

---

# Negative Interest Rates

---

*Anders Jørgensen, Market Operations, and Lars Risbjerg, Economics*

---

## INTRODUCTION AND SUMMARY

---

In early July 2012, Danmarks Nationalbank lowered its monetary-policy interest rates to historically low levels in connection with the ECB reduction of interest rates. The rate of interest on certificates of deposit was reduced to -0.20 per cent. This means that the monetary-policy counterparties are paying for placing liquidity in certificates of deposit with Danmarks Nationalbank. For the first time in its nearly 200-year history, one of Danmarks Nationalbank's interest rates is negative. Negative monetary-policy interest rates are also unique in an international perspective. Negative interest rates on banks' deposits with Sveriges Riksbank were introduced for a period during 2009-10, but the amounts were small and did not result in negative market rates.

The negative rate of interest on certificates of deposit was set solely with consideration to maintaining Denmark's fixed-exchange-rate policy. The fixed-exchange-rate policy entails that monetary policy is laid down with a view to stabilising the krone against the euro.

To counter a sustained inflow of foreign exchange and a tendency for the krone to strengthen, Danmarks Nationalbank has conducted intervention purchase of foreign exchange for considerable amounts since August 2011, as well as lowered the monetary-policy interest rates several times due to ECB interest-rate reductions and unilaterally to reduce the interest-rate spread between Denmark and the euro area. In connection with the interest-rate reduction in July, the spreads between the monetary-policy interest rates in Denmark and the euro area remained unchanged.

Some market rates were already negative before the rate of interest on certificates of deposit became negative. In the 2nd half of 2011, Danish market rates fell after the flare-up of financial and political tensions in the euro area. As was the case in e.g. Germany, interest rates on short-term Danish Treasury bills were negative at the end of 2011 due to strong demand from foreign investors. At times during the weeks up to Danmarks Nationalbank's interest-rate reduction in July 2012, other Danish money-market interest rates and interest rates on Danish govern-

ment securities with maturities of up to around 3 years were also below 0 per cent.

Transmission to market rates and the krone rate has been clear since the introduction of the negative interest rate on certificates of deposit. The money-market interest rates have become even more negative than before the interest-rate reduction, and the krone has weakened slightly from around 0.3 per cent to approximately 0.1 per cent above the central rate against the euro.

This article describes the background to negative monetary-policy interest rates and other examples of negative interest rates. This is followed by an account of the introduction of negative monetary-policy interest rates in Denmark and a description of the transmission to market rates.

## BACKGROUND

---

Since the onset of the financial crisis in 2007, central banks around the world have gradually lowered their interest rates to levels close to zero in response to the severe global economic downturn.<sup>1</sup> The subsequent sovereign debt crisis in a number of countries in the euro area further weakened global growth prospects. In addition to the interest-rate reductions, extraordinary monetary-policy measures have been taken to stimulate the economy, including securities purchases and communication about the central banks' expectations as regards the future monetary-policy interest rates.

The economic literature often assumes a zero lower bound on nominal monetary-policy interest rates, cf. Blomquist et al. (2011). Otherwise, a higher return could be achieved by holding cash. However, holding cash and settlement of large payments in cash that has to be moved, counted, stored and insured, are associated with costs. Banks settle large interbank payments via accounts in the central bank, so in practice they are willing to pay for placing funds with the central bank. Similarly, investors are willing to accept negative interest rates on e.g. bank deposits and investments in securities, cf. Thornton (1999).

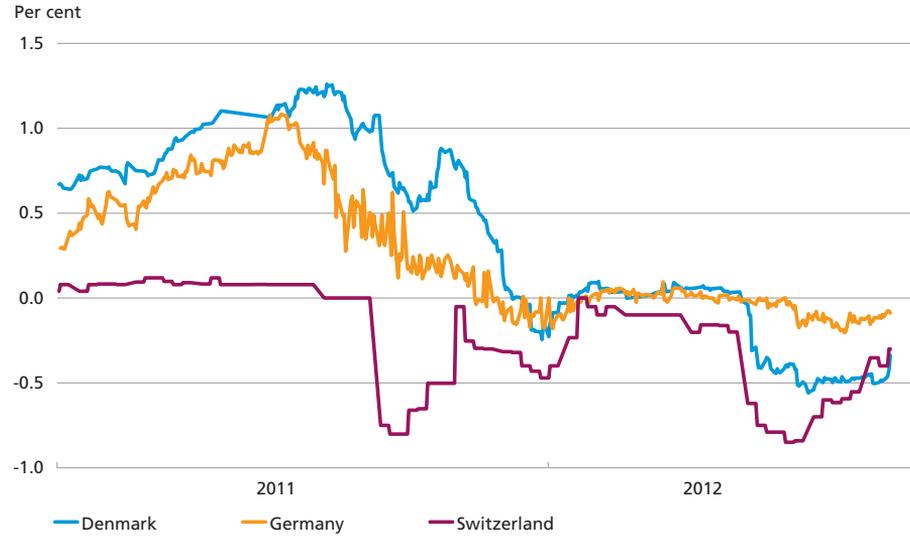
The literature proposes a number of options for central banks to breach the zero lower bound on nominal monetary-policy interest rates. Goodfriend (2000) proposes taxation of the banks' deposits at the central bank, thus rendering the effective yield negative. This would have the same impact on market rates as introducing a negative monetary-policy interest rate on deposits at the central bank.

---

<sup>1</sup> In December 2008, the Federal Reserve lowered the fed funds target rate to 0.00-0.25 per cent at which level it has remained. Most recently, in July 2012, the ECB reduced the lending rate to 0.75 per cent in its weekly refinancing operations, at the same time lowering the deposit rate to zero.

3-MONTH T-BILL RATES IN DENMARK, GERMANY AND SWITZERLAND

Chart 1



Note: Interest rates for Germany are stated according to a Bloomberg index for the 3-month interest rate (mid-prices). Interest rates for Switzerland are based on auction prices of 3-month T-bills. The Danish interest rate is calculated by linear interpolation between the interest rates for the two closest T-bills. Last observation: 12 September 2012.  
Source: Bloomberg, MTS, Nordea Analytics and Schweizerische Nationalbank.

### Experience with negative interest rates

Situations with nominal negative interest rates are rare, but there are examples from several countries. In Japan, the T-bill rate became negative at the end of 1998, and short-term money-market interest rates in e.g. Germany, Switzerland and Denmark have been negative at times since mid-2011, cf. Chart 1.

To our knowledge, the only earlier example of negative monetary-policy interest rates in recent times was when Sveriges Riksbank lowered the rate of interest on its deposit facility to -0.25 per cent in July 2009. The interest rate remained negative until September 2010. The deposit that was subject to negative interest was very small, however. In the period of negative deposit rates the money-market rates did not become negative, but remained relatively close to the repo rate.<sup>1</sup>

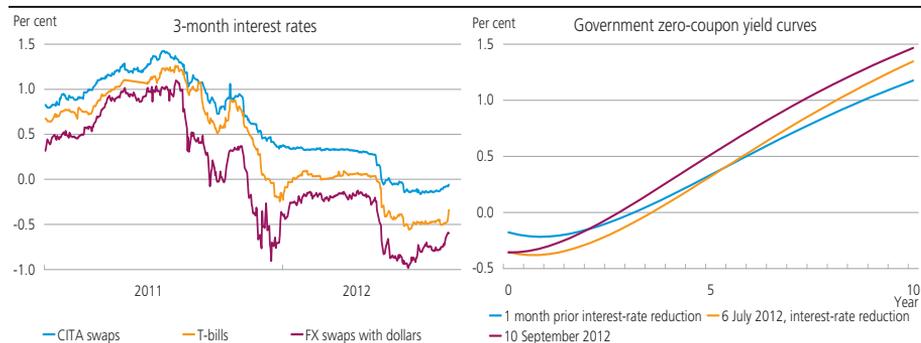
In the 1970s, Switzerland introduced a number of measures to counter appreciation pressures on the Swiss franc. The monetary-policy interest rates were not negative, but negative interest rates on non-residents' deposits at Swiss banks were introduced.<sup>2</sup>

<sup>1</sup> The reason is that Sveriges Riksbank conducted fine-tuning operations on a daily basis to keep the overnight interest rate close to its repo rate of +0.25 per cent. On 23 August 2009, the banks only had deposits on the deposit facility at a negative interest rate amounting to 34 million Swedish kronor. The banks had certificates of deposit amounting to 130 billion Swedish kronor and placed 167 billion Swedish kronor at Sveriges Riksbank via the fine-tuning operations.

<sup>2</sup> The introduction of negative interest rates on short-term deposits with Swiss banks has been referred to as commission.

## SELECTED DANISH 3-MONTH INTEREST RATES AND GOVERNMENT ZERO-COUPON YIELD CURVES

Chart 2



Note: Left-hand chart: CITA swaps indicate the swap rate of 3-month interest-rate swaps at the overnight interest rate, the T/N rate. Such swaps are also referred to as CITA swaps. T-bills indicate the 3-month interest rate found by linear interpolation between the interest rates for the two closest T-bills. FX swaps with dollars indicate the implied interest-rate spread between kroner and dollars from 3-month FX swaps between dollars and kroner plus the 3-month swap rate in dollars. The vertical line is placed at 6 July 2012, the effective date of Danmarks Nationalbank's interest-rate reduction. Last observation: 12 September 2012. Right-hand chart: The government zero-coupon yield curve is estimated on the basis of central-government issuance.

Source: Reuters EcoWin, Nordea Analytics, MTS and Danmarks Nationalbank.

## Negative market rates in Denmark

Danish money-market interest rates were negative in several instances even before the introduction of negative monetary-policy interest rates, cf. Chart 2 (left).

At the T-bill auction at the end of December 2011, T-bills with maturities of 2 and 5 months were issued at negative interest rates, but the T-bills had already been traded at negative interest rates in the secondary market. At the end of May 2012, T-bills were again issued at negative interest rates, while the other money-market interest rates were around zero. Part of the explanation for the low T-bill rates is a distortion of the FX swap market, particularly between kroner and dollars, but also between kroner and euro.<sup>1</sup> The FX swap market distortion is also partly attributable to considerable interest, including from the pension sector, in selling foreign exchange on forward terms in FX swaps in order to hedge foreign-exchange exposure from foreign investment. This drove down the forward rate of e.g. dollars compared to the spot rate, making it more expensive to hedge the dollar exposure. On the other hand, it made it cheaper to buy dollars forward and to convert the exposure in kroner into dollars. As a result, investors with good and direct access to dollars have been able to achieve a higher dollar return even when

<sup>1</sup> The swap market distortion implies deviations from the covered interest-rate parity between kroner and dollars. The parity indicates that the same dollar return can be obtained by placing funds directly in dollars as by placing them in kroner while at the same time concluding an FX swap from kroner to dollars where the krone exposure is converted into dollar exposure. Major imbalances also existed during the financial crisis in the autumn of 2008, cf. Jensen et al. (2008), Box 2.1, which also describes the causes of imbalances in the FX swap market in more detail.

placing funds at negative T-bill rates in Denmark while buying dollars on forward terms, thereby converting krone exposure into dollar exposure via FX swaps, rather than placing funds directly in the money market for dollars.<sup>1</sup>

Before the introduction of a negative monetary-policy interest rate, interest rates on CITA swaps were periodically negative in June 2012 for maturities up to 1 year. CITA swaps are interest-rate swaps based on the overnight interest rate, the T/N rate, and reflect market expectations about the future overnight money-market interest rates.<sup>2</sup> The T/N rate is closely linked to Danmarks Nationalbank's monetary-policy interest rates. Negative CITA swap rates can thus be seen as an expression of market expectations of negative monetary-policy interest rates. Interest rates on Danish government securities with maturities of up to around 3 years were also negative prior to the interest-rate reduction, cf. Chart 2 (right). In the period leading up to the interest-rate reduction, the market expected the ECB to reduce the interest rate and that Danmarks Nationalbank would follow suit.

### **Fixed-exchange-rate policy and monetary-policy instruments**

Monetary policy and the monetary-policy instruments, cf. Box 1, are aimed at keeping the krone stable against the euro within the framework of ERM 2.<sup>3</sup> In the euro area, monetary policy aims to keep inflation below, but close to 2 per cent. Keeping the krone stable against the euro creates a framework for low inflation in Denmark in the slightly longer term. Considerations other than the exchange rate, e.g. economic development in Denmark, are not taken into account in relation to monetary policy.

In the short term, Danmarks Nationalbank can keep the krone stable against the euro by buying and selling foreign exchange in the market. In periods when the foreign-exchange market is stable, Danmarks Nationalbank usually changes its interest rates in step with the ECB. In situations with prolonged inflow or outflow of capital and pressure against the krone, Danmarks Nationalbank unilaterally changes its interest rates to stabilise the krone. Monetary-policy interest rates are determinative for the money-market interest rates that influence capital flows and the exchange rate.

Since August 2011, Danmarks Nationalbank has made intervention purchases of foreign exchange in the amount of kr. 91 billion and lowered

<sup>1</sup> T-bills have almost exclusively been purchased by foreign investors. T-bills have been seen as a convenient way to make short-term placements with high credit ratings.

<sup>2</sup> The pricing of CITA swap rates takes into account the average expected T/N rates (the forward rates) during the lifetime of the swap.

<sup>3</sup> Exchange Rate Mechanism 2, applying from the introduction of the euro in 1999.

DANMARKS NATIONALBANK'S MONETARY-POLICY INSTRUMENTS<sup>1</sup>

Box 1

Danmarks Nationalbank's manages its accounts with the monetary-policy counterparties, the banks and mortgage banks, via its monetary-policy instruments, i.e. the terms for using the lending and deposit facilities made available by Danmarks Nationalbank to the monetary-policy counterparties. The monetary-policy counterparties have access to two facilities at Danmarks Nationalbank: open market operations and current-account deposits, the latter often referred to as current-account liquidity or just liquidity.

#### Current accounts

Current accounts are demand accounts where the counterparties can place liquidity overnight. Current accounts play a key role in the Danish payment system. Current-account deposits can be used at the initiative of the counterparties for immediate settlement of interbank payments and the banks' accounts with Danmarks Nationalbank. Via its open market operations, Danmarks Nationalbank ensures that there is adequate liquidity within the banking system for smooth and secure settlement of payments. Limits have been set for current-account deposits in order to reduce the funds available for speculation in a weakening of the krone, cf. below.

#### Open market operations

Through Danmarks Nationalbank's regular open market operations on the last banking day of each week, the counterparties can borrow against collateral and place the funds in certificates of deposit, which are deposits at Danmarks Nationalbank with an original maturity of 7 days. If necessary, Danmarks Nationalbank also conducts extraordinary open market operations, in which it buys or sells certificates of deposit in order to manage the banking sector's liquidity. This is typically done in connection with large-value government payments and intervention in the foreign-exchange market. In addition, Danmarks Nationalbank conducts monthly open market operations where the counterparties can borrow against collateral for 6 months. The rate of interest on 6-month loans is variable, reflecting Danmarks Nationalbank's 7-day lending rate.

#### Current-account limits

An overall limit has been determined for the monetary-policy counterparties' total current-account deposits with Danmarks Nationalbank at the close of the day. The purpose of the limit is to prevent the build-up of large current-account deposits immediately available for speculation in a weakening of the krone.

In its open market operations, Danmarks Nationalbank will normally ensure that the counterparties' total current-account deposits do not exceed the limit. If the counterparties' current-account deposits exceed the overall limit, they will be converted into certificates of deposit. Prior to the introduction of negative rates of interest on certificates of deposit, this only happened three times: on 2 March 2006 and on 6 January and 8 June 2012.<sup>2</sup> After the introduction of negative rates of interest on certificates of deposit, conversions have been conducted three times: on 9 July, 13 July and 31 August.

<sup>1</sup> For a description, see Danmarks Nationalbank (2009).

<sup>2</sup> The two latter conversions reflect the narrowing of the spread between the rate of interest on certificates of deposit and the current-account rate to 0.05 percentage point, the lowest level so far, reducing the interest-rate loss from depositing funds in current accounts.

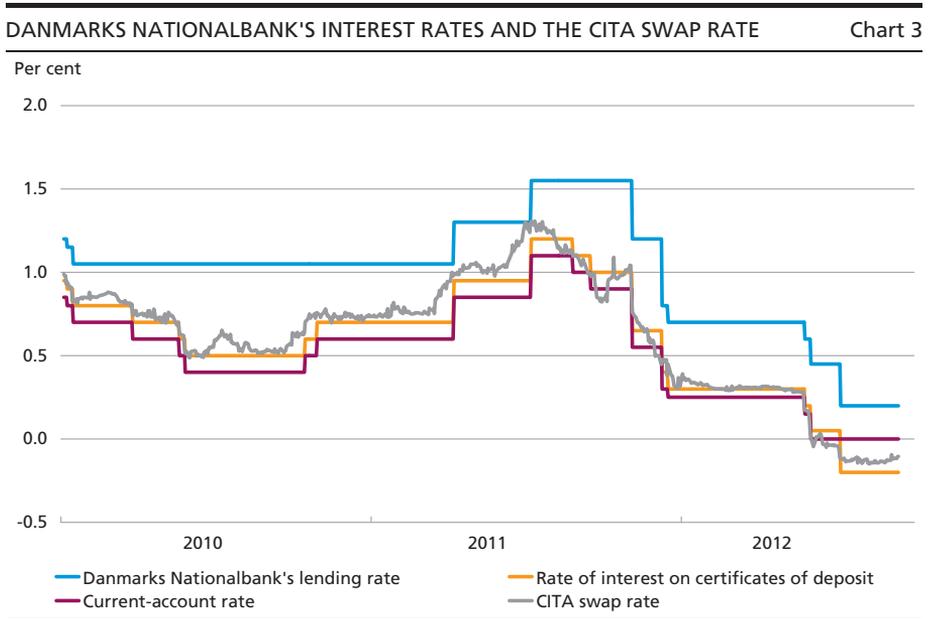
CONTINUED Box 1

The overall current-account limit is made up of the sum of current-account limits for the individual counterparties. The individual current-account limits are determined in accordance with the counterparties' activity in the money market. Counterparties with extensive activity in the money market, which are key contributors to smooth exchange of liquidity, have the highest current-account limits.

its monetary-policy interest rates several times, cf. Chart 3, both as a result of the ECB interest-rate reductions and unilaterally to reduce the interest-rate spread between Denmark and the euro area. Since the autumn of 2011 when the sovereign debt crisis intensified in a number of euro area member states, the Danish krone has been stable and slightly stronger than the ERM 2 central rate against the euro.

Today, Danmarks Nationalbank's deposit rates are key to the money-market interest rates in Denmark. The reason is that the Danish banks and mortgage banks, i.e. the monetary-policy counterparties, currently have a substantial need to deposit funds at Danmarks Nationalbank (a positive net position), cf. Chart 4.

The monetary-policy counterparties' need to deposit funds at Danmarks Nationalbank reflects the autonomous factors on Danmarks

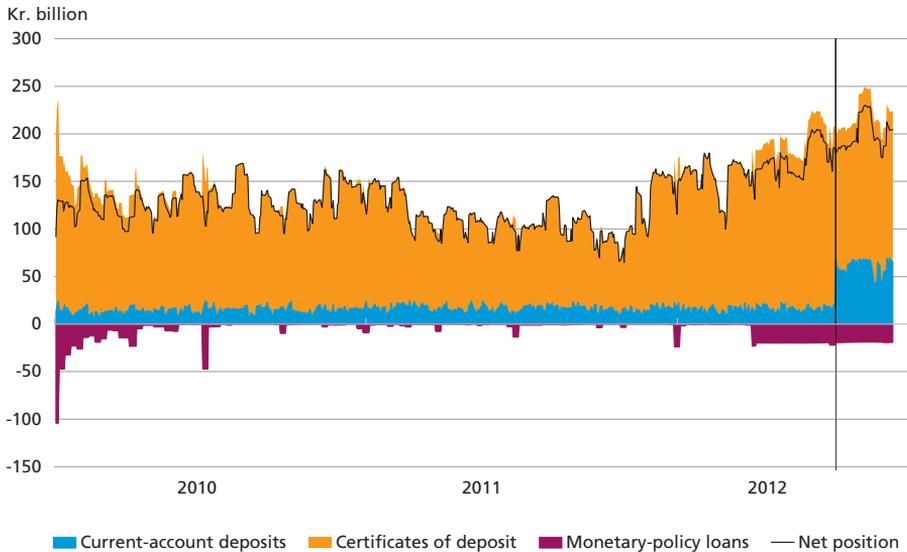


Note: The CITA swap rate is the 1-month interest rate of interest-rate swaps at the overnight interest rate, the T/N rate. Last observation: 12 September 2012.  
 Source: Reuters EcoWin and Danmarks Nationalbank.

---

**THE BANKS' AND MORTGAGE BANKS' OUTSTANDING ACCOUNTS WITH DANMARKS NATIONALBANK**

Chart 4



Note: The vertical line is placed at 6 July 2012, the date Danmarks Nationalbank's interest-rate reduction became effective. Last observation: 11 September 2012.

Source: Danmarks Nationalbank.

Nationalbank's balance sheet, e.g. the foreign-exchange reserve, the balance of the central government's account with Danmarks Nationalbank, and currency in circulation. When Danmarks Nationalbank makes e.g. intervention purchases of foreign exchange from banks, the banks' need to deposit kroner at Danmarks Nationalbank increases. Individual banks may change their outstanding account with Danmarks Nationalbank by e.g. depositing kroner at other banks, but the banks and mortgage banks taken as one cannot change the overall need to deposit funds at Danmarks Nationalbank.

---

**INTRODUCTION OF NEGATIVE MONETARY-POLICY INTEREST RATES**

Three factors in particular have been of importance in connection with the introduction of negative monetary-policy interest rates. Firstly, it is crucial to ensure a pass-through to the money market and thus the exchange rate of the krone. Secondly, it has been important to use existing monetary-policy instruments wherever possible, without adding new instruments or facilities. Finally, emphasis has been placed on communicating clearly to prepare the monetary-policy counterparties for the extraordinary situation involving negative monetary-policy interest rates.

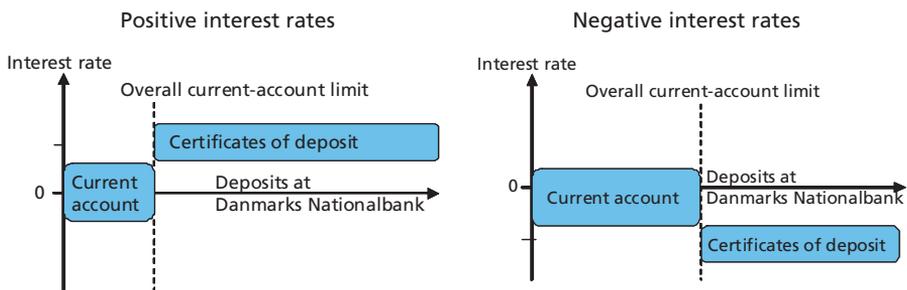
### Adjustment of the monetary-policy instruments

The introduction of negative monetary-policy interest rates implied that Danmarks Nationalbank reduced the rate of interest on certificates of deposit, which is essential to the money-market interest rates, rendering it negative and, unlike before, lower than the current-account rate, cf. Chart 5. Current-account deposits that are used for settlement of payments accrue interest at a rate of 0 per cent.

At the current net position, the overall current-account limit ensures that the monetary-policy counterparties taken as one will have deposits placed in certificates of deposit at a negative interest rate, meaning that their marginal liquidity deposits with Danmarks Nationalbank, e.g. in connection with capital inflows to Denmark, will accrue negative interest rates. When the rate of interest on certificates of deposit is lower than the current-account rate, the counterparties will have an incentive to deposit funds in a current account rather than purchasing certificates of deposit. If the total current-account deposits exceed the overall current-account limit, Danmarks Nationalbank will, as previously, convert current-account deposits into certificates of deposit.

When the negative rate of interest on certificates of deposit was introduced, the current-account limits were adjusted upwards from kr. 23.15 billion to kr. 69.70 billion to reduce the strain of a negative rate of interest on certificates of deposit on the monetary-policy counterparties. The fact that there is an even larger current-account deposit at 0 per cent may counter any substitution to cash. In relation to the fixed-exchange-rate policy, the current-account limits are normally aimed at reducing the funds immediately available for speculation in a weakening of the krone. In the current situation with a strong krone where Danmarks Nationalbank is intervening in the foreign-exchange market and reducing its monetary-policy interest rate to counter a strength-

ILLUSTRATION OF THE ADJUSTMENT OF MONETARY-POLICY INSTRUMENTS WHEN NEGATIVE MONETARY-POLICY INTEREST RATES WERE INTRODUCED Chart 5



Note: Note that Danmarks Nationalbank's lending is not included in the outline of the monetary-policy instruments.

ening of the krone, increasing the current-account limits does not constitute a problem in relation to the fixed-exchange-rate policy. In connection with the upward adjustment, banks with higher money-market activity saw the largest increase in their current-account limits in relation to the overall limit.

In February 2012, Danmarks Nationalbank posted a technical description on the handling of potentially negative monetary-policy interest rates on its website. The financial sector was then informed directly. The purpose was to give the counterparties the opportunity to ensure that their IT systems and business procedures were able to handle a situation with negative interest rates. The Monetary Review, 2nd Quarter 2012, which was issued in mid-June 2012, contained a description of Danmarks Nationalbank's instruments for handling a situation with negative interest rates.

### Transmission to money-market interest rates

There has been a clear pass-through to the market rates following Danmarks Nationalbank's interest-rate reduction to a negative rate of interest on certificates of deposit. The immediate effect was a drop in the money-market interest rates with the CITA rates for maturities up to 1 year falling to further negative levels.

In the hour after Danmarks Nationalbank's announcement of its interest-rate reduction at 4.00 p.m. on 5 July 2012, following the ECB interest-rate reduction at 1.45 p.m., the krone weakened from approximately 7.4365 to 7.4405 against the euro. Danmarks Nationalbank's monetary-policy spread to the euro area remained unchanged, cf. Chart 6 (right), but the krone did weaken slightly when there was no longer

THE KRONE RATE AGAINST THE EURO RATE AND THE SPREAD BETWEEN DENMARK AND THE EURO AREA

Chart 6



Note: The vertical lines are placed at 6 July 2012, the date Danmarks Nationalbank's interest-rate reduction became effective. Last observation: 12 September 2012. Right-hand chart: The monetary-policy spread between Danmarks Nationalbank's lending rate and the ECB's lending rate in the weekly open market operations.

Source: Reuters and Danmarks Nationalbank.

any doubt left in the market as to whether Danmarks Nationalbank would in fact introduce a negative rate of interest on certificates of deposit.

Since then, the krone has weakened slightly further to around 0.1 per cent above the central rate against the euro against 0.3 per cent above the central rate prior to the interest-rate reduction, cf. Chart 6 (left). The ERM 2 fluctuation band for the krone is +/- 2.25 per cent in relation to the central rate. The subsequent weakening of the krone to some extent reflects that confidence in the handling of the sovereign debt crisis in a number of European countries improved in August and the euro was strengthened.

As was the case before the interest-rate reduction, the rate of interest on certificates of deposit is key to the overnight interest rate and the long-term money-market interest rates. Fluctuations of a technical nature in the overnight interest rate are seen, but on average the overnight interest rate will follow the rate of interest on certificates of deposit, cf. Box 2.

As a result of the rate of interest on certificates of deposit becoming negative and lower than the current-account rate of 0 per cent, the monetary-policy counterparties now have a financial incentive to place funds in current accounts rather than in certificates of deposit, and they increased their current-account deposits when the current-account limits were raised, cf. Chart 4. However, the counterparties have also purchased certificates of deposit to bring the total current-account deposit below the overall current-account limit, so Danmarks Nationalbank has only converted current-account deposits into certificates of deposit three times since the interest-rate reduction.

Today, the counterparties overall hold certificates of deposit amounting to approximately kr. 150 billion. If the holding and the rate of interest on certificates of deposit remain unchanged in the coming year, this will entail interest expenses in the range of kr. 300 million. It is still too early to determine the interest-rate pass-through to the banks' retail rates for the private and corporate sectors, but so far the banks have not introduced negative retail rates on deposits.<sup>1</sup>

The turnover for overnight money-market loans has been declining since the interest-rate reduction. According to a general seasonal trend, turnover falls over the summer, cf. Chart 8 (left). At the same time, due to the upward adjustment of their current-account limits, the banks' daily liquidity management scope has increased. This may reduce the need

---

<sup>1</sup> In a few instances, firms have had negative interest rates on deposits, primarily special short-term time deposits.

MONETARY-POLICY INTEREST RATES AND THE OVERNIGHT INTEREST RATE

Box 2

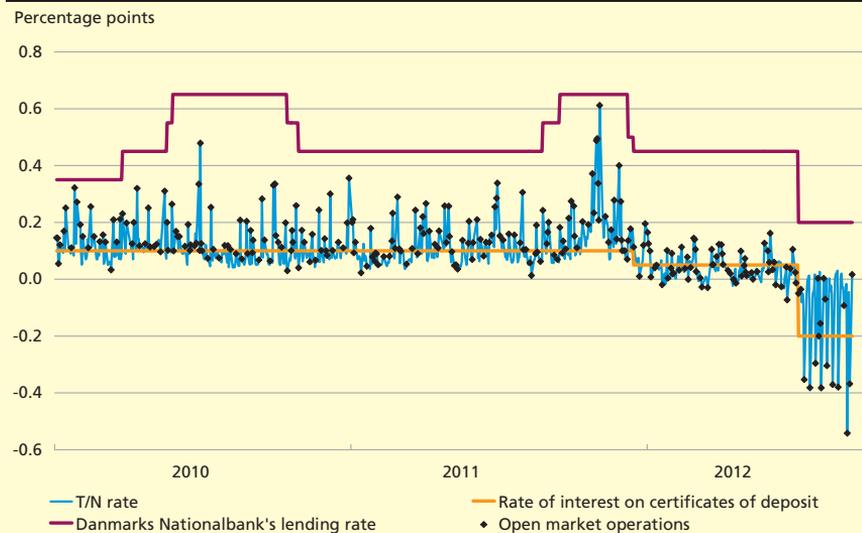
The monetary-policy counterparties mainly use the overnight money market in their daily liquidity management, and the overnight interest rate is closely linked to the monetary-policy interest rates. Since certificates of deposit have longer maturities than current-account deposits, fluctuations of a technical nature in the overnight interest rate occur, but on average the overnight interest rate will be close to the rate of interest on certificates of deposit when, as is currently the case, the counterparties overall have a substantial need to deposit funds at Danmarks Nationalbank (a positive net position).

On days without open market operations, the overnight money-market interest rate will tend to be close to the current-account rate, which constitutes the alternative to the interest rate on deposits in the money market, cf. Chart 7.

On days with open market operations, certificates of deposit constitute an alternative to money-market deposits. Counterparties with a liquidity surplus will weigh the returns from placing funds in certificates of deposit or placing funds in the overnight money market on an ongoing basis until the next open market operation. As previously stated, placing funds in the money market results in interest rates close to zero on days without open market operations. Therefore, on days with open market operations, it may be an advantage for a counterparty to grant loans in the overnight market at an interest rate that is lower (more negative) than the rate of interest on certificates of deposit, if this means that the bank can avoid placing funds in certificates of deposit.

THE SPREAD OF THE T/N RATE, THE RATE OF INTEREST ON CERTIFICATES OF DEPOSIT AND DANMARKS NATIONALBANK'S LENDING RATE TO THE CURRENT-ACCOUNT RATE

Chart 7



Note: Open market operations include both ordinary and extraordinary open market operations. Extraordinary open market operations include both announced and unannounced operations. The T/N interest rate is shown on the settlement date. Last observation: 10 September 2012.

Source: Danmarks Nationalbank.

## TURNOVER IN THE MONEY MARKET AND CURRENCY IN CIRCULATION

Chart 8



Note: Left-hand chart: Turnover is calculated as a 20-day moving average of uncollateralised money-market lending and lending in kroner in connection with repo transactions and FX swaps. Last observation: 7 September 2012. Right-hand chart: Banknote circulation is based on monthly observations up until the beginning of June 2012 and subsequently on daily observations. Last observation: 11 September 2012.

Source: Danmarks Nationalbank.

for the exchange of liquidity in the market, but the total turnover has not fallen to unprecedented levels.

The Danish banknotes most commonly used for deposits of cash are the 500-krone and 1,000-krone notes, and the circulation of large banknotes has remained stable, cf. Chart 8 (right), the decisive factor undoubtedly being that the banks have not introduced negative retail rates on deposits.

Danmarks Nationalbank carefully monitors developments in the money market and can make technical adjustments to the monetary-policy instruments to ensure the pass-through to the money market. This is done in accordance with the activity in the money market. Under the monetary-policy regulations applying from time to time, Danmarks Nationalbank reserves the right to make adjustments without prior notice if it is deemed necessary due to monetary- and foreign-exchange-policy considerations.

## LITERATURE

---

Blomquist, Niels, Niels Arne Dam and Morten Spange (2011), Monetary-policy strategies at the zero lower bound on interest, Danmarks Nationalbank, *Monetary Review*, 4th Quarter, Part 1.

Danmarks Nationalbank (2009), *Monetary policy in Denmark*.

Goodfriend, Marvin (2000), Overcoming the zero bound on interest rate policy, *Journal of Money, Credit and Banking*, Vol. 32, No. 4, November.

Jensen, Carina Moselund, Anders Jørgensen, Paul Lassenius Kramp and Lars Risbjerg (2011), The money and foreign-exchange markets during the crisis, Danmarks Nationalbank, *Monetary Review*, 2nd Quarter, Part 2.

Thornton, Daniel L. (1999), Nominal interest rates: Less than zero?, The Federal Reserve Bank of St. Louis, *Monetary Trends*.