

ECONOMIC COMMENTARIES

Negative interest rates: Central bank reserves and liquidity management

NO. 2 | 2015

TOM BERNHARDSEN AND
KATHRINE LUND,
MARKET OPERATIONS AND
ANALYSIS

The views expressed are those of the authors and do not necessarily reflect those of Norges Bank



NORGES BANK

In a number of countries, short-term money market rates have now become negative, either because the central bank has set a negative policy rate or because excess central bank reserves are pushing down short-term money market rates towards the rate on the central bank's marginal deposit facility, which is negative. In Norway, the so-called "reserve rate" is the rate on the central bank's marginal deposit facility. The reserve rate is intended to give banks an incentive to redistribute reserves among banks. As long as Norges Bank keeps the reserves in the banking system lower than the total of banks' quotas for sight deposits with Norges Bank, the overnight rate will remain at around the key policy rate. This will also be the case if the reserve rate should become negative.

In recent years, many central banks have reduced policy rates to very low levels. At the same time, alternative monetary policy instruments have been used, such as long-term loans to the banking sector, purchases of government bonds and private securities and foreign exchange market interventions.

Several central banks are now pursuing a monetary policy whereby the shortest money market rates have become negative. This is the case in countries such as Switzerland, Denmark and Sweden and in the euro area. A central bank can achieve negative short-term money market rates in two ways, either by setting a negative policy rate or, in some situations, supplying the banking system with excess central bank reserves, while the interest rate on the central bank's marginal deposit facility is negative. However, it is important to note that as long as the policy rate is positive and the central bank maintains normal liquidity management without excess central bank reserves, a negative interest rate on the central bank's marginal deposit facility will not result in negative short-term money market rates.

In this commentary, we examine the significance of the liquidity management framework for interest rate formation when a central bank seeks to achieve negative short-term money market rates. As background, we first discuss what is meant by central bank reserves and central banks' liquidity management. Then we look at liquidity management in the euro area, Denmark, Switzerland and Sweden. Finally, we address the quota system in Norway and the reserve rate's role in this system.

Central bank reserves and liquidity management

The purpose of a central bank's liquidity management is to ensure that the policy rate has a broad impact on money market rates. A central bank achieves this by setting the terms for banks' loans from and deposits with the central bank and by managing the quantity of central bank reserves in the system. Central bank reserves, or simply reserves, mean banks'

deposits with the central bank. The instruments that the central bank uses in managing bank reserves and terms associated with these instruments constitute the liquidity management system.¹ There is a further distinction between standing facilities and market operations. Market operations to supply or withdraw reserves are carried out on the initiative of the central bank, usually in the form of auctions. On the other hand, the standing facilities are always available to banks and often consist of a deposit and lending facility and an intraday facility.²

Banks have accounts with the central bank to settle transactions with one another. If a customer of Bank A transfers funds to a customer of Bank B, to settle the transaction, Bank A's deposits with the central bank are reduced, while Bank B's deposits with the central bank are increased. To ensure that interbank transactions are carried out efficiently, banks can normally borrow reserves from the central bank intraday interest-free, but against collateral. At the end of the day, such intraday loans must be repaid to the central bank.

A liquidity management system can be designed in several ways. A number of central banks implement monetary policy through a system in which the central bank's policy rate lies in the middle of a corridor between the rate on the central bank's deposit facility and the rate on the central bank's lending facility.³ At the same time, the central bank aims towards keeping reserves in the banking system equal to zero or marginally greater than zero.⁴ But even if the total quantity of reserves in the system at the end of the day is zero, some banks may still have excess reserves, i.e. a positive balance with the central bank, while others have a deficiency of reserves, i.e., a negative balance (intraday loan). In such cases banks have two options: Banks with a deficiency of reserves can borrow reserves from banks with an excess. The borrowed reserves are used to repay the intraday loan from the central bank. Alternatively, banks can use

¹ Systems for managing central bank reserves are discussed and explained in detail in Bernhardsen and Kloster (2010) and Syrstad (2011). See also Norges Bank's website under liquidity management <http://www.norges-bank.no/en/Liquidity-and-markets/The-liquidity-management-system/>

² The deposit facility enables banks to deposit reserves overnight in the central bank at a given interest rate. The lending facility enables banks to borrow reserves overnight from the central bank at a given interest rate, normally against collateral in the form of securities.

³ Such a system is often referred to as a corridor system.

⁴ In some countries, banks are subject to a reserve requirement, i.e. banks must maintain a certain amount on account with the central bank. Normally these reserves are remunerated at a rate equal to or close to the policy rate. In a system with reserve requirements, the central bank aims to keep the quantity of reserves in the banking system equal to the level determined by the reserve requirement.

the central bank's standing facilities.⁵ Since the interest rate on the central bank's deposit facility is lower than the policy rate, while the interest rate on the central bank's lending facility is higher than the policy rate, this gives banks an incentive to deal with one another rather than use the central bank's standing facilities. Normally, the interest rates on the standing facilities therefore constitute an upper and lower limit for short-term market rates.

Chart 1 illustrates a classic liquidity management system. The demand for reserves is a declining function of the short-term interbank market rate. The smaller the difference between the market rate and the rate on the deposit facility, the cheaper it is for banks to hedge against the need for reserves and the greater the demand. As mentioned above, the interest rate on the central bank's lending facility normally serves as a ceiling for the overnight rate, while the interest rate on the central bank's deposit facility serves as a floor for the overnight rate.^{6,7} The central bank's supply of reserves is illustrated by the vertical supply curve.⁸ Reserves can be changed owing to so-called autonomous factors, i.e. factors beyond the control of the central bank. The central bank counteracts these changes with the aid of market operations, such as loans and time deposits or purchasing and selling securities or foreign exchange.⁹

⁵ A bank with a deficiency of reserves and a negative balance with the central bank at the end of the day that is unable to borrow the necessarily quantity of reserves from other banks will automatically have to use the central bank's lending facility. A bank with excess reserves that does not lend these reserves to other banks must automatically use the central bank's deposit facility.

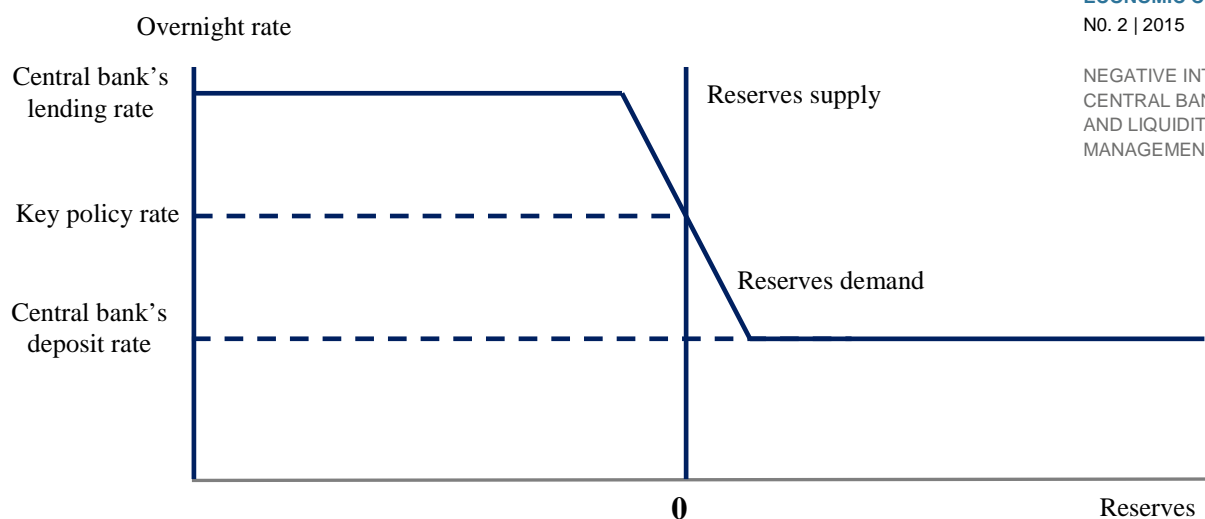
⁶ A stigma may be attached to use of the lending facility. In cases where this stigma cost is high, the market rate may exceed the rate on the standing lending facility.

⁷ In cases where one or more banks do not have access to the central bank's deposit facility, the market rate may fall below the deposit rate. Money market rates with maturities longer than overnight may be lower than the deposit rate in the central bank if market participants expect a reduction in the policy rate. It is therefore the shortest money market rates that the corridor normally serves as a ceiling and floor for.

⁸ This model is a simplified presentation of the model of Whitesell (2006). This model is also used by Keister, Martin and McAndrews (2008) to illustrate the Federal Reserve's liquidity policy. Bernhardsen and Kloster (2010) also provide a presentation of this model.

⁹ Two common autonomous factors are the government's account and banknotes and coins. When the government receives tax payments from households and firms, funds are transferred from banks' accounts with the central bank to the government's account with the central bank, reducing the quantity of reserves in the banking system. When banks purchase notes and coins, the banks pay by drawing on their deposits with the central bank, reducing the quantity of reserves. For details, see Bernhardsen and Kloster (2010), Syrstad (2012) and Aamodt and Tafjord (2013).

Chart 1. Reserves supply and reserves demand in a corridor system

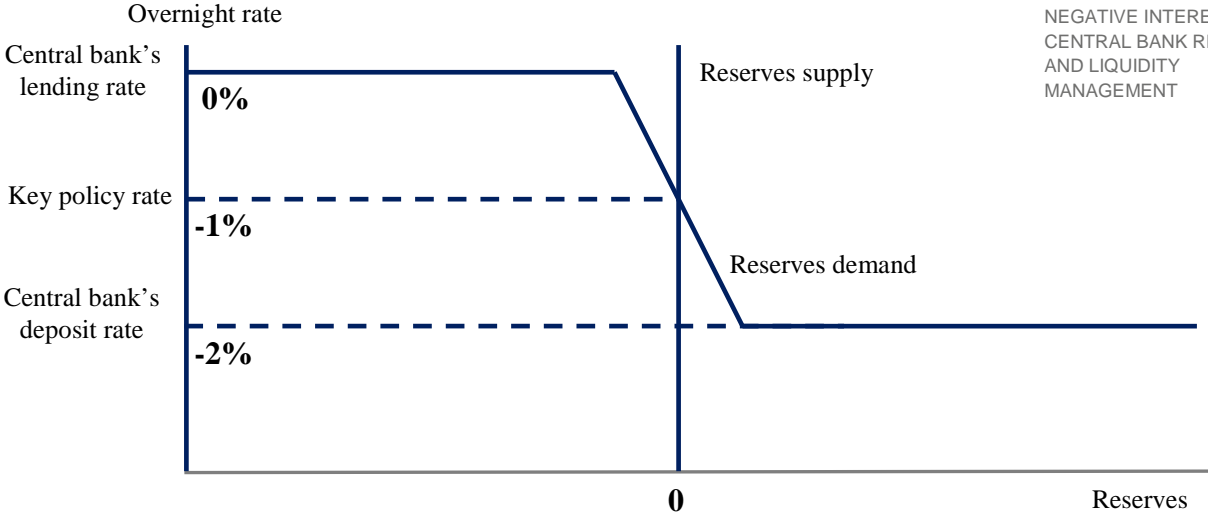


Central bank reserves are distributed among banks in a closed system. Banks as a group cannot on their own initiative get rid of reserves in any other manner than by depositing them in an account with the central bank. A bank with excess reserves must either lend them to other banks or deposit them in the central bank at a low interest rate. If the reserves are lent to other banks, it is these banks that must deposit them in their account with the central bank. When the central bank ensures that the overall level of reserves is equal to zero, excess reserves in some banks always correspond to an equally large deficiency in the other banks. By redistributing reserves in the interbank market, no banks need to avail themselves of the central bank's standing facilities.

How can the central bank achieve negative short-term money market rates?

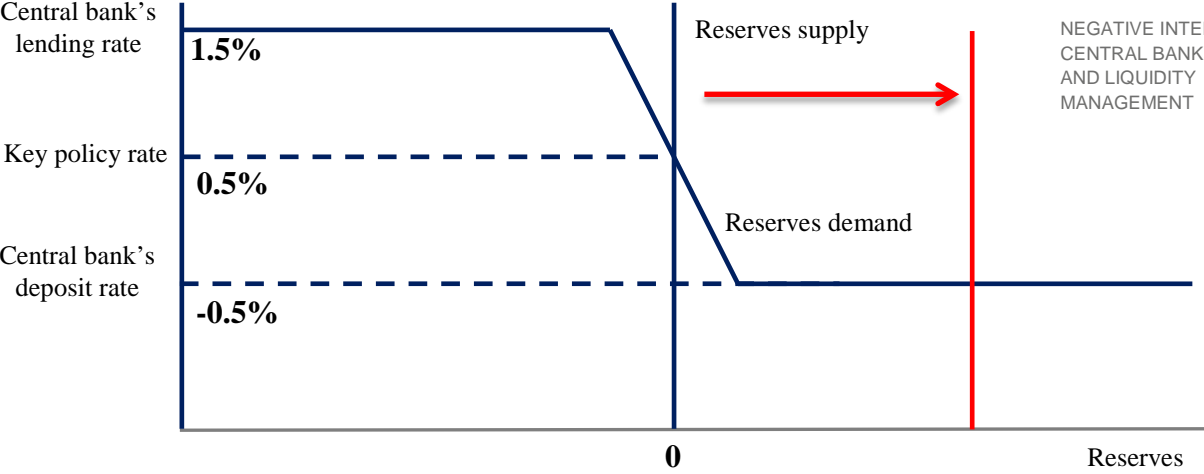
On the basis of the liquidity management system discussed above, we shall now examine how the design of the liquidity management system is crucial for interest rate formation when a central bank seeks to achieve negative short-term money market rates. First, the central bank can set a negative policy rate, combined with normal liquidity management without excess reserves in the banking system. This is illustrated in Chart 2, where the hypothetical policy rate is negative 1 percent, with an interest rate corridor equal to plus/minus one percentage point around the policy rate. When the central bank aims to maintain reserves in the banking system equal to zero, the overnight rate will be kept close to the policy rate, which in this case is negative.

Chart 2. Negative key policy rate and normal liquidity supply in a corridor system



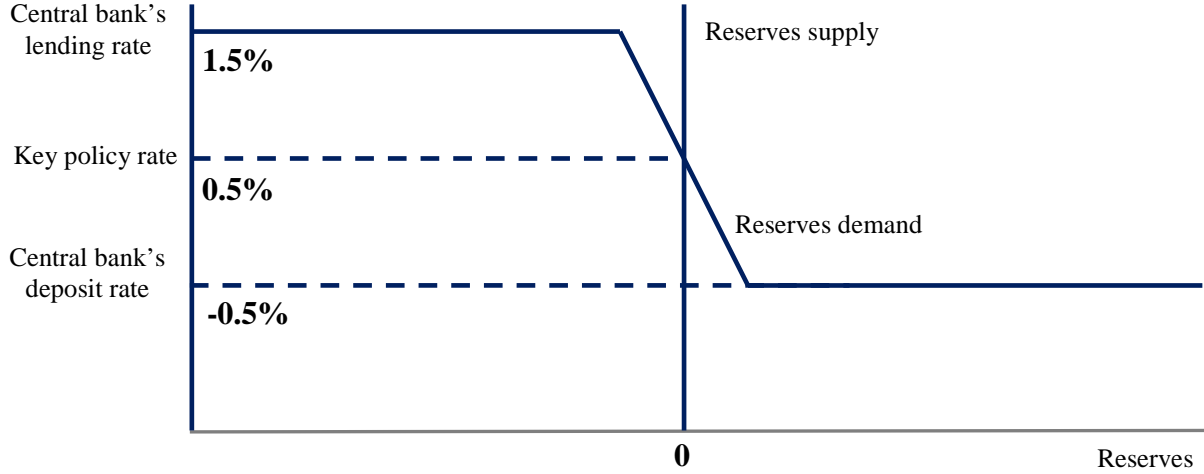
Furthermore, the central bank can achieve negative short-term money market rates by setting a positive policy rate and a negative interest rate on the deposit facility and maintaining excess reserves in the banking system. This is illustrated in Chart 3, where the supply curve has been shifted to the right. The quantity of reserves has now increased and the overnight rate is pushed down towards the interest rate on the central bank's deposit facility. The reason is that banks individually will try to lend reserves to other banks in the interbank market in an attempt to avoid having to use the central bank's deposit facility. As mentioned above, some banks must in the end hold excess reserves as deposits with the central bank, but the process has a price effect: the overnight rate in the market is bid downward towards the central bank's deposit rate. Such a liquidity management system assumes that the central bank at the outset has implemented measures that increase the reserves in the banking system. Examples may be long-term loans to banks, securities purchases or foreign exchange interventions.

Chart 3. Positive key policy rate, negative deposit rate and excess supply of reserves



A negative interest rate on the deposit facility does not in itself mean that the overnight rate will be negative, assuming that the central bank maintains normal liquidity management without excess reserves in the banking system. This is illustrated in Chart 4, where the policy rate is positive, the interest rate on the central bank's deposit facility is negative and reserves are equal to zero. There are thus no excess reserves. In this case, the overnight rate will keep close to the policy rate. The interest rate corridor and the negative interest rate on the central bank's deposit facility are intended to give banks an incentive to trade reserves with one another, so that no banks need to use the central bank's standing facilities.

Chart 4. Positive key policy rate, negative deposit rate and normal liquidity supply



Summing up, we can thus imagine three cases:

- The policy rate is negative, and the central bank maintains normal liquidity management without excess reserves. This results in a negative overnight rate.
- The policy rate is positive, the interest rate on the central bank's deposit facility is negative, and as a consequence of measures taken by the central bank, there are excess reserves in the banking system. This results in a negative overnight rate.¹⁰
- The policy rate is positive, the interest rate on the central bank's deposit facility is negative, but the central bank maintains normal liquidity management without excess reserves in the banking system. The overnight rate keeps close to the positive policy rate.

Liquidity management and interest rate setting internationally

In this section, we will examine how some central banks have oriented their interest rate and liquidity policy to achieve negative short-term money market rates.

Euro area

Prior to the financial crisis, the European Central Bank (ECB) maintained a traditional corridor system as described above. Up until autumn 2008, the overnight rate, EONIA, varied around the policy rate (the refi rate).¹¹ This is illustrated in Chart 5, which shows the overnight rate, the policy rate, the interest rate on the ECB's deposit facility and excess reserves in the banking system.¹² During the financial crisis and the crisis in the European sovereign bond market, the ECB provided banks with loans with longer maturities, substantially increasing excess reserves. As a result, the overnight rate fell below the policy rate and down towards the interest rate on the central bank's deposit facility. In recent years, the ECB has also cut its policy rate, and in September 2014, the policy rate and the interest rate on the deposit facility were reduced to 0.05 percent and -0.2 percent, respectively. Subsequently, the EONIA fix has mainly been negative.

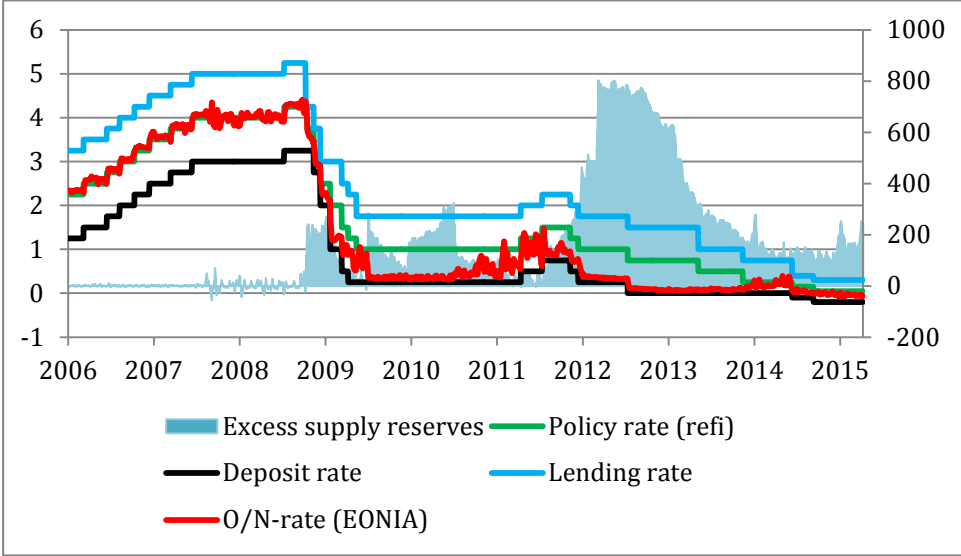
¹⁰ In addition, one can also imagine a situation where both the policy rate and the interest rate on the central bank's deposit facility are negative, while there are excess reserves in the banking system. In this case, the overnight rate will fall towards the interest rate on the deposit facility.

¹¹ The refi rate is the interest rate on the ECB's weekly main refinancing operations.

¹² Euro area banks must hold required reserves in the ECB that are remunerated at an interest rate close to the policy rate. Excess reserves are defined as the quantity of reserves banks must hold in excess of what is needed owing to the reserve requirement and changes in autonomous factors. Chart 1, which serves as a "model" for the discussion, does not take into account reserve requirements, but this does not matter for the principle under discussion.

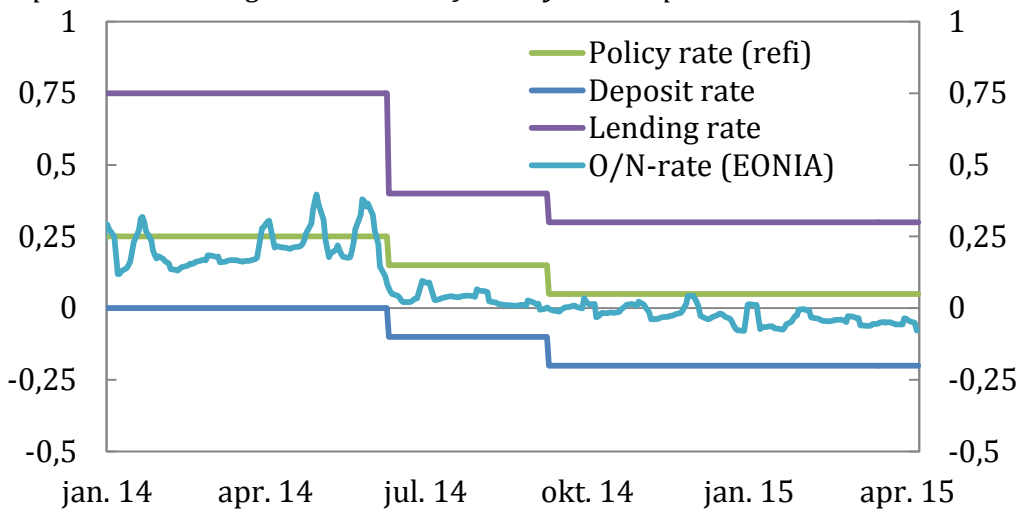
Chart 6 shows the overnight rate, the policy rate and the interest rate on the ECB's deposit facility from January 2014, where it is clear that the overnight rate fix is negative, below the policy rate. This is an example of where the central bank maintains large excess reserves in the banking system, while the interest rate on the deposit facility is negative. Even though the policy rate is positive, short-term money market rates are negative.

Chart 5. Overnight rate (EONIA)*, ECB's key policy rate (refi-rate), ECB's deposit and lending rate (all percent, left-hand side) and excess reserves supply in the banking system* (bill. euro, right-hand side). 2006-2015



*EONIA and excess reserves supply are measured as a five-day moving average

Chart 6. Overnight rate (EONIA)*, ECB's key policy rate (refi-rate), ECB's deposit and lending rate. Percent. January 2014-April 2015



*EONIA is measured as a five-day moving average

Denmark

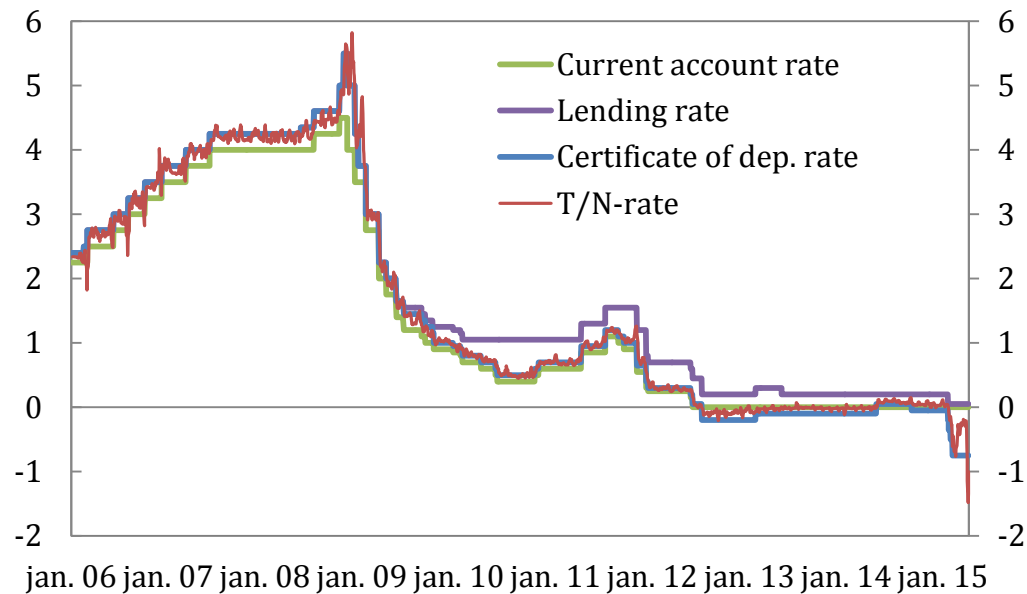
Danmarks Nationalbank maintains a system of current-account limits in its liquidity management, not unlike the quota system in Norway (discussed in detail below). Deposits under the limit are remunerated at the current-account rate (policy rate), while deposits above the limit are converted to certificates of deposit that are remunerated at the certificates of deposit rate. In this system, excess reserves are defined as the quantity of reserves exceeding the total current-account limit. With excess reserves, the certificates of deposit rate will be the guiding interest rate for the shortest money market rates.¹³

In Denmark, monetary policy is oriented towards a fixed krone exchange rate against the euro. Following strong appreciation pressure on the Danish krone, Danmarks Nationalbank has reduced the certificates of deposit rate in several steps to -0.75 percent so far in 2015, whereas the current-account rate is 0 percent. In the same period, the central bank has purchased large quantities of foreign exchange (sold DKK), which has contributed to substantial excess reserves in the banking system. At the same time, current-account limits have been raised several times, but much of the reserves are deposited at the certificates of deposit rate.¹⁴ Chart 7 shows Danmarks Nationalbank's policy rates along with the tomorrow/next (T/N) rate, which is the shortest money market rate in Denmark. After the turn of the year, the T/N rate has fallen markedly in step with the reduction in the certificates of deposit rate and the T/N fix is now negative. This is an example of how excess reserves in the banking system contribute to negative short-term money market rates, when the interest rate on the central bank's deposit facility is negative, even if the policy rate is positive or zero.

¹³ In relation to our model, Chart 1, the certificates of deposit rate corresponds to the interest rate on the central bank's deposit facility.

¹⁴ As at 9 April 2015, banks' current-accounts were DKK 168.5 billion, while certificates of deposit totalled DKK 215.2 billion.

Chart 7. The interest rates of the central bank of Denmark, Nationalbanken, and the tomorrow-next rate. Percent. January 2014-April 2015



Switzerland

The Swiss National Bank (SNB) has a policy rate in the form of a target range for the three-month Swiss franc Libor. The target range is normally one percentage point, and the central bank normally aims to keep the rate in the middle of this range. In August 2011, the SNB decided to aim for a three-month Libor of 0 percent.¹⁵ In addition, in the period between 6 September 2011 and 15 January 2015, the SNB operated with a minimum exchange rate of CHF 1.20 per euro to prevent an appreciation of the Swiss franc above this level. To defend this floor, in periods, the SNB had to purchase considerable quantities of foreign exchange. The result is that the banking system has a large surplus of central bank reserves deposited with the SNB.

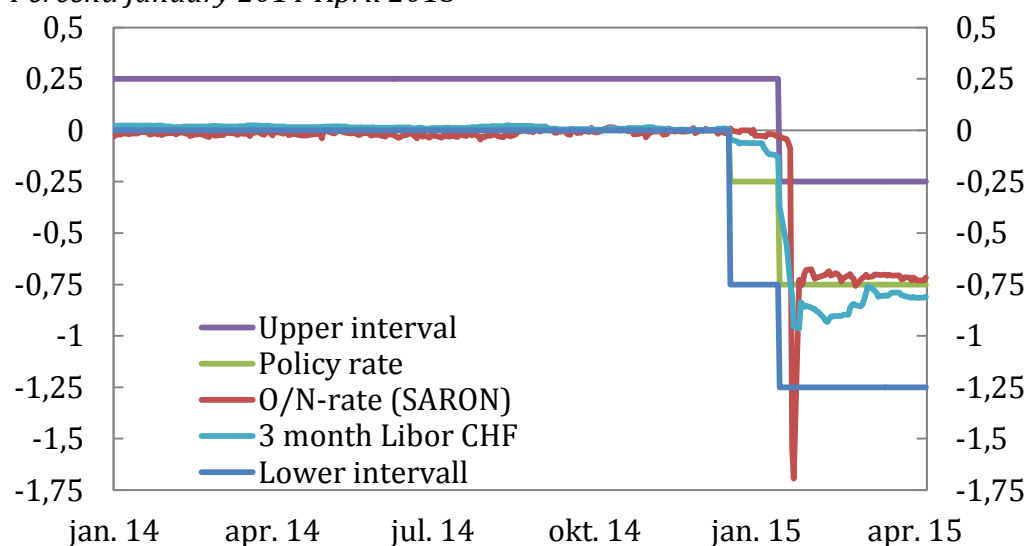
On 18 December 2014, the SNB announced that its target for the three-month Libor was lowered from 0 percent to a range of between -0.75 percent and 0.25 percent. To achieve this target, a negative interest rate was introduced of minus 25 basis points on deposits with the central bank. The negative deposit rate is levied on deposits exceeding a given exemption threshold.¹⁶ On 15 January 2015, the SNB announced that it was discontinuing the minimum exchange rate against the euro. At the same time, the target range for the three-month Libor was reduced by 50 basis points to a range of between -1.25 percent and -0.25 percent. As a consequence of this adjustment, the interest rate on deposits with the

¹⁵ The range in this period was 0-0.25 percent.

¹⁶ See http://www.snb.ch/en/mmr/reference/pre_20141218/source/pre_20141218.en.pdf for a detailed description of the exemption thresholds.

central bank was reduced by 50 basis points to -0.75 percent. Reflecting this, money market rates in Switzerland are now negative (see Chart 8).

Chart 8. Upper and lower bound in the target interval for 3mth. Libor CHF, 3mth. Libor CHF, key policy rate and the overnight rate in Switzerland. Percent. January 2014-April 2015



Sweden

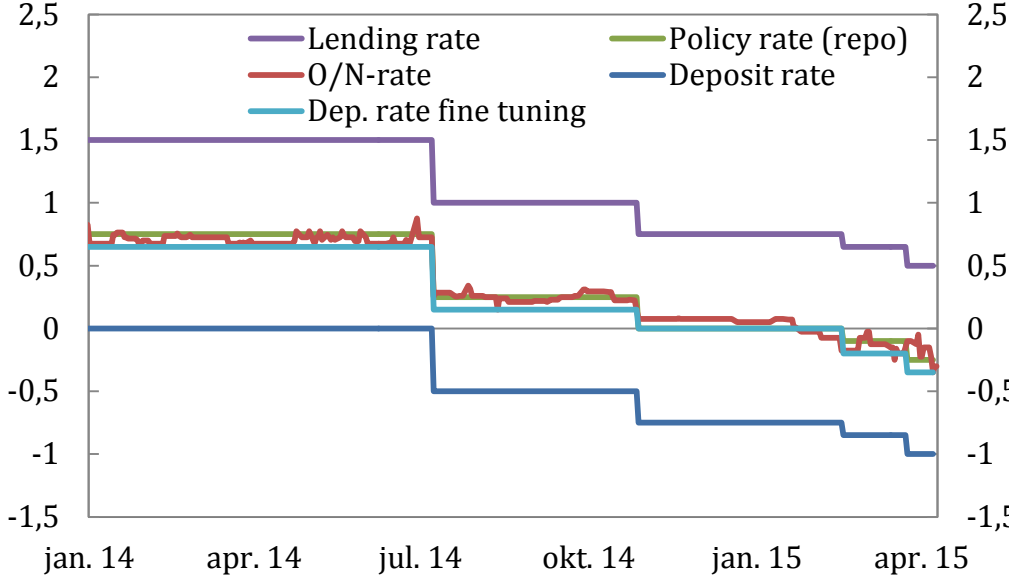
In principle, Sveriges Riksbank uses a corridor system (without reserve requirements) to manage bank reserves. The interest rate corridor is normally +/- 0.75 percentage point. The policy rate in Sweden, the repo rate, is the interest rate on the Riksbank's weekly market operations. In addition, the Riksbank conducts daily fine-tuning operations, normally at the repo rate, plus/minus 0.1 percentage point. In Sweden, banks have a structural surplus of reserves and thus a need to deposit reserves in the Riksbank. The Riksbank aims to keep the reserves in the system "approximately in balance", i.e. nearly all reserves are withdrawn in the weekly repo transactions or in the daily fine-tuning operations. Only very marginal amounts are remunerated at the deposit rate.

In October 2014, the Riksbank reduced the repo rate to 0 percent and the interest rate on its deposit facility to -0.75 percent. It was also decided at the time that fine-tuning operations would be conducted at the repo rate. This was an example of where the central bank has a negative interest rate on its deposit facility, but manages the reserves in the banking system in a way that banks do not have excess reserves. Thus, short-term money market rates did not fall below zero.

On 12 February 2015, the Riksbank lowered the repo rate to -0.10 percent, and at the same time reintroduced the corridor of +/- 10 basis points for

fine-tuning operations. On 18 March the repo rate was cut further to -0.25 percent. The reserves in the system are now withdrawn partly in the weekly market operations at the repo rate of -0.25 percent and partly in the fine-tuning operations at -0.35 percent. The amounts remunerated at the deposit rate of -1 percent are very marginal. Chart 9 shows changes in the Riksbank’s interest rates plus the overnight rate in the unsecured interbank market. Because the policy rate is now negative, the overnight market rate is now negative.

Chart 9. Overnight rate in Sweden, and the Riksbank’s interest rates. Percent. January 2014-April 2015



Sweden is thus an example of where the central bank maintains normal liquidity management without excess reserves, but sets a negative policy rate. In this case, the overnight rate is also negative. On the other hand, the examples from the euro area, Denmark and Switzerland show cases where the policy rates are zero or positive, while the central bank aims for excess reserves in the banking system. This has pushed short-term money market rates down towards the negative interest rates on the central banks’ deposit facility.

Liquidity management in Norge

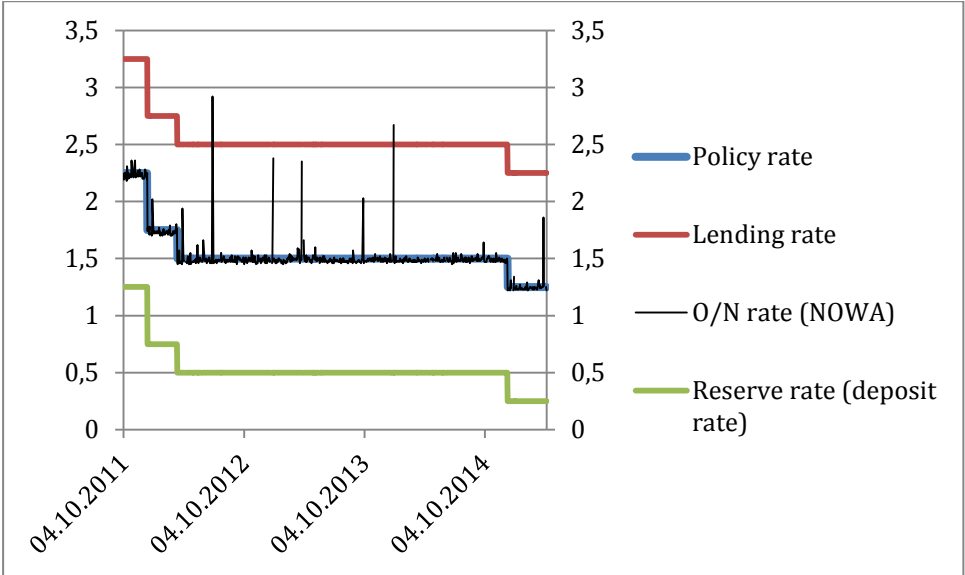
Norway maintains a “quota system” for managing reserves. Each bank is assigned a quota for deposits with Norges Bank. Deposits within the quota are remunerated at the key policy rate, while deposits in excess of the quota are remunerated at the reserve rate, which is the interest rate on Norges Bank’s standing deposit facility. Since the quota system went live in October 2011, the reserve rate in Norway has been one percentage point below the sight deposit rate (key policy rate), while the interest rate

on Norges Bank’s lending facility, the D-loan rate, has been one percentage point above the sight deposit rate. The total of banks quotas has been NOK 45 billion (total quota), while Norges Bank has aimed towards keeping the reserves in the banking system at NOK 35 billion (with an interval of plus/minus NOK 5 billion). As long as the reserves in the banking system are below the total quota, no banks need to hold deposits with Norges Bank that are remunerated at the reserve rate. In this case the overnight rate, the NOWA rate, will remain close to the key policy rate.¹⁷

Chart 10 shows the overnight rate in Norway, the key policy rate and Norges Bank’s D-loan and reserve rates since the introduction of the quota system in October 2011. During the entire period, the overnight rate has remained close to the key policy rate. The overnight rate will be close to the level of the key policy rate as long as Norges Bank keeps the total quantity of reserves lower than the total quota.

Therefore, a negative reserve rate in Norway will not result in a negative overnight rate as long as the key policy rate is positive and Norges Bank maintains the reserves in the banking system at a level lower than the total quota. In such a situation, a negative reserve rate is solely intended to maintain its function as an alternative return for banks that do not offer their excess reserves in the market.

Chart 10. Overnight rate (NOWA), Policy rate in Norway and Norges Bank’s lending rate and deposit rate/Reserve rate. Percent. October 2011-April 2015



¹⁷ Prior to October 2011, Norges Bank used a “floor system” in its liquidity management, see Bernhardsen and Kloster (2010) and Syrstad (2012) for details. More information on the current quota system is available on Norges Bank’s website (see <http://www.norges-bank.no/en/Liquidity-and-markets/The-liquidity-management-system/>).

References

- Aamodt, E. og K. Tafjord (2013) «Structural liquidity», Norges Bank Economic Commentaries 2013/9
- Bernhardsen, T. and A. Kloster (2010) «Liquidity management system: Floor or corridor?», Staff-memo 2010/4 Norges Bank
- ECB (2014) «Recent developments in excess liquidity and money market rates», Monthly Bulletin January 2014
- Jørgensen, A. and L. Risbjerg (2012) «Negative interest rates», Monetary Review, 3. Quarter 2012, part 1, Nationalbanken in Denmark
- Keister, T., A. Martin and J. McAndrews (2008) «Divorcing money from monetary policy», *FRBNY Economic Policy*, September 08, 41-55
- Riksbanken (2014) «The Riksbank's operational framework for the implementation of monetary policy – a review», Riksbank Studies, March 2014.
- Syrstad, O. (2011) «Systemer for likviditetsstyring: Oppbygging og egenskaper», Staff-memo 2011/5 Norges Bank (In Norwegian only)
- Whitesell, W. (2006) «Interest rate corridors and reserves», *Journal of Monetary Economics*, 53, 1177-1195