments in the RIX system which are registered as overnight loans, and which also have an overnight maturity – that is where a repayment of the loan is registered for the following business day and is not a transaction with the Riksbank. Whether transactions with the Swedish National Debt Office should be included in the analysis depends on which question is to be answered. If the aim is to study how efficiently monetary policy is being implemented, the Swedish National Debt Office should be included, as transactions with the Swedish National Debt Office affect the average interest rate, which forms the basis for the determination of longer-term interest rates. If, on the other hand, the aim is to study how well the overnight interbank market functions, the Swedish National Debt Office should not be included. The reason for this is that lending to the Swedish National Debt Office can be considered to be a risk-free overnight investment for the commercial banks. Consequently, transactions with the Swedish National Debt Office have been included in the analysis of the overnight rate in section 3. However, in the analysis of activity on the overnight market in section 4, the emphasis lies on transactions exclusively between the commercial banks.

In this article, particular emphasis has been placed on the analysis of how the functioning and structure of the bank's overnight balancing of liquidity changed during the financial crisis and what the consequences of this may have been for the implementation of monetary policy. Consequently, in the study, the collected transaction data has been divided into four periods:

- *Period 1:* The period prior to the collapse of the investment bank Lehman Brothers, from 5 October 2007 until and including 14 September 2008.
- *Period 2:* The period from the collapse of Lehman Brothers until the Riksbank started to issue loans in foreign currency and Swedish kronor for longer maturities, 15 September until and including 1 October 2008.
- *Period 3:* The period of the crisis during which the Riksbank's lending in foreign currency and Swedish kronor is in place, 2 October 2008 until and including 6 October 2010.

- *Period 4:* The period after the withdrawal of the extraordinary measures adopted during the crisis and the maturity of the final fixed-interest rate loan with a maturity of one year, 7 October 2010 until 31 of December 2010.

SCOPE AND RELEVANCE

The transactions included in the analysis correspond with the transactions made by the banks in the overnight market to even out any deficit or surplus of Swedish kronor arising in their accounts in the payment system RIX. These transactions are standardised deposit contracts in which the loans are made without collateral. The banks also make overnight transactions in the form of repos⁶ and swaps⁷. Data reported directly by the banks to the Riksbank indicates that the overnight market in Swedish kronor for repos and swaps is not unimportant in extent and that its pricing may differ from that on the overnight deposit market. However, overnight transactions in the form of repos and swaps are not captured by the statistics.

At the same time, the analysis only includes overnight transactions made between banks that are members in RIX. However, outside RIX there exist a number of banks that balance their liquidity by taking overnight loans with their correspondent banks, who are members of RIX. These transactions and the interest rate payments they generate are not directly captured by the data in the RIX system. On the other hand, the transactions are captured indirectly by the analysis, as they affect the correspondent banks' net balances and thus the correspondent banks' overnight loan requirements.

Transactions are registered one by one in the RIX system as they are carried out. The banks themselves classify which transactions are to be defined as overnight loans on the basis of certain criteria. For each separate loan, the following information exists:

- the amount of the loan, in Swedish kronor
- the amount of the repayment, in Swedish kronor
- the names of the transaction's parties
- the time of the transaction (applicable from the start of October 2009).

The calculation of the average overnight rate is based on almost 5 700 transactions between banks, and between banks and the Swedish National Debt Office during the period 5 October 2007-31 December 2010. Tables 1 and 2 present descriptive statistics for the underlying transactions.

6 *Repo:* A financial instrument resembling a loan. The seller in the transaction transfers a security to the purchaser in the transaction. At the same time, the seller commits to buy the security back from the purchaser at a given point in time for a price determined in advance. (The term is a shortened form of *repurchase agreement*.)

7 *Swap:* A bilateral agreement to exchange a specific currency or interest rate in return for another currency or interest rate for a predetermined period, according to specific conditions.

Table 1. Turnover in Swedish kronor on the overnight market, daily average

	PERIOD 1 2007-10-05– 2008-09-14	PERIOD 2 2008-09-15– 2008-10-01	PERIOD 3 2008-10-02– 2010-10-06	PERIOD 4 2010-10-07– 2010-12-31	PERIOD 1-4 2007-10-05– 2010-12-31
SEK billion					
Total overnight loans	45.2	45.8	15.1	25.3	25.1
<i>between commercial banks</i>	39.3	40.1	5.7	10.1	16.3
<i>with the Swedish National Debt Office</i>	5.9	5.7	9.3	16.1	8.8
Riksbank's fine-tuning operations	0.3	0.2	109.5	11.4	68.8

Table 2. Number of transactions on the overnight market, daily average

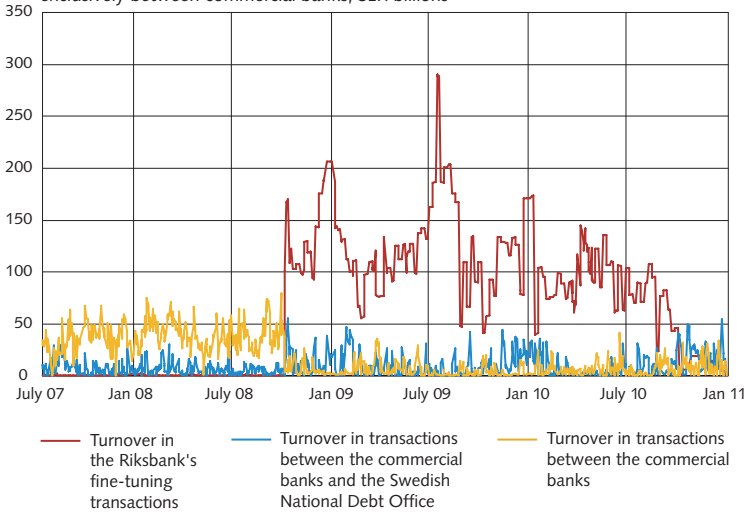
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Number of transactions					
Total overnight loans	12.5	12.7	4.1	9.7	7.0
<i>between commercial banks</i>	11.3	11.6	2.7	5.5	5.5
<i>with the Swedish National Debt Office</i>	1.2	1.1	1.4	4.2	1.5
Riksbank's fine-tuning operations	0.7	0.6	8.2	4.1	5.6

From the tables, it can be seen that turnover and the number of transactions, both total and between commercial banks, decreased considerably during the period (see also Figure 1). The major change took place when the Riksbank implemented its first measures to strengthen liquidity during the crisis. The consequence of these measures was that the banking system as a whole, including all banks in the RIX system, received a liquidity surplus in relation to the Riksbank. Both the number of transactions between commercial banks and the value of these decreased to an average of one-third of the number and value prior to the crisis, as well as prior to the Riksbank's introduction of these measures.

With the discontinuation of the extraordinary measures and the maturation of the Riksbank's fixed-interest rate loans with maturities of one year, a large portion of the extra liquidity that existed in the banking system has been withdrawn. This has led the level of turnover and number of transactions on the overnight market to approach the pre-crisis levels. However, even after all of the extraordinary loans had matured, liquidity in the banking system vis-à-vis the Riksbank remains higher than it was before the crisis and at a surplus. The Riksbank is therefore offering Riksbank certificates with maturities of one week. However, the banking system seems to have preferred to deposit its surplus in the Riksbank's fine-tuning operations. This has reduced the banks' need to borrow from other banks overnight to even out the liquidity deficit in the payment system at the end of the day. By period four, the sum of the number of overnight loans and the Riksbank's fine-tuning operations, as well as the total turnover of these, have returned to the pre-crisis levels.

Figure 1. Turnover in Swedish kronor on the overnight market, July 2007-December 2010

Transactions with the Riksbank and Swedish National Debt Office, and transactions exclusively between commercial banks, SEK billions



3. Overnight rate

In this article, the overnight rate has been calculated as the difference between the value of the overnight loan and its repayment, divided by the value of the loan.⁸ To make overnight rates comparable over time, the difference – known as the spread – between the observed overnight rate and the current repo rate has been calculated so that:

$$r_{i,t} = \frac{V_{i,t+1} - V_{i,t}}{V_{i,t}} * 360, \text{ where } r_t \text{ is the interest rate calculated for each transaction, } V_t \text{ is the}$$

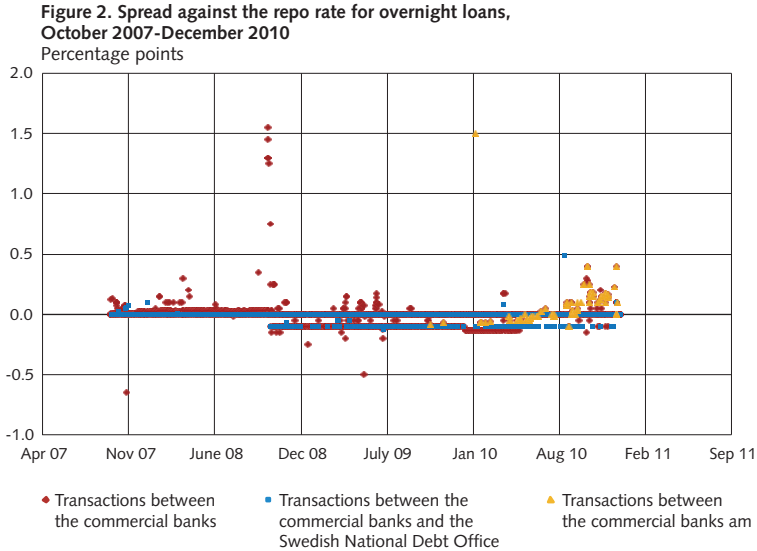
amount of the loan i expressed in Swedish kronor and V_{t+1} is the amount of the repayment.

$$spread_{i,t} = r_{i,t} - repo_t$$

The average overnight rate for a certain day has been calculated partly as the volume-weighted average of each day's overnight rates, and partly as the arithmetical mean value. Both methods lead to the same conclusions. However, when the average interest rate is calculated as the arithmetical mean value, all overnight loans receive the same weight in the calculation. The consequence of this is that outliers have a very strong influence on the calculated overnight rate. When the overnight rate is calculated as the volume-weighted mean value, the impact of the outliers is reduced – as long as these cases concern small

8 Neither the interest rate nor the contractual maturity of the loans is specified in the data that the analysis is based upon. By matching loans and repayments between the same counterparties and of about the same amount, but with the opposite direction of flow, on the following business day, the (implied) overnight rate can be calculated.

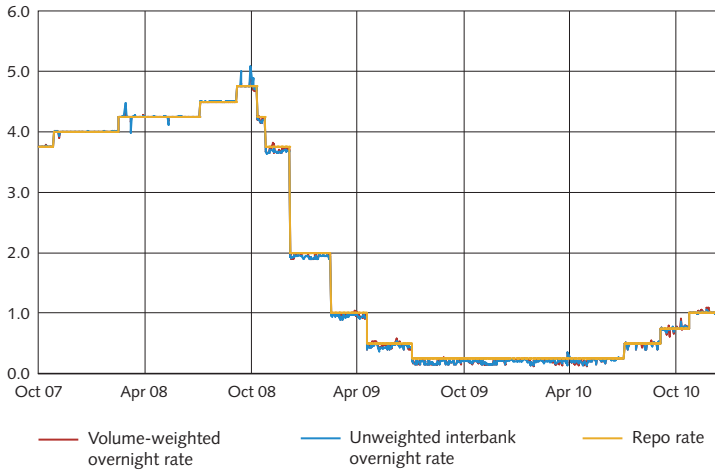
overnight loans. The volume-weighted average is preferable because it does not require an evaluation of which outliers are to be included in the calculations, as these represent the correct values. Neither does it require an evaluation of which outliers are to be excluded on the grounds that they are incorrect. Figure 2 shows the spread against the repo rate of overnight loans during the period.



Note. Transactions *between commercial banks and* refers to loans between commercial banks that the banks have classified as overnight loans, with time to maturity of the next business day, but which were registered before 12.00.

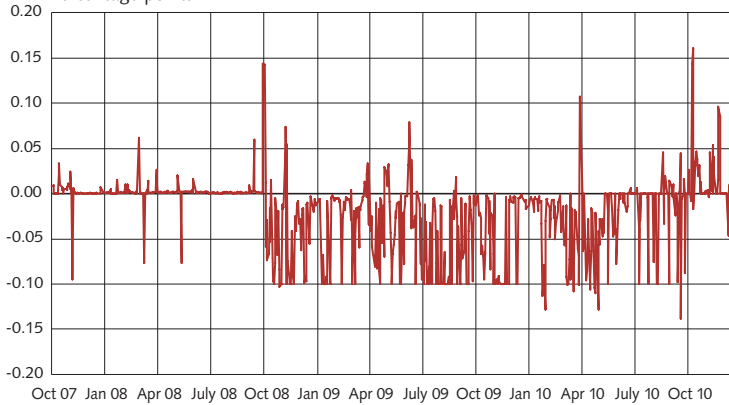
The calculation of the effective overnight rate as the volume-weighted average interest rate shows that the overnight rate lay relatively close to the repo rate over the entire period. Even so, the deviations – the spreads – against the repo rate increased slightly after the Riksbank introduced its liquidity-strengthening measures (see Figures 3 and 4). Before the crisis (period 1), the average overnight rate deviated from the repo rate by an average of 0.002 percentage points. After the introduction of the liquidity-strengthening measures (period 3), the deviation was -0.034 percentage points. After these measures were withdrawn, it became 0.016 percentage points (see Table 3).

Figure 3. Average overnight rate, unweighted and volume-weighted
Per cent



Note. The calculations include transactions between commercial banks, and between commercial banks and the Swedish National Debt Office.

Figure 4. Deviation from the repo rate of the average overnight rate, volume-weighted
Percentage points



Note. The calculations include transactions between commercial banks, and between commercial banks and the Swedish National Debt Office.

Table 3. Average repo rate and overnight rate in periods 1-4, with descriptive statistics for the deviation between the repo rate and the volume-weighted overnight rate

	PERIOD 1 2007-10-05– 2008-09-14	PERIOD 2 2008-09-15– 2008-10-01	PERIOD 3 2008-10-02– 2010-10-06	PERIOD 4 2010-10-07– 2010-12-31	PERIOD 1-4 2007-10-05– 2010-12-31
Repo rate, average (per cent)	4.19	4.75	0.90	0.93	1.92
Spread to repo rate, average <i>unweighted overnight rate</i> (percentage points)	0.003	0.024	-0.045	0.009	-0.026
<i>volume-weighted overnight rate</i> (percentage points)	0.002	0.006	-0.034	0.016	-0.019
Spread to repo rate (percentage points)					
<i>Average</i>	0.002	0.006	-0.034	0.016	-0.019
<i>Max</i>	0.06	0.06	0.14	0.16	0.16
<i>Min</i>	-0.10	0.00	-0.14	-0.05	-0.14
<i>Standard deviation</i>	0.01	0.02	0.04	0.04	0.04

Note. Includes transactions with the Swedish National Debt Office. If the calculations of the overnight rate are solely based on loans between the commercial banks, the deviation of the overnight rate from the repo rate is larger than it is if all loans are considered, i.e. including loans between the commercial banks and the Swedish National Debt Office. This was the case both before the crisis and after the crisis broke out. Moreover, this difference increased after the crisis broke out.

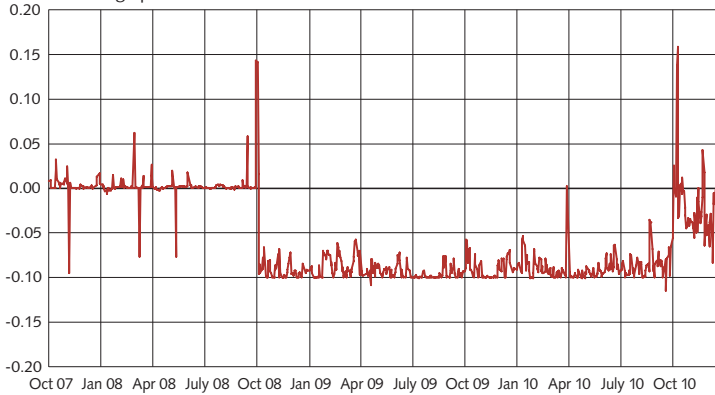
Before the crisis, the overnight rate thus only deviated marginally from the repo rate and its variance was small. This corresponds well with the idea of a gentlemen’s agreement on the Swedish overnight market under which the banks even out their liquidity at the repo rate – without any spread. Such an agreement would be based on the banks’ understanding that the level of credit risk in overnight lending is very low and that the administrative costs of adjusting the pricing of overnight loans to whichever bank may be counterparty in the transaction would be so high as to be unprofitable. However, such an agreement can only work under the conditions that the banks use the overnight market for the same intentions and that no bank exploits it for its own gain. Despite this, the fact that a small number of transactions every day deviate from the repo rate indicates that not all banks are party to the agreement.

Furthermore, that there is a negative average spread during period 3 (when the Riksbank’s measures were in place) is a consequence of the surplus liquidity held by all banks during that period. They were able to fine-tune this liquidity with the Riksbank at the end of the day at an interest rate of 10 basis points below the repo rate. This meant that, due to its extraordinary lending, the Riksbank acted as intermediary on the overnight market during the crisis, which reduced the banks’ need to mutually balance their liquidity positions.

During period 3, most banks thus only balanced their liquidity in Swedish kronor with the Riksbank in the fine-tuning operations. It can thereby be argued that the fine-tuning rate during this period was the banks’ alternative cost for transactions with the shortest

maturity and that the fine-tuning rate should thus also be included when calculating the average overnight rate. With such a weighting, the average overnight rate is closer to (and more stable around) the fine-tuning rate, 10 basis points below the repo rate (see Figure 5). At the same time, it would not have been necessary to carry out any fine-tuning if the banks had chosen to deposit the “extra” liquidity in Riksbank certificates.

Figure 5. Deviation from repo rate of the average interest rate in overnight loans and fine-tuning transactions with the Riksbank, volume-weighted
Percentage points



Note. The calculations include transactions between commercial banks, and between commercial banks and the Swedish National Debt Office.

While the average spread was certainly lower during the period October-December 2010 than it was during the crisis, it was still higher than it was before the crisis. One contributory factor for this can be the uncertainty that arose in conjunction with the maturity of the third and final of the Riksbank’s one-year fixed-interest rate loans. The maturity of the loan led the surplus liquidity in the banking system to largely disappear. With this, the banks were forced to balance their daily deficits and surpluses in liquidity with each other – as they had done before the crisis. This uncertainty remained for a few days. In Figure 2, the event can be seen in the form of the greater number of overnight loans made in the morning. In Figure 5, the event can be seen in the form of the increase of the spread of early overnight loans and other overnight loans at the start of October 2010.

It is worth noting that both the number of overnight loans and the total value of these transactions have decreased considerably since the Riksbank introduced its liquidity-strengthening measures. Consequently, the fact that the spread on the overnight market has not increased to any greater extent may be a consequence of the reduction of the number of transactions. The extra liquidity supplied to the banking system by the Riksbank has allowed the banks to execute their payments without having to risk a liquidity deficit that may force them to borrow from another bank at the end of the day. As the majority of the banks have chosen not to deposit their extra liquidity in Riksbank certificates, but have retained the liquidity supplied as a reserve to be deposited overnight in the fine-

tuning with the Riksbank, there has been no incentive for the banks to borrow from each another on the overnight market. However, it is a fact that the banks chose to accept the cost of retaining this liquidity as an immediately available reserve in the form of overnight deposits in fine-tuning, instead of investing it in Riksbank certificates. Consequently, one interpretation of the result is that the banks have not considered any increased risk by charging more for overnight loans, but, instead, have entirely refrained from executing these transactions when uncertainty has been considered to be too high.

THE VOLATILITY OF THE OVERNIGHT RATE

The indicator used by the Riksbank says that the overnight rate should not deviate by more than 10 basis points above or below the repo rate, so that monetary policy can be considered to have been efficiently implemented. The degree of compliance with this is captured by the deviation between the estimated average overnight rate and the repo rate. Parallel to this measure, the variance (also known as volatility) of the pricing of overnight loans also provides information on the efficiency of the overnight market. A high variance or volatility reflects a wide differentiation regarding the pricing of lending to different counterparties. The differentiation of pricing may reflect the risk associated with lending to different counterparties or a general uncertainty on the markets, but it may also reflect the negotiating strength of different banks in the pricing of overnight loans. However, an efficiently implemented monetary policy in which the overnight rate does not deviate by more than 10 basis points above or below the repo rate should be associated with low volatility.

The volatility of the overnight rate can be measured in various ways. In this article, the standard deviation of the effective overnight rate per day has been calculated as follows:

$$\text{std} = \sqrt{\sum_{i=1}^N (w_i \cdot x_i - \mu^*)^2}$$

x_i is the spread against the repo rate for an individual transaction i , μ^* is the volume-weighted mean value of the spread on the day in question and w_i is the amount of each transaction as a proportion of the total transaction value on the day that the transaction was executed, so that:

$$1 = \sum_{i=1}^N w_i$$

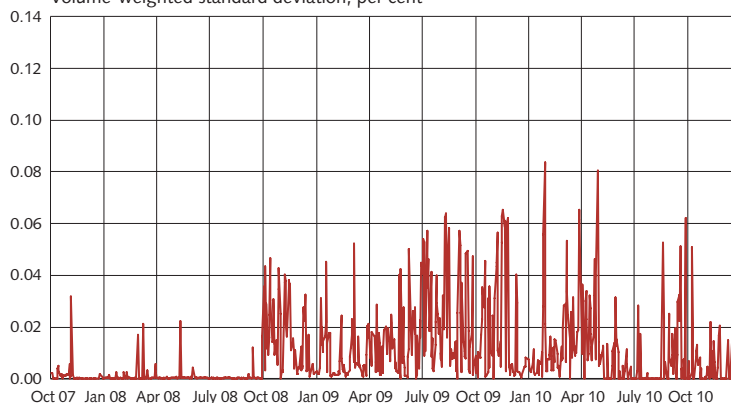
The result indicates that the volatility of the average overnight rate has increased since the financial crisis broke out (see Figure 6). However, the volatility of the overnight rate over the entire period must be considered to be low. During the period from the collapse of Lehman Brothers until the Riksbank introduced its liquidity-strengthening measures, the volatility of the average overnight rate did not increase more than marginally. Instead, the result indicates that the volatility of the overnight rate increased after the Riksbank introduced its measures.

Seen over the entire period, volatility was highest during the last six months of 2009, during a period in the spring of 2010 and during a few days in October 2010. To a certain extent, this higher volatility is probably due to the significantly lesser number of transactions taking place during these periods, compared with before the crisis. This means that a divergent interest rate in one transaction has a greater impact on the average overnight rate and in the estimated volatility.

Nevertheless, the higher level of volatility in the overnight rate coincides with periods during which uncertainty on the financial markets abroad or in Sweden was increasing. For example, the increased volatility in the spring of 2010 coincided with the increased uncertainty over Greece’s fiscal problems. The increased volatility in October 2010 coincided, in turn, with the maturity of the Riksbank’s third and final fixed-interest rate loan with a maturity of one year. These periods also saw an increase in interest rates and the level of volatility in interest rates with other maturities. Foremost, this was true for the *tomorrow next rate*, which is to say the interest rate applicable to loans with maturities lasting from tomorrow until the day after that.⁹ Following these periods of high volatility, and after October 2010, volatility decreased again.

One interpretation of this result is that increased uncertainty on the financial markets in general is also reflected in overnight rates. Furthermore, the statistics indicate that, in conjunction with the maturity of the Riksbank’s final fixed-interest rate loan, the banks have needed a period to adjust to a more “normal” level of liquidity on the overnight market, which has led to increased uncertainty and friction on the market.

Figure 6. Volatility of overnight rates per day, October 2007-December 2010
Volume-weighted standard deviation, per cent



Volatility increases slightly when transactions with the Swedish National Debt Office are excluded from the calculations. Consequently, the presence of the Swedish National Debt Office on the overnight market seems to have a certain stabilising effect on the overnight rate. As the commercial banks can regard lending to the Swedish National Debt Office as

⁹ The Riksbank is presently conducting a study of the tomorrow next market.

a risk-free investment, the Swedish National Debt Office's overnight borrowing from the commercial banks forms a complement to the Riksbank's standing facilities and fine-tuning.

4. Turnover and borrowing behaviour on the overnight market

TURNOVER AND VOLUME

During the period October 2007-October 2008, before the financial crisis, the average value of overnight loans amounted to SEK 45 billion per day. The average number of transactions per day was 12.5 (see Tables 1 and 2 in section 2). As turnover on the overnight market is related to turnover in the payment system in general, there exist certain seasonal variations in turnover on the overnight market – for example, turnover is lower during the summer months than during the rest of the year. Before the crisis, the Riksbank's transactions only answered for a lesser part of the turnover. During the period October 2007-October 2008, these amounted to an average of SEK 100-500 million per day. The transactions with the Riksbank are almost exclusively fine-tuning transactions. During the same period, the Swedish National Debt Office's transactions with the banks amounted to SEK 3-14 billion per day (on average, SEK 6 billion per day), corresponding to about 15 per cent of the total daily turnover. Even though unease on the financial markets was evident at the end of September 2008, due to the problems faced by the US investment bank Lehman Brothers, there was no sign of a decreased number of transactions or of decreased turnover in the Riksbank's overnight data during this period.

However, as was previously mentioned, in October 2008, the Riksbank adopted liquidity-strengthening measures, including offering loans in addition to the ordinary repos. A part of this extra lending was recovered by the Riksbank via the issuance of certificates, but the banks chose to retain the largest part of the extra lending as extra liquidity, depositing it in the Riksbank overnight. This led to the banking system as a whole receiving a comparatively large liquidity surplus with the Riksbank. Furthermore, at the end of the day, each individual bank usually had a surplus on its account in RIX. As most banks had a deposit requirement, surpluses could not be deposited with other banks. This resulted in a decrease in turnover among the banks on the overnight market, both as a proportion of total turnover on the overnight market and in absolute terms.

During the period October 2008-October 2010, turnover in overnight loans amounted to an average of about SEK 15 billion per day, just less than a third of the level of overnight loan turnover before the crisis. At the same time, the Swedish National Debt Office's share of overnight loans increased. Turnover in overnight loans between the commercial banks decreased during the period to about one-sixth of the pre-crisis level, from about SEK 39 billion per day to just less than SEK 6 billion per day. Calculated as the number of overnight loans, the total number of these decreased during the period from an average of 12.5 to 4 per day. As regards loans exclusively between commercial banks, these decreased from 11 to 2.5 (see Tables 1 and 2).

Over the end of 2009 and the start of 2010, the number of transactions and turnover on the overnight market both continued to be low. However, as from October 2010, turnover has increased again. As the total liquidity in the banking system towards the Riksbank is higher than it was before the crisis (when the banking system had a deficit towards the Riksbank), the banks' need for balancing of their liquidity positions among each other is lesser. However, compared with the period preceding the financial crisis, turnover on the overnight market continues to be lower.

BORROWING BEHAVIOUR – ACTIVITY AND NET BORROWING

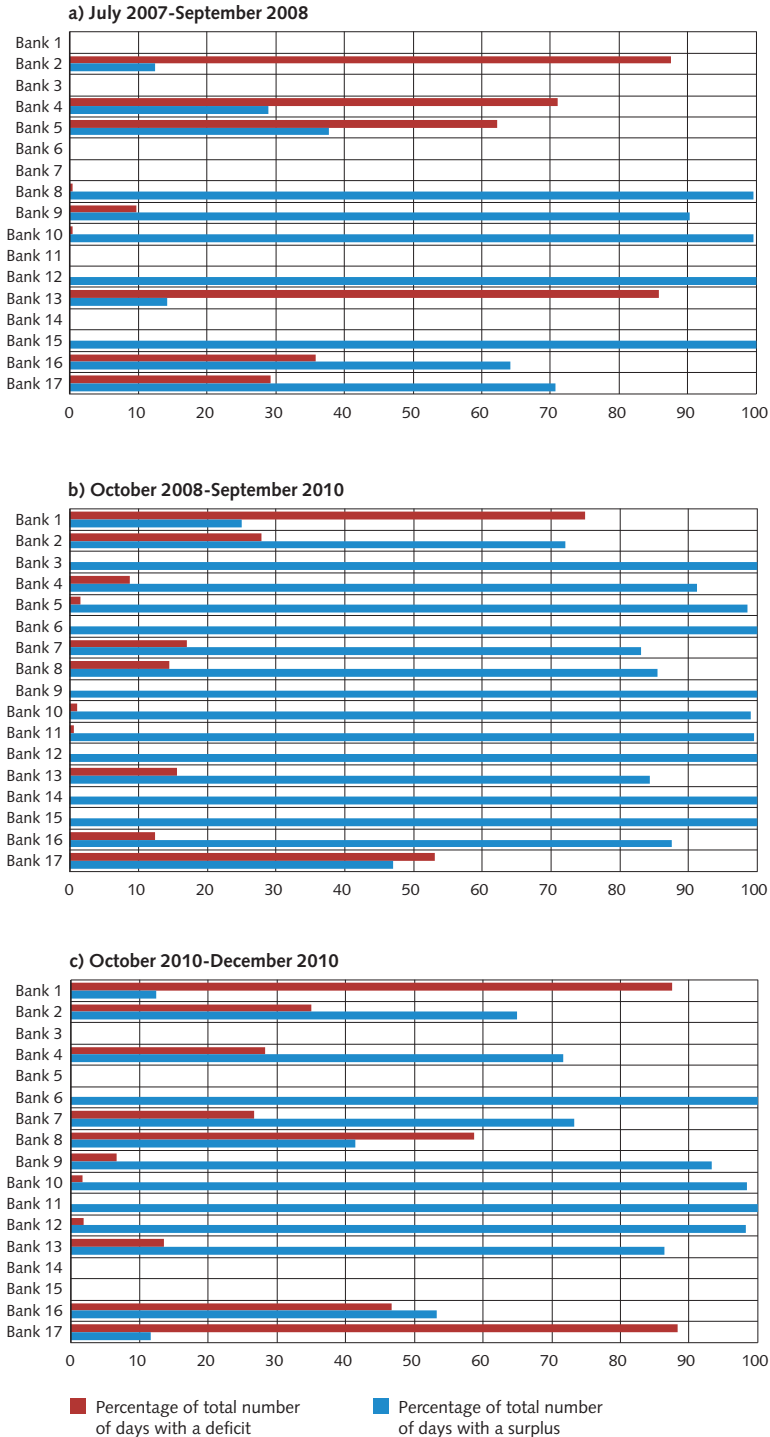
Before the financial crisis, until October 2008, there were clear differences between the banks in their borrowing behaviour on the overnight market. Many banks seem, to a very great extent, to have had a strategy of either systematically borrowing or systematically depositing liquidity overnight. Typically, those banks depositing on the overnight market were smaller banks. Also among the larger banks, there were banks which deposited liquidity on the majority of days, but this behaviour is not as clear-cut as among the smaller banks (see Figure 7a-c).

Three of the larger banks borrowed significantly more frequently than they deposited, indicating that their strategy was to fund part of their liquidity requirement in Swedish kronor on the overnight market. At the same time, the larger banks often both borrowed and deposited liquidity overnight on the same day. One possible explanation for this is that the banks' own restrictions on their exposure towards individual counterparties – counterparty limits – confine their ability to even out their entire balance with a single counterparty. Consequently, on certain days, they have been forced to resort to another bank to intermediate in the transactions in order to balance their borrowing or deposit requirements. However, this seems to have worked well, on the whole – without any bank being forced to use the Riksbank's standing facility.

During the crisis, participation on the overnight market decreased, as did the value of the transactions being executed. Banks that had previously almost exclusively been borrowers on the overnight market borrowed significantly less frequently during the financial crisis. This is probably a result of the major liquidity surplus existing in the banking system as a whole. This resulted in a reduction of the banks' incentive to balance their liquidity position with the other banks – on most days, the banks had no need to borrow from other banks and could frequently fine-tune their entire deficits directly with the Riksbank.

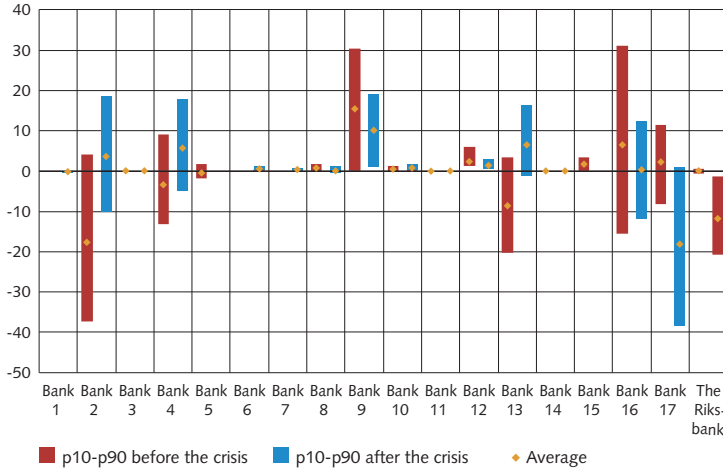
As activity on the overnight market increased after October 2010, it has been possible to observe changes in the banks' behaviour on the overnight market. The distinct borrowing or depositing behaviour shown by the banks before the crisis can no longer be observed to the same extent. Above all, the three major banks that consistently funded deficits on the overnight market seem to have changed strategy. Since October 2010, they have run liquidity surpluses more often than deficits (see Figure 7c). Also, the amount of the banks' balances on the days that they have had a deficit on the overnight market has been smaller during the period October-December 2010 than it was before the crisis (see Figure 8).

Figure 7. Borrowing behaviour, proportion of days that the banks borrow or deposit money overnight
 Percentage of total number of days that the bank participates on the overnight market



The return to balancing liquidity between the banks has thus entailed a certain change in the structure of the Swedish overnight market. As the change in the banks' behaviour is so clear, there is reason to believe that this is something that has been consciously implemented by the banks. Apart from the larger liquidity surplus towards the Riksbank held by the banking system as a whole (compared with before the crisis), it is also likely that the seemingly increased liquidity deficit held by the Swedish National Debt Office has contributed towards facilitating a change in the banks' behaviour.

Figure 8. Average and variance of the banks' liquidity position in Swedish kronor balanced overnight, before and after the crisis
SEK billion



Note. The red and blue bars show the spread between the total amounts deposited (+) and borrowed by each bank (-) on average per day on the overnight market, before (red bars) and after (blue bars) the crisis. The upper edges of the bars represent the 90th percentile and the lower edges represent the 10th percentile of each period. The yellow rhombus marks the average value of each period, i.e. the bank's average overnight borrowing or deposit. These calculations include transactions with the Swedish National Debt Office and fine-tuning with the Riksbank. 'Before the crisis' refers to the period July 2007- September 2008. 'after the crisis' refers to the period October 2010-December 2010.

COUNTERPARTY PATTERNS

Before the financial crisis, transactions on the overnight market were largely made between the same counterparties every day. In other words, each bank had one or two banks with which it mostly conducted its overnight loans. This was partly a consequence of the fact that most banks almost always deposited funds overnight at the same time as a few almost always borrowed, which normally meant that there were very few counterparties to choose from when making deposits. In the few transactions conducted during the crisis, until October 2010, the counterparty patterns were approximately the same as they were before the crisis in the sense that the banks mostly turned to the same counterparties as previously. However, as almost all banks made fewer transactions during this period, this also resulted in each bank having fewer counterparties. In addition, data for this period indicates that above all one major bank had become a more important counterparty for

more banks, while the other major banks considerably decreased their activities on the market, in certain cases completely refraining from making transactions with other banks.

Between October 2010 and December 2010, the counterparty patterns observed were also unchanged compared with before the crisis. The banks largely use the same counterparties as before the crisis and, as a rule, also balanced with about the same number of counterparties each day as before (one to three). The possible counterparties that each individual bank may turn to at the end of the day has been affected, to some extent, by the appearance and disappearance of banks in the group of banks on the overnight market, as well as by changes in the behaviour of certain banks. However, this has not led to any clear structural changes.

One change worth noting, which primarily occurred in the autumn of 2010, is the tendency for more overnight loans to be taken out during the morning, occasionally before the markets open for the day (see Figure 2). One possible explanation could be that uncertainty related to the crisis has made the banks more cautious, with the result that they want to secure their liquidity requirements in the mornings when they expect there to be large outflows of liquidity and the risk of facing a large deficit at the end of the day. If so, the interpretation of this is that certain banks have chosen to act early in the day so as to avoid the risk of finding themselves in a tight spot just before the market closes. This may also have affected the choice of counterparty and may also provide an explanation for the changed borrowing behaviour of certain banks.

5. Concluding remarks

Using transaction data from the Riksbank's payment system RIX, it is possible to follow, on an ongoing basis, the pricing and activity levels on the overnight market for loans between the banks. This contributes to improving the Riksbank's perception of how efficiently monetary policy is being implemented. The study shows that, for the period October 2007-December 2010, the average interest rate on the overnight market varied within the band deemed by the Riksbank to represent efficiently implemented monetary policy. Nevertheless, both the deviation of the overnight rate from the repo rate and the level of volatility of the overnight rate have increased since the financial crisis broke out. This indicates that the pricing of overnight loans has been affected, to a greater extent than previously, by the uncertainty prevailing on the financial markets in both Sweden and globally. This may be due to increased uncertainty abroad, to the greater adjustment to prevailing factors of the pricing of overnight loans by the banks, or to a combination of these.

With the adoption of liquidity-strengthening measures by the Riksbank in October 2008, the overnight market changed. As a result, the banking system's liquidity position towards the Riksbank turned to a large surplus, which led to almost all banks being able to retain a surplus in the RIX system during the day. In addition, the need for end-of-the-day balancing with other banks decreased, as did the opportunities for this. Activity

on the overnight market decreased markedly during the crisis, in terms of both turnover volumes and the number of transactions for overnight loans. During the period October 2008-October 2010, turnover in overnight loans between commercial banks decreased to about one sixth of its pre-crisis level, while, at the same time, the number of overnight loans decreased to about one quarter.

During late 2009 and early 2010, the number of transactions and level of turnover on the overnight market continued to be lower than before the crisis. However, as from October 2010, turnover in transactions between commercial banks has increased again. As the total liquidity of the banking system towards the Riksbank is higher than it was before the crisis (when the banking system had a deficit towards the Riksbank), the banks' need for mutual balancing has, in some sense, decreased – some of the banks with a surplus can always deposit, at least part of it, in the Riksbank's fine-tuning operations. However, compared with before the financial crisis, turnover on the overnight market continues to be lower.

At the same time, the statistics indicate that the banks have changed their behaviour to a certain extent, as compared with before the crisis. Firstly, there are signs that, since October 2010, the banks have abandoned the borrowing or deposit strategies that were observed before the crisis, and that the amount of the banks' net balances was generally smaller during the period October-December 2010 than it was before the crisis. Secondly, there are certain indications that the banks more frequently than before act earlier in the day – taking out overnight loans during the morning, so as to avoid the risk of finding themselves in a difficult situation just before the market closes. One possible explanation to the observed changed behaviour is that uncertainty connected with the crisis has made the banks more cautious.

So far, the overnight rate has remained within the accepted band of 10 basis points above or below the repo rate, which indicates that monetary policy has been efficiently implemented. However, for monetary policy to be considered efficient, the way that the overnight rate is reflected in interest rates with longer maturities is equally important as having an overnight rate that is stable and close to the repo rate. One condition for the Riksbank to be able to affect longer-term market interest rates in a predictable manner is that the banks can expect to borrow or deposit the surpluses and deficits arising over the day on the overnight market at an interest rate close to the repo rate. During the financial crisis, turnover on the overnight market decreased. This indicates that any uncertainty on the interbank markets has reduced activity, rather than affected pricing. Narrow limits or other restrictions affect the banks' ability to utilise the overnight market for managing their liquidity. In turn, this has repercussions on the setting of interest rates for markets with longer durations and contributes towards reducing the efficiency of a monetary policy that is focused on steering the overnight rate. At the same time, restrictions such as, for example, limits between the banks can contribute to more disciplined liquidity management, which is positive from the perspective of financial stability.

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