The banking system's liquidity surplus and interest rate formation

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In recent years, the Swedish banking system has gone from having a structural liquidity deficit towards the Riksbank, to having a surplus. This has led to the Riksbank regularly withdrawing liquidity from the banking system instead of supplying it, as it used to do. The surplus has grown over time because the Riksbank has not used the return on its assets for distributing profits to the government and for interest and administrative expenses. Instead, such payments have been allowed to affect the size of monetary policy operations. Also, notes and coins have been in less demand from the general public since 2007, which is also a reason for the surplus growth. In this paper, we attempt to highlight whether the surplus has had any consequences for the practical implementation of monetary policy, and for the impact from the repo rate to short interbank rates.

Background to the liquidity surplus

In this section, first of all we briefly describe how a liquidity surplus in the banking system emerged, and why it could be problematic.

HOW THE BANKING SYSTEM ENDED UP WITH A SURPLUS

Until the summer of 2008, the banking system had a structural *liquidity deficit* towards the Riksbank. Hence, the Riksbank had a net receivable from the banks in Swedish kronor. Until the summer of 2008, the Riksbank supplied the banking system with liquidity by purchasing securities from the banks, and paid by crediting their accounts in the RIX payments system. At the same time, it was agreed that the banks would buy back the securities at a later date. This is known as *monetary policy repos*. They commonly had a one-week maturity and the price was determined by the repo rate decided by the Riksbank's Executive Board. So as to manage daily fluctuations in the liquidity of the banking system, the Riksbank conducted fine-tuning operations through overnight lending or depositing at the repo rate plus/minus 10 basis points. This enabled the banks to avoid

ending up in the Riksbank's lending or deposit facility, in which they must instead pay the repo rate plus/minus 75 basis points.[1]

Since 2010, the banking system has instead had a structural *liquidity surplus* towards the Riksbank, with the Riksbank regularly withdrawing liquidity from the banking system. In order to withdraw the surplus from the banking system, once a week the Riksbank offers *Riksbank certificates* with a one-week maturity at the repo rate. The banks lend the part of the surplus that they do not put in Riksbank certificates to the Riksbank through daily *fine-tuning operations* at the repo rate, or to the Riksbank's *deposit facility* at the repo rate minus 75 basis points.[2]
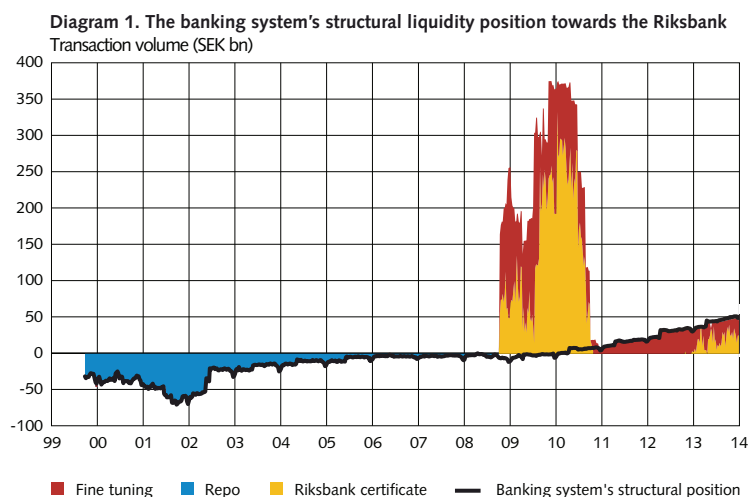
Diagram 1. The banking system's structural liquidity position towards the Riksbank
Transaction volume (SEK bn)

■ Fine tuning   ■ Repo   ■ Riksbank certificate   — Banking system's structural position

Diagram 1 shows the development over time of the banking system's structural liquidity position towards the Riksbank.[3] In September 1999, the Riksbank's net receivable from the banks equalled around SEK 31 billion in monetary policy repos. In July 2014, the Riksbank's net liability to the banks equalled a total of SEK 53 billion in Riksbank certificates and fine-tuning. This marks a major change in the structural position. The fundamental reason for this change has been that the Riksbank has not used the return on its assets for distributing profit to the government. Instead, the Riksbank has allowed profit distributions to affect the size of its monetary policy operations, i.e. the size of fine-tuning operations and issuances of Riksbank certificates. The same applies to the Riksbank's operating expenses. When the banking system had a liquidity deficit toward the Riksbank, monetary policy repos became lower over time, and the size of deposits in the form of Riksbank certificates and fine-tuning operations subsequently grew. Also, in recent years, demand from the

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1   For a description of the Riksbank's operational framework for the implementation of monetary policy, see Sellin and Åsberg Sommar (2012).
2   Starting on 29 October 2014 the fine-tuning operations are made at the repo rate rather than at the repo rate plus/minus 10 basis points as before.
3   We have defined the structural liquidity surplus of the banking system as the banking system's net receivable from the Riksbank in Swedish kronor.

general public for notes and coins has been lower, which has also affected the size of the surplus. When a bank delivers notes to the Riksbank, the latter credits the former's account with the corresponding amount, hence increasing the liquidity surplus of the Swedish banking system.

Each year, the Riksbank pays part of its profit to the government. In order to obtain money for this, the Riksbank has not sold off any assets; rather, it has created new kronor. In purely practical terms, the Riksbank credits the account of the Swedish National Debt Office in RIX. Because no interest is paid on that account, the National Debt Office usually transfers the newly created kronor to an account held with a commercial bank. Then, the liquidity position of the banking system towards the Riksbank increases. The Riksbank pays out these profit distributions in April each year, and they have amounted to an average of SEK 5.5 billion each year in the past 10 years. Diagram 1 shows relatively clearly the profit distributions to the government. The Riksbank's administrative expenses of around SEK 700 million annually are also financed by the creation of new kronor. Since the banking system gained a liquidity surplus, the Riksbank has also had interest expense instead of interest income from its market operations. These expenses too are financed by new kronor.

The structural surplus of the banking system will automatically increase over time, unless the Riksbank acts to break the trend. While the profit distribution in April 2014 of SEK 3.3 billion indeed came out of the assets, which meant that the surplus did not increase correspondingly that year, the Executive Board of the Riksbank has not made any decisions of principle stating that profit distributions shall come out of the assets.

IS A GROWING LIQUIDITY SURPLUS A PROBLEM?

Three main arguments are commonly expressed to suggest why it might be a problem for the banking system to have a liquidity surplus towards the central bank:[4]
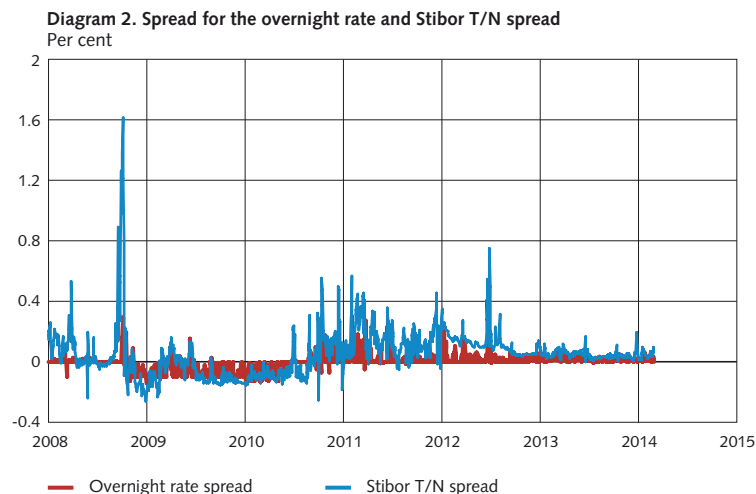
1. *The surplus can be so large that it exerts downward pressure on the overnight rate, such that it ends up close to the central bank's deposit rate rather than the target rate.*

The first argument hence pertains to interest rate formation. The operational target of the Riksbank is for the overnight rate to be between its lending and deposit rates – in the middle of the so-called "interest rate corridor"; that is, close to the Riksbank's repo rate.[5] With a lot of liquidity in the banking system, the overnight rate will be pushed down towards the deposit rate. This was evidenced in the financial crisis, when the Riksbank ensured that the banking system had ample liquidity by lending an extraordinarily high volume of money in Swedish kronor. However, because the Riksbank conducted fine-tuning

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4   See e.g. Gray (2006) and Ganley (2002).
5   Here, the overnight rate refers to the interest rate on loans overnight between the banks to equalise their positions on accounts in the RIX payments system. It is in the banks' own interest to equalise the position because otherwise they end up in the Riksbank's standing facilities and have to pay lending rates on deficits or receive deposit rates on surpluses. It is more beneficial to conduct an overnight loan (loan from one business day to the next) with another bank at a rate that is between the Riksbank's lending and deposit rates.

operations each day at the repo rate minus 10 basis points, the pressure on the overnight rate was very limited. During the financial crisis, we noted that the fine-tuning rate actually set a lower limit to the overnight rate (see Diagram 2). If, in addition, the banks put a large part of the liquidity surplus into Riksbank certificates, the Riksbank needs to withdraw less liquidity from the banking system at the end of each day, and the overnight rate ends up closer to the repo rate.

Diagram 2. Spread for the overnight rate and Stibor T/N spread
Per cent

Overnight rate spread ——   Stibor T/N spread ——

2. *The banks need to borrow less money from each other on the overnight market, and this reduces their incentive to have sound liquidity management. In turn, this can have consequences for interest rates and functions of the money market, even for longer maturities.*

The second argument pertains to the incentive of banks. The banks have a weaker incentive to allocate resources to taking care of their own liquidity management in a good way if liquidity is readily available and relatively inexpensive. The banks usually cover their short-term liquidity needs by borrowing from other participants, either using unsecured interbank loans or through issuing bank certificates. With a substantial and predictable liquidity volume in an account at the central bank, both individual banks and the banking system at large have less of an incentive to plan and actively manage their liquidity. Norges Bank has experienced the problems that can arise when the banks are given generous, inexpensive access to liquidity from the central bank, see Norges Bank (2010). Norges Bank attempted to steer the overnight rate by supplying so much liquidity that the overnight rate was pushed downwards towards its deposit rate. However, after a while the banks grew accustomed to the liquidity level, and the overnight rate started to inch upwards again. Norges Bank then had to supply even more liquidity, and so continued the upward spiral.

3. The central bank pays interest when it withdraws liquidity from the banking system,
unlike when it supplies liquidity through secured loans or monetary policy repos.

The third argument pertains to the financial consequences for the central bank. The central
bank indeed pays interest for withdrawing liquidity from the banking system. However,
that liquidity can be invested in foreign government bonds, which ought to generate a
higher return for the Riksbank over time compared to Riksbank certificates and fine-tuning
operations.

Analysis of the effects of the liquidity surplus

In the following sections, we focus on what the consequences will be of the surplus for
interest rate formation and turnover. We provide a statistical overview depicting the short
money market in Sweden, and present the results of a statistical analysis of the relationships
between the liquidity surplus on the one hand, and interest rates and turnover on the other.

STATISTICS REGARDING LIQUIDITY SURPLUS, RATE FORMATION AND TURNOVER

When monetary policy is to be applied to the actual economy, the initial step is for the
Executive Board to make a decision on the overnight rate target. This rate will, in turn,
affect longer interest rates on the money market. The most important of these is the
interest rate on loans from tomorrow until the following business day (tomorrow/next or
T/N) and the interest rate on three-month loans. The interest rates are important reference
rates for various types of financial contract, and they will hence influence the interest rates
that various decision-makers in the economy must take into account. A liquidity surplus
could affect the money market, partly by changing the level of the overnight rate and other
interest rates, and partly by affecting activity on the market, i.e. the number of transactions
or the transaction volume. Using simple descriptive statistics of the Swedish money market,
we can shed light on these relationships.

   In Table 1 below, we present statistics for the overnight rate and turnover in the
overnight market. The table also shows statistics for spreads for T/N, 1-month and
3-month Stibor fixing.[6] The statistics cover the period October 2007 to February 2014 and
are broken down into three periods.

- **Period 1**: pre-crisis period, when the banking system had a liquidity deficit.
- **Period 2**: the period between October 2008 and October 2010, when the banking
  system had a major liquidity surplus due to the Riksbank having lent substantial
  amounts to the banks during the financial crisis.
- **Period 3**: the period between October 2010 and January 2014 when the banking
  system had a small but growing liquidity surplus.

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6   For a formal description of rate spreads in the money market, see the appendix.

Based on the tables, we can make several interesting observations of the relationships between the liquidity surplus and rate spreads:

- The overnight rate spread, that is the difference between the overnight rate and the Riksbank's repo rate, was close to zero in period 1 when the banking system had a liquidity deficit before the crisis, negative in period 2 with extraordinary measures, and positive and slightly higher in period 3 (see diagram 2).

- The T/N spread, i.e. the difference between the T/N rate and the Riksbank's repo rate was also negative in period 2 and positive on average in period 3, but less volatile in period 1, before the crisis.

- The basis spreads for the 1- and 3-month maturities, i.e. the difference between the 1- and 3-month STIBOR rate, respectively, and the expected average T/N rate for the corresponding period, were relatively narrow in period 2, but more volatile.

- Total turnover on the overnight market (like the number of transactions) was much higher in period 1, very low in period 2 and slightly higher in period 3, but still much lower than before the crisis.

In order to explain the level for the very shortest rates, account must also be taken, besides the total liquidity surplus, of the part of the surplus not put into the Riksbank's weekly certificates, i.e. liquidity available in the system each day. In that sense, the volume of fine-tuning operations is important in explaining how liquidity affects the very shortest rates.

Diagram 1 shows how the surplus has been placed in certificates or in fine tuning at the Riksbank since 2008. In period 2, between October 2008 and September 2010, when the banking system had a large liquidity surplus towards the Riksbank, the banks put around 50 per cent of the surplus in weekly certificates. After that time and until the beginning of 2013, the surplus was more or less equal to the fine-tuning operations, because the banks no longer bid in Riksbank certificate issues. However, since the beginning of 2013, the banks have once again put a large share of the surplus into Riksbank certificates.
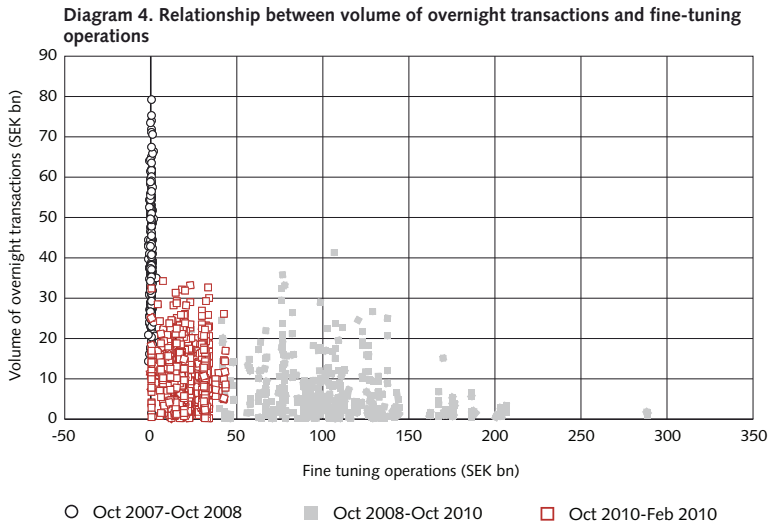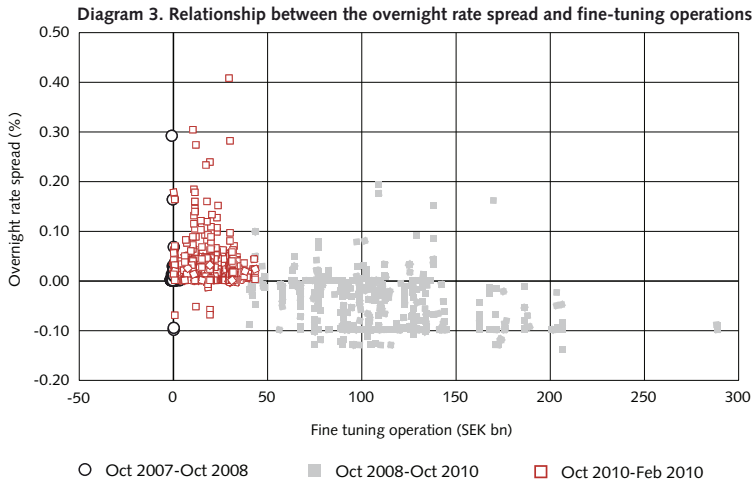
Table 1. Descriptive statistics for money markets

DESCRIPTIVE STATISTICS		PERIOD 1 OCT 07-SEP 08	PERIOD 2 OCT 08-SEP 10	PERIOD 3 OCT 10-FEB 14
S_t^{ON}	OVERNIGHT RATE – REPO RATE (BP)			
	Mean	0	-4	2
	Median	0	-4	1
	Min	-10	-14	-7
	Max	29	19	41
	Standard deviation	2	5	4
S_t^{TN}	T/N RATE – REPO RATE (BP)			
	Mean	12	-6	11
	Median	6	-9	9
	Min	-24	-26	-19
	Max	161	80	75
	Standard deviation	23	10	10
b_t^{1m}	BASIS SPREAD 1 MONTH (BP)			
	Mean	17	16	15
	Median	14	10	12
	Min	-5	-5	-6
	Max	45	108	56
	Standard deviation	12	19	11
b_t^{3m}	BASIS SPREAD 3 MONTHS (BP)			
	Mean	39	38	35
	Median	38	26	32
	Min	22	11	9
	Max	70	146	94
	Standard deviation	10	28	20
Vol	TURNOVER ON OVERNIGHT MARKET (SEK BN)			
	Mean	39	5	11
	Median	38	3	10
	Min	1	0	0
	Max	79	41	34
	Standard deviation	14	6	6

Note. The number of basis points, or hundredths of a percentage point, is denoted as bp. The notation in the column to the left is intended to facilitate a comparison with the formal definitions in the appendix. For each variable a mean, median, minimum, maximum and standard deviation are given.

Diagrams 3 and 4 show the relationship between the spread for the overnight rate and the volume of overnight transactions and fine-tuning operations, respectively.[7] The diagrams confirm what we observed in Table 1: both the spread and volumes were lower in period 2, when the Riksbank supplied a lot of liquidity to the banking system. However, the diagrams also show that the relationship is not linear, and also that it differs between the periods. We analyse this in more detail in the next section.

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7   Similar diagrams are obtained when using the total surplus liquidity instead of fine-tuning transactions.

Diagram 3. Relationship between the overnight rate spread and fine-tuning operations

Overnight rate spread (%)

Fine tuning operation (SEK bn)

○ Oct 2007-Oct 2008   ■ Oct 2008-Oct 2010   □ Oct 2010-Feb 2010

Diagram 4. Relationship between volume of overnight transactions and fine-tuning operations

Volume of overnight transactions (SEK bn)

Fine tuning operations (SEK bn)

○ Oct 2007-Oct 2008   ■ Oct 2008-Oct 2010   □ Oct 2010-Feb 2010

ANALYSIS OF LIQUIDITY SURPLUS, RATE FORMATION AND TURNOVER

In this section, we calculate empirical relationships between the spread in the overnight market, traded volumes and total surplus liquidity in the system. We also study the effect of the liquidity surplus on longer interbank rates.

The effects of the liquidity surplus on the overnight rate

Diagram 3 shows that there is a non-linear relationship between the spread and liquidity in the banking system. Also, the variance of the spread does not appear to be the same in different periods. We appraise a model that takes account of this fact.

The results are presented in Table 2, column 1.[8] They seem reasonable and are in line with the results we might have expected, although they ought to be interpreted with caution due to the short time series. We obtain a negative relationship between the spread and the liquidity surplus, i.e. the higher the surplus, the narrower the spread. This relationship is not linear and varies depending on the period. In periods 1 and 3, in which the spread is positive on average, an extra billion kronor in the banking system leads the spread to narrow by 0.07 basis points. So, when the surplus grew by SEK 17 billion in 2013, the overnight rate was pushed down by around 1.2 basis points. However, this only had a limited effect on the overnight rate. Because the Riksbank conducted fine-tuning operations each day at the repo rate minus 10 basis points, the fine-tuning rate serves as a lower limit for the overnight rate.

When we add the ratio between the volume of issued Riksbank certificates and the total liquidity surplus as a further variable in the model, we find a positive relationship between this variable and the spread. That variable is called "cover ratio" in the model. When, for example, the entire surplus is absorbed by the Riksbank certificates issued each week, the new variable assumes the value one and the spread then increases by 2.1 basis points on average.

This relationship is stronger in period 2. Then, the average spread was only -3 basis points, despite the extra liquidity in the system being around SEK 250 billion on average. This is because, during that period, the banks placed more money in Riksbank certificates, and that neutralised the effect of the liquidity surplus on the spread.[9] This is an interesting result bearing in mind that, since 2013, the banks have shown greater interest in the weekly issues of Riksbank certificates. This could in fact neutralise a potential effect of an increasing surplus on the overnight rate spread.

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8   We obtain similar results if we instead commence the time series in 2011.
9   For example, during that period, the effect of an average liquidity surplus of around SEK 250 billion was -7.5 points (250 × (-0.07+0.04)) and the effect of the average use of Riksbank certificates of around 50 per cent was 5.1 points (50% × (2.07+8.22)).

Table 2. Liquidity surplus, rate formation and turnover

VARIABLE	SPREAD O/N	SPREAD T/N	BASIS SPREAD 1M	TURNOVER O/N
C		1.82 (0.50)	0.53 (0.18)	20.74 (1.17)
IMM	2.32 (0.25)	7.15 (0.68)		1.94 (0.80)
DUM2	-2.56 (0.32)	-3.84 (1.16)		-17.35 (1.22)
DUM3	2.83 (0.21)	3.43 (0.88)	0.69 (0.27)	-14.28 (1.04)
Dependence variable (-1)	0.24 (0.03)	0.71 (0.01)	0.94 (0.01)	0.39 (0.03)
Dependence variable (-2)	0.08 (0.02)	0.08 (0.01)		0.10 (0.03)
SL	-0.07 (0.01)	-0.12 (0.03)		-0.06 (0.02)
SL*DUM2	0.04 (0.01)	0.12 (0.03)		0.05 (0.02)
Cover ratio	2.07 (0.36)	2.96 (1.07)		4.33 (0.71)
Cover ratio*DUM2	8.22 (0.68)			
Riskp US		0.59 (0.17)	0.84 (0.08)	
VARIANCE EQUATION				
C	5.92 (0.10)	0.96 (0.23)	0.47 (0.06)	0.87 (0.20)
RESID(-1)^2	0.66 (0.05)			0.11 (0.02)
GARCH(-1)		0.98 (0.01)	0.95 (0.01)	0.88 (0.01)
Adjusted R square	**0.47**	**0.77**	**0.95**	**0.75**

Note. Time series for the period 8/10 2007 - 28/2 2014. Standard error in brackets. All coefficients are significant at a significance level of 5 per cent. IMM = dummy variable for IMM day, DUM2 = dummy variable for period 2, DUM3=dummy variable for period 3, SL= liquidity surplus, cover ratio = issued volume Riksbank certificates/SL, riskp US = standardised risk premium on the interbank market in the US. Spreads in basis points and volume in SEK billion.

The effects of the liquidity surplus on longer rates

The estimated effect of the surplus on the T/N spread is much greater than the estimated effect on the overnight rate spread. This can also be seen in Table 2, which shows that in periods 1 and 3, an extra billion kronor in the banking system leads to a reduction in the T/N spread of 0.12 basis points. The variable *"cover ratio"* also shows a greater estimated effect on the T/N spread compared with the overnight rate spread. On the days preceding an IMM day, the T/N spread increases by 7 basis points on average. We also include a variable to capture the international risk premium by including the standardised risk premium on the interbank market in the US (denoted *"riskp US"*). We find that if that variable increases by one standard deviation, the T/N spread increases 0.6 basis points. Hence, international increases in spreads on different money markets are passed on to Sweden to a certain degree.

When we calculate the effect of the surplus on the basis spread with a 1-month maturity, we cannot find any significant effect. The result is presented in Table 2, column 3. Hence, the surplus can have an indirect effect on the levels of the longer rates through the levels of the overnight and T/N rates, but no effect beyond that. Our estimated result also confirms that increased risk premiums abroad are passed on to Swedish markets, but not to any great extent. An increase of one standard deviation in our measure for the risk premium for the US increases the basis spread with a 1-month maturity by 0.8 basis points. We also obtain similar results for basis spreads with maturities of 3 and 6 months, although they are not described here.

The effects of the liquidity surplus on the overnight market

Table 2 shows the results of a regression, in which the variable we attempt to explain is the daily volume traded on the overnight market in RIX. Here, we see that the intercept is different in the three periods and higher in period 1. This also coincides with the result in Table 1. During periods 1 and 3, an increase in the liquidity surplus of SEK 1 billion leads to a reduction in daily turnover of SEK 60 million. In addition, there is a positive and statistically significant response of the turnover to our "cover ratio" variable: Turnover on the days during which most of the liquidity surplus has been drained using Riksbank certificates is on average SEK 4 billion higher.

To sum up, the most important results are as follows:

• A greater structural surplus has been associated with compressed short interbank rates in Swedish data since 2008. However, that effect is small when the majority of the surplus has been put into Riksbank certificates.

• We find no effect of a higher liquidity surplus on basis spreads with maturities of 1 to 6 months. Hence, the liquidity surplus can have an indirect effect on the levels of the longer rates through the levels of the O/N and T/N rates, but probably no additional effect beyond that.

• The greater the surplus, the lower turnover will be among monetary policy counterparties in the overnight market. However, that effect is also small when the majority of the surplus is put into Riksbank certificates.

These results suggest that a growing liquidity surplus in future could cause lower activity on the interbank market and an overnight rate (and T/N rate) close to the fine-tuning rate. However, this need not be the case if the banks submit bids in the Riksbank's weekly issues of Riksbank certificates to a greater extent. The results should be interpreted with caution, however, because most of the observations coincide with the period that featured the financial crisis, and that might have affected turnover volumes.

An international comparison

In this section, we make a comparison between developments in other countries and look at the effects of a liquidity surplus, and how it has been addressed.

THE STRUCTURAL LIQUIDITY POSITION OF THE BANKING SYSTEM

Contrary to what appears to be the common perception, it is not unusual for the banking system to have a liquidity surplus towards the central bank. In Table 3, we list all OECD countries and whether their banking systems have a structural surplus or deficit. The OECD countries that use the euro are included in the Eurosystem last in the table.[10] We

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10 OECD countries that are members of the Eurosystem are Belgium, Estonia, Finland, France, Ireland, Luxembourg, the Netherlands, Portugal, Slovakia, Slovenia, Spain, Germany and Austria.

can observe that, for 13 out of the 20 countries, the banking system had a liquidity surplus towards the central bank at the end of 2012.

Table 3. The banking system's structural liquidity position in the OECD countries in 2012, as a percentage of the central bank's balance sheet, and open market operations (OMO), etc.

LAND	BANKING SYSTEM NET	AS A % OF CB'S BS	OMO	STRUCTURAL OPERATIONS	MINIMUM RESERVE REQUIREMENTS
Australia	*Deficit*				
Chile	Surplus	12	R, TD	CBB	Yes
Denmark	Surplus	37	TL, CD		No
Iceland	*Deficit*				
Israel	Surplus	74	TD	CBC	Yes
Japan	*Deficit*				
Canada	*Deficit*				
Mexico	*Deficit*				
New Zealand	Surplus	52	R, RR, CBC	FXS, FXBS	No
Norway	Surplus	7*	TL, CD		No
Poland	Surplus	34	CBC, FT		Yes
Sweden	Surplus	8	CBC, FT		No
Switzerland	Surplus	43		FX	Yes
United Kingdom	Surplus	75		AP	Not currently
South Korea	Surplus	5	RR, TD	CBB	Yes
The Czech Republic	Surplus	27	RR		Yes
Turkey	*Deficit*				
Hungary	Surplus	27	CBC		Yes
USA	Surplus	51		AP	Yes
Euro system	*Deficit*				

Note. Abbreviations used: R (repo), RR (reverse repo), TL (term loan), TD (term deposit), CD (certificate of deposit), CBC (central bank certificates), CBB (central bank bonds), FXS (FX swaps), FXBS (FX basis swaps), FT (fine tuning), AP (asset purchase).
* The government pension fund has been excluded from total assets of the balance sheet.

In Table 3 we show the size of the liquidity surplus as a share of the balance sheet total of each central bank. Calculated in this manner, we note that Sweden, Chile, Norway and South Korea have the lowest surpluses. In Chile and South Korea, the surpluses are kept at a low level through the central bank issuing central bank bonds.

Norway (like New Zealand) has an operational framework for the implementation of monetary policy that is usually called a floor system. In this system, a liquidity surplus is intentionally created in the banking system, and the overnight rate is hence pushed down towards the rate corridor floor, i.e. towards the central bank's deposit rate which serves as the target rate.

The Swedish surplus is at a relatively low level thanks to the fact that the foreign exchange reserve is partially financed through borrowings in foreign currency. The most common reason for the banking system having a liquidity surplus is otherwise growth in the central bank's foreign exchange reserve. This is commonly due to the fact that an inflow of foreign currency has tended initially to push up the value of the domestic currency. The central bank has then opted to purchase foreign currency with newly created money in order to keep the value of the domestic currency down (Chile, Israel, Poland, Switzerland,

South Korea, the Czech Republic and Hungary). The newly created money leads to an increase in the liquidity surplus.[11]

It can be expensive for the central bank to accept the surplus as deposits in countries with relatively high interest rates in relation to the countries whose bonds are included in the central bank's foreign exchange reserve. Consequently, Banco de Chile, Bank of Israel and Czech National Bank (CNB) have had negative equity of respectively 19, 13 and 12 per cent compared to total assets. However, this need not be a serious problem if the phenomenon is temporary. According to the Governor of CNB, Miroslav Singer, "the real capital of a central bank is its credibility and reputation, not a figure on its balance sheet" (Singer, 2011).

HOW HAS THE IMPLEMENTATION OF MONETARY POLICY AND INTEREST RATE FORMATION WORKED?

In a working paper from the Czech National Bank, Babecká Kucharcuková et al. (2013) note that rate formation has worked well. Empirical studies conducted approximately cover the period 1995-2010, which coincides with a time when the banking system had a liquidity surplus. In the financial crisis, however, impact through interest rate formation weakened due to rising risk premiums. Rate formation has also worked well in South Korea. According to a report from the Bank of Korea (2012) the rate channel and expectations channel have gained importance in recent years. When the Bank of Korea introduced an overnight rate target in 1998, economic agents became more rate-sensitive and the transmission from the policy rate through money market rates to the banks' deposit and lending rates has worked smoothly ever since. The National Bank of Poland (NBP) used to experience problems with the overnight rate POLONIA often being pushed down towards the deposit rate at the end of reserve maintenance periods. This was because the banks were not very interested in submitting bids on NBP's certificates in the final week of the reserve maintenance period. Instead, they wanted to have a liquidity buffer so as to avoid having to borrow from the lending facility. So, in December 2010, NBP introduced fine-tuning operations at the end of reserve maintenance periods and hence managed to stabilise POLONIA close to the policy rate.

It can be relatively easy to steer the shortest rates with a high degree of surplus liquidity in the banking system, as demonstrated by experiences from the US money market. In 2012 the Fed managed to keep the overnight rate within the target range of 0 to 0.25 per cent without conducting any open market operations at short maturities (Federal Reserve Bank of New York, 2013). However, the question is how well the interest rate on reserves will serve as a floor for the US overnight rate once the Fed initiates rate hikes. There are participants in the US overnight market that may not receive interest on reserves. They will hence be willing to lend on the market at a rate below the rate on reserves. In this case, other participants that receive interest on their reserves will have to borrow money on the

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11 The strongest factor that instead counteracts a deficit is that demand from the general public for notes and coins usually grows in pace with nominal national income.

market and put it in the Fed so that the overnight rate does not fall below the floor. The UK has the same problem. The counterparties of the Bank of England report that they are not willing to arbitrage away a low overnight rate before it is around 10 basis points below the rate on reserves. In order to counteract the problem, the Bank of England wishes to extend its circle of counterparties to provide more with direct access to interest on reserves (Jackson and Sim, 2013).

HOW HAS MONEY MARKET FUNCTIONALITY BEEN AFFECTED?

A consistent pattern seems to be that transaction volumes on the money market decrease when the banks have less of a need to equalise liquidity between themselves. When the liquidity surplus is high, most banks will have a liquidity surplus at the end of the day (or reserve maintenance period), and not many will need to borrow. In particular, the volume of borrowings on the unsecured market decreases, while there is a tendency for the banks to increase the share of loans conducted on a secured basis.

The Bank of England reports that non-banks, e.g. money market funds and non-financial companies, are still relatively active and lend money unsecured to banks (Jackson and Sim, 2013). Although the banks do not have any direct need to borrow money, they continue to do so to some extent on the market. This is in order to safeguard existing customer relationships, and to secure the ability to use the loan as a funding source if so required in future. As more banks want to conduct secured lending, demand for collateral has increased. In turn, this has led to those lending money on a secured basis receiving a slightly lower interest rate than before. The preference for secured lending can be partially explained by the new liquidity regulations, and it can hence be expected that secured lending will be an attractive alternative even once the liquidity surplus has returned to a more normal level. Non-banks in the UK have not switched to secured lending to any great extent because they do not have the required systems and expertise in place.

In Poland, the interbank market for unsecured borrowing is a local market with a low number of active participants. The market features a highly uneven liquidity distribution, and trade is thus dependent on transactions with a couple of major banks with a structural liquidity surplus. However, daily trade takes place on this market, primarily at the overnight maturity. For maturities longer than a week, there is hardly any trade at all. However, there is a liquid, secured market, particularly in FX swaps (National Bank of Poland, 2011).

Concluding remarks

A large structural liquidity surplus in the Swedish banking system has been associated with compressed short interbank rates since 2007. However, that effect will be small when the majority of the surplus is put into Riksbank certificates. We find no effect of a higher liquidity surplus on basis spreads with maturities of 1 to 6 months. Hence, the liquidity surplus can have an indirect effect on the levels of the longer rates through the levels of the O/N and T/N rates, but probably no effect beyond that. The greater the surplus, the lower turnover will be among monetary policy counterparties in the overnight market. However, that effect will also be small when the majority of the surplus is put into Riksbank certificates. This is what we have observed since the beginning of 2013. Similar patterns are also visible in other countries that have had a liquidity surplus in the banking system for a lengthy period of time.

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APPENDIX: Relationships between different money market rates

The overnight rate[12], R_t^{ON}, can be broken down into the target for the overnight rate, the Riksbank's repo rate R_t^*, plus the deviation from the overnight rate from the repo rate, which we denote as s_t^{ON}:

(1) $R_t^{ON} = R_t^* + s_t^{ON}$.

The T/N rate can be written as a forward-looking parity condition, in which the T/N rate is equal to the expected overnight rate tomorrow given the volume of information Ω_t:

(2) $R_t^{TN} = E[R_{t+1}^{ON} | \Omega_t] + v_t = E[R_{t+1}^* | \Omega_t] + s_t^{TN}$,

where v_t denotes the deviation from the parity condition and where we, in the next step, have used equation (1) to derive $s_t^{TN} = E[s_{t+1}^{ON} | \Omega_t] + v_t$, which is the deviation of the T/N rate from the expected repo rate.

We can write an interbank rate of maturity N as:

(3) $R_t^N = E\left\{\frac{1}{N}\sum_{k=0}^{N} R_{t+k}^{ON} | \Omega_t\right\} + s_t^N$,

i.e. as the average expected overnight rate and deviation of R_t^N from that expected, the spread s_t^N. We call spread s_t^N a credit spread, and it includes premiums for creditworthiness of banks that lend on an unsecured basis and other demand and supply factors that affect the rate of this maturity. A special case of equation (3) is when we rewrite it to express the expectation in terms of the expected T/N rate

(4) $R_t^N = E\left\{\frac{1}{N}\sum_{k=0}^{N-1} R_{t+k}^{ON} | \Omega_t\right\} + b_t^N$.

Then, the first term constitutes an expectation of the T/N rate over period N, which resembles the STINA swap of an N day and b_t^N is what we usually call the "basis spread" in the Swedish money market.[13]

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12 The overnight rate is defined as the interest rate from one business day to the next for unsecured loans in Swedish kronor between the Riksbank's monetary policy counterparties.
13 We have not taken account of the exact settlement dates in this theoretical presentation.