The Money and Foreign-Exchange Markets during the Financial Crisis

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INTRODUCTION AND SUMMARY

The money market, comprising the market for interbank loans and short-term securities, played a central role during the financial turmoil which erupted in August 2007 and developed into an international financial and economic crisis following the suspension of payments by Lehman Brothers in September 2008. Part 2 of this Monetary Review contains a more detailed analysis of the money and foreign-exchange markets during the crisis.[1] This article summarises the most important findings and experience.

The banks in a number of countries, including Denmark, were highly dependent on funding in the international money and capital markets. During the crisis, the banks in several countries became reluctant to lend to each other, and it became difficult for them to raise funding in the money market, especially in dollars. The money markets froze at the peak of the crisis in the autumn of 2008.

The crisis has shown that it is important for banks to structure their liquidity management so as to limit their dependence on funding in individual markets where liquidity can disappear very rapidly. Against this background, Danmarks Nationalbank and the Danish Financial Supervisory Authority have intensified the supervision of banks' liquidity management.

Central banks worldwide responded quickly and massively to the crisis, launching a number of extraordinary measures to support the banks' liquidity and access to funding. Danmarks Nationalbank provided dollar and euro loans to the banks via the foreign-exchange reserve and via swap lines with the Federal Reserve and the European Central Bank, ECB. According to our regression analyses, these measures substantially improved the liquidity conditions in foreign currency.

[1] Cf. Carina Moselund Jensen, Anders Jørgensen, Paul Lassenius Kramp and Lars Risbjerg, The money and foreign-exchange markets during the crisis, part 2 of this Monetary Review.

The Danish money market in kroner was also affected. This was reflected e.g. in the Danish spread between uncollateralised and collateralised money-market interest rates, which widened considerably, as was the case in a number of countries. Our empirical analyses show that, at the beginning of the crisis, the Danish spread was driven mainly by liquidity conditions in the euro area. In the course of 2009 the spread came to predominantly imply a credit premium, reflecting that the crisis evolved from a liquidity crisis into a credit crisis.

On average, small banks paid a higher excess financing rate in the money market compared with large banks, and they had to increase the number of counterparties in order to obtain the necessary liquidity. Danmarks Nationalbank established extraordinary liquidity facilities, but the extent of loans provided in that connection was very limited. Hence, Danmarks Nationalbank's provision of liquidity was predominantly allotted through the usual channels via the monetary-policy instruments, which proved to be robust and flexible in terms of ensuring the necessary liquidity for the banks.

The krone came under pressure when international investors withdrew from minor currencies in the autumn of 2008. In accordance with the fixed-exchange-rate policy Danmarks Nationalbank intervened massively in the foreign-exchange market in support of the krone, which remained stable against the euro during the crisis. At the peak of the crisis, it was impossible to substitute the outflow from the foreign-exchange reserve for government loans. The crisis thus showed that a large foreign-exchange reserve was needed for intervention in support of the krone, and Danmarks Nationalbank more than doubled the foreign-exchange reserve in relation to the situation before the crisis in the autumn of 2008. The crisis also showed that because banks are dependent on funding in foreign currency, Danmarks Nationalbank may need to provide foreign-currency loans out of the foreign-exchange reserve.

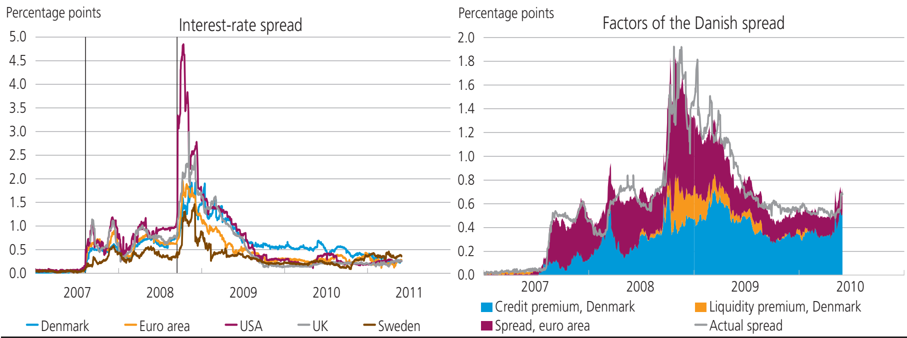
HOW DID THE CRISIS SPREAD TO DENMARK?

A key cause of the crisis was the market for mortgages to less creditworthy American homeowners (the subprime market). Several US banks as well as banks in other countries had invested in assets exposed to the US housing market, which was suffering mounting losses. The assets were often complex financial instruments with opaque exposure. In addition to making the banks increasingly uncertain about their counterparties' credit standings and their own liquidity situation, these conditions made them hesitant to grant credit in the money market. This was reflected in a widening of the spread between uncollateralised and collateralised money-market interest rates, cf. the left-hand side of Chart 1. From the end of 2008 until the end of 2010, the Danish spread was wider than that of the euro area.

The crisis in the US market spread to the Danish market through the euro area. Our estimations in the article in Part 2 indicate that a large share of the Danish spread between uncollateralised and collateralised interest rates can be explained by the corresponding spread for the euro area, which mainly reflected a shortage of liquidity. However, in the course of 2009 the Danish spread came to predominantly imply a credit premium, i.e. a price for credit risk, cf. the right-hand side of Chart 1, reflecting that the crisis evolved from a liquidity crisis into a credit crisis. On the face of it, the wide credit-related spread was remarkable in view of Bank Rescue Package 1, which included a government guarantee for all deposits at banks from October 2008 to September 2010. A key explanatory factor is that most banks determined their credit policies as if Bank Rescue Package 1 did not exist. Furthermore, some market participants may have been uncertain about how fast they would be able to receive government funds if a counterparty failed. If the government was only able to honour claims with a certain lag, the failure of a counterparty might have lead to losses due to a shortage of liquidity.

Several banks in a number of countries were to a large extent funding themselves via short-term loans in foreign currency, especially dollars, in the international money markets. This is the key to understanding why the problems in the US mortgage market, which spread to the US money

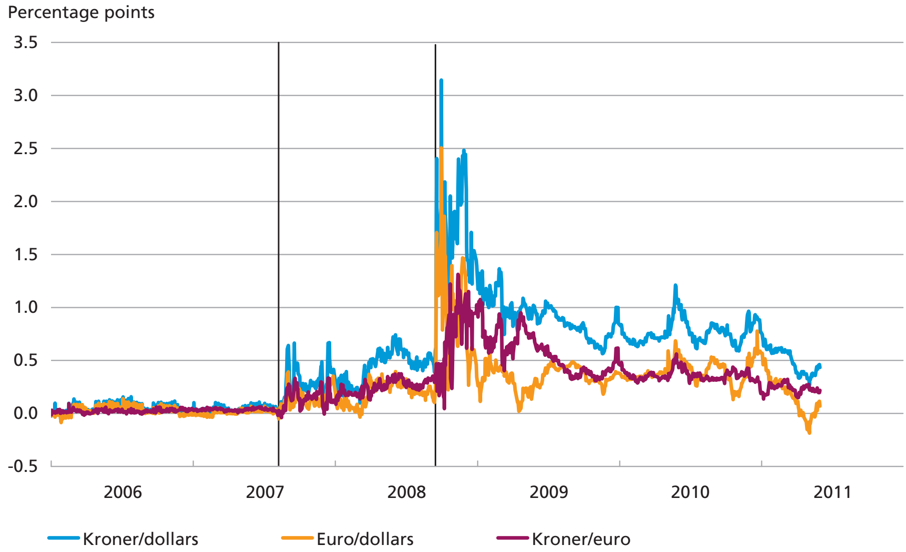
SPREADS BETWEEN UNCOLLATERALISED AND COLLATERALISED INTEREST RATES IN SELECTED COUNTRIES AND FACTORS OF THE DANISH SPREAD — Chart 1



Note: Based on 3-month money-market interest rates. Left-hand side of the chart: Vertical lines are set at 9 August 2007 (the turmoil erupted when French bank BNP Paribas announced that it would stop paying instalments on its debt and calculating mark-to-market for three investment vehicles that were exposed to the subprime market) and 15 September 2008 (Lehman Brothers suspended payments). Last observation: 31 May 2011. The right-hand Chart shows the result of a regression analysis in which the Danish spread is explained by the spread of the euro area and variables for credit and liquidity risk premiums in the Danish market. Last observation: 1 June 2010.

Source: Own calculations based on data from Bloomberg and Reuters EcoWin.

DEVIATION FROM THE COVERED INTEREST-RATE PARITY Chart 2

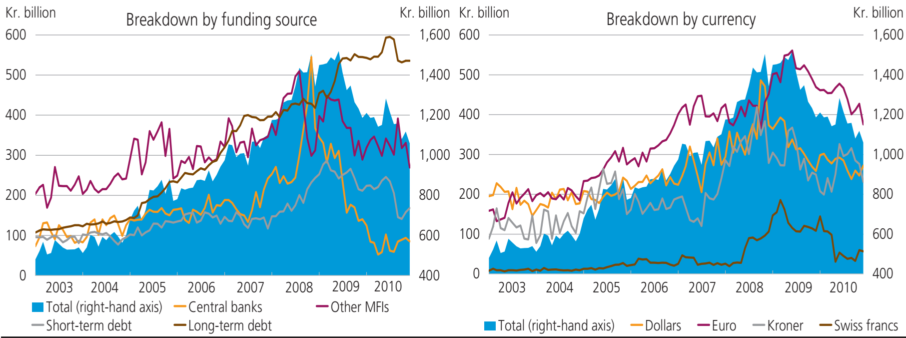


Note: Vertical lines are set at 9 August 2007 and 15 September 2008, cf. Chart 1. "Kroner/dollars" expresses the costs of borrowing in kroner combined with FX swaps to dollars less the costs of direct borrowing in dollars. The same applies to "Kroner/euro" and "Euro/dollars". Last observation: 31 May 2011.
Source: Bloomberg.

market, rapidly developed into a global crisis. The backdrop for the rapid spreading of the crisis is that several large international banks that were central providers of credit across currencies were severely affected by the problems in the US housing market, so they generally put a stop to their international money-market lending. As the crisis evolved, it became more difficult and expensive to obtain dollars because the US banks became less willing to grant loans. They needed the dollar liquidity themselves and were concerned about the credit standings of the European banks. Consequently, there was a shortage of dollars in the sense that it became difficult for e.g. European banks to borrow dollars directly in the money market. They increasingly had to raise dollars indirectly by borrowing in other currencies, e.g. euro, and swapping to dollars via the FX swap market. This forced up the rate of interest on dollar funding via FX swaps considerably compared with the rate of interest on direct dollar loans, thereby creating large deviations from the covered interest-rate parity, cf. Chart 2.[1] Similarly, there were deviations from the covered interest-rate parity between dollars and kroner and between euro and kroner.

[1] The covered interest-rate parity indicates that the cost of borrowing directly in a currency, e.g. dollars, is equivalent to the cost of raising a loan in another currency, e.g. kroner, while at the same time acquiring an FX swap from kroner into dollars. Large deviations from the covered interest-rate parity are indications of poorly functioning financial markets.

THE BANKS' BORROWING IN THE MONEY AND CAPITAL MARKETS BROKEN DOWN BY FUNDING SOURCE AND CURRENCY
Chart 3



Note: The compilation comprises Danish banks in the Danish Financial Supervisory Authority's groups 1 and 2, excluding their foreign branches and subsidiaries. Loans from MFIs constitute net borrowing from MFIs other than central banks and foreign branches and subsidiaries. Debt is debt securities issued. Short-term debt is issuance with an original maturity of less than 1 year, while long-term debt has a maturity of more than 1 year. Last observation: December 2010.

Source: Danmarks Nationalbank.

Danish banks' direct credit exposure to the US housing market was limited, but, like the banks in a number of other countries, they were exposed to the development in the international money markets due to their high dependence on short-term funding in foreign currency, particularly dollars and euro, cf. the right-hand side of Chart 3. As foreign banks generally ceased to grant interbank loans in the autumn of 2008, the banks borrowed mostly from central banks instead, cf. the left-hand side of Chart 3.

WHAT DID DANMARKS NATIONALBANK DO TO ENSURE FUNDING IN FOREIGN CURRENCY?

In the autumn of 2008, against the backdrop of the shortage of dollars and euro, Danmarks Nationalbank, like some other central banks, established swap lines with the Federal Reserve, the Fed, and the ECB in order to be able to provide dollars and euro to Danish banks. Danmarks Nationalbank also provided dollar and euro FX swap loans from the foreign-exchange reserve in September and October 2008. Danmarks Nationalbank's swap lines with the Fed and the ECB substantially improved the conditions for funding in foreign currency. According to our empirical studies in the article in Part 2, the swap line with the Fed led to a reduction in the deviation from the covered interest-rate parity between dollars and kroner totalling almost 70 basis points, while the swap line with the ECB reduced the deviation from the covered interest-rate parity between euro and kroner by just over 60 basis points. This reflects that market participants were reassured by the support of the Fed and the

ECB for dollar and euro funding. The results are in line with similar studies for other countries.

Danmarks Nationalbank's euro loans from the foreign-exchange reserve supported the conditions for funding in euro, while the effect of lending in dollars was less clear-cut. Part of the explanation is that lending in euro amountwise far exceeded the dollar lending.

WHAT HAPPENED IN THE DANISH MONEY MARKET IN KRONER?

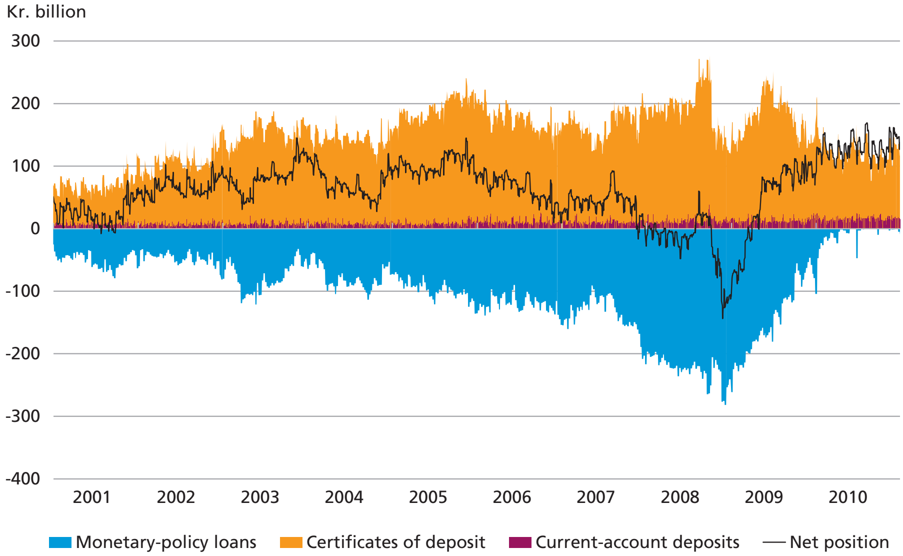
Thanks to the flexible structure of Danmarks Nationalbank's monetary-policy instruments, the Danish money market functioned comparatively well during the first part of the crisis.

Extraordinary facilities were introduced at a later stage. The extent of loans in that connection was very limited, but the measures were important in order to ensure the banks' ability to meet the liquidity requirements under the Danish Financial Business Act.[1]

Turnover in the Danish money market fell, as in other countries, during the crisis. It became concentrated at the very short end of the market and switched from uncollateralised to collateralised lending as growing credit and liquidity risks kept banks from granting long-term uncollateralised loans. The short-term interbank market was partly replaced by accounts with Danmarks Nationalbank, with banks increasing both their loans and deposits at Danmarks Nationalbank in the autumn of 2008, cf. Chart 4. The gross accumulation peaked in December 2008 when the banks and mortgage banks' holdings of certificates of deposit exceeded their net position vis-à-vis Danmarks Nationalbank by just over kr. 280 billion. Kr. 170 billion of this could be put down to the fact that some banks placed certificates of deposit while others raised monetary-policy loans. Hence, the increased gross positions vis-à-vis Danmarks Nationalbank to a large extent reflected that banks with a liquidity surplus placed it at Danmarks Nationalbank rather than relending it. Consequently, banks with a funding requirement had to raise monetary-policy loans rather than borrowing in the money market. As from October 2008, Bank Rescue Package 1 supported the interbank exchange of liquidity. The interest-rate margin between Danmarks Nationalbank's lending rate and the rate of interest on certificates of deposit, which was introduced in June 2009 to give the banks a greater incentive to even out mutual liquidity differences rather than using Danmarks Nationalbank's facilities, also contributed to reducing the banks' gross positions vis-à-vis Danmarks Nationalbank.

[1] Cf. section 152 of the Danish Financial Business Act.

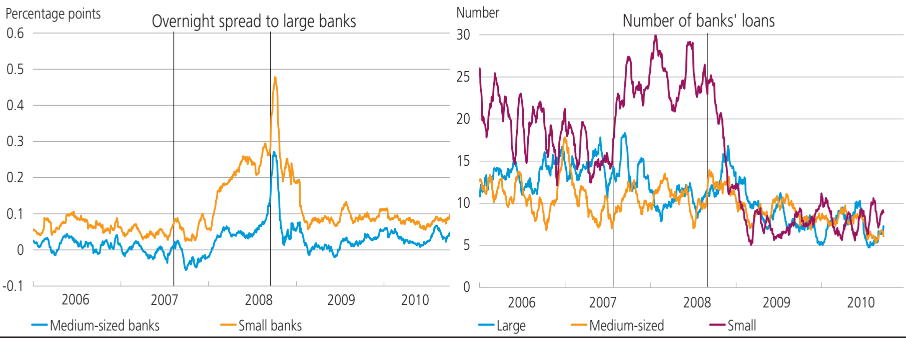
THE LOANS AND DEPOSITS OF BANKS AND MORTGAGE BANKS VIS-À-VIS DANMARKS NATIONALBANK — Chart 4



Note: Last observation: 30 December 2010.
Source: Danmarks Nationalbank.

Some of the small and medium-sized banks in particular were affected by the problems in the money market. In the autumn of 2008, the small and medium-sized banks on average paid a substantial premium amounting to 0.25-0.5 percentage point on uncollateralised overnight loans, cf. the left-hand side of Chart 5. In a few instances for some banks the premium amounted to 2-3 percentage points. The small banks had to increase the number of loans and counterparties in order to ensure their funding, and they almost doubled the number of loans and coun-

SPREAD BETWEEN THE BANKS' DEPOSIT RATES AND THE NUMBER OF LOANS IN THE OVERNIGHT MARKET — Chart 5



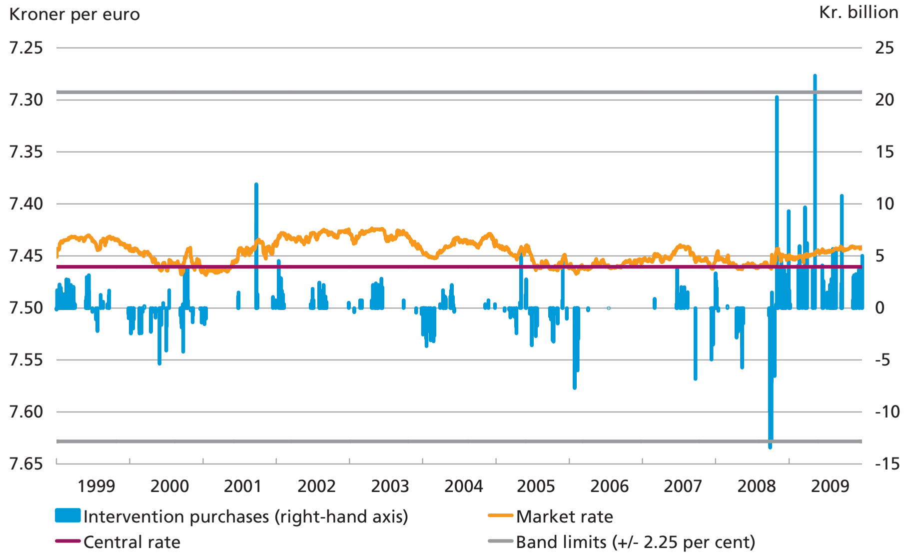
Note: The vertical lines are set at 9 August 2007 and 15 September 2008, cf. Chart 1. Large, medium-sized and small banks refer to the Danish Financial Supervisory Authority's groups 1, 2 and 3. 21-day moving averages. Last observation: 30 September 2010.
Source: Danmarks Nationalbank.

terparties in connection with the onset of the turmoil in the summer of 2007, cf. the right-hand side of Chart 5.

WHAT HAPPENED IN THE FOREIGN-EXCHANGE MARKETS AND TO THE DANISH KRONE?

The krone came under pressure when international investors withdrew from minor currencies in the autumn of 2008. The shortage of foreign currency also contributed to the pressure on the krone, as some investors repaid their loans in foreign currency rather than renewing them and funded themselves in kroner instead. This increased the demand for foreign currency in relation to kroner. Furthermore, there were indications of some investors speculating in Danmarks Nationalbank not being able to maintain the fixed-exchange-rate policy. As a result of the Danish fixed-exchange-rate policy against the euro, Danmarks Nationalbank made intervention purchases for considerable amounts, cf. Chart 6, and raised its monetary-policy interest rates in a time where other central banks generally lowered theirs. The transmission from monetary-policy interest rates to the exchange rate of the krone lost considerable momentum, making it impossible to immediately substitute the outflow from the foreign-exchange reserve for government currency loans at the peak of the crisis.

THE KRONE RATE AGAINST THE EURO AND INTERVENTION PURCHASES — Chart 6



Note: Central rate and band limits in ERMII. Inverted scale on the left-hand axis. Daily interventions. Last observation: 30 December 2009.
Source: Danmarks Nationalbank.

Danmarks Nationalbank's measures contributed to stabilising the krone. The issuance of 30-year government bonds, which were in high demand from the Danish pension sector, and Bank Rescue Package 1 also contributed to stabilising the situation.[1] During the crisis the krone remained stable at a level close to its central rate against the euro.

CONCLUSION: EXPERIENCE FROM THE CRISIS

The crisis has shown that it is important for banks to structure their liquidity management so as to limit their dependence on individual markets where liquidity can disappear very rapidly. Against this background, Danmarks Nationalbank and the Danish Financial Supervisory Authority have intensified their supervision of the banks' liquidity.

The crisis led to a widening of the spread between uncollateralised and collateralised Danish money-market interest rates. The Danish spread at the beginning of the crisis was driven mainly by liquidity conditions in the euro area. In the course of 2009 the spread came to predominantly imply a credit premium, reflecting that the crisis evolved from a liquidity crisis into a credit crisis.

Another sign of crisis was that banks and mortgage banks with a liquidity surplus increasingly chose to place it at Danmarks Nationalbank rather than relending it. Consequently, banks with a funding requirement had to borrow from Danmarks Nationalbank rather than borrowing in the money market. At the end of 2008, the banks' failure to exchange liquidity in the money market was reflected in the fact that the banks overall borrowed and placed liquidity at Danmarks Nationalbank amounting to almost kr. 280 billion. This gross accumulation was subsequently reduced. A contributory factor was Danmarks Nationalbank's introduction in June 2009 of a margin between the lending rate and the rate of interest on certificates of deposit.

Some of the small banks in particular were affected by the problems in the money market. Compared with the large banks, at the end of 2008 the small banks on average paid a premium of 0.25-0.5 percentage point for loans in the overnight money market, which is fundamental to the banks' ongoing liquidity management. In a few instances for some banks the premium amounted to 2-3 percentage points. The small banks doubled the number of counterparties. They had to increase the number of counterparties in order to ensure their liquidity.

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[1] The issuance of 30-year government bonds supported the demand for kroner to the extent the pension sector sold European bonds to buy Danish government securities.

The structure of Danmarks Nationalbank's monetary-policy instruments proved to be robust during the crisis and did not require adjustment. The open window in Danmarks Nationalbank's open market operations, which makes it possible for the banks to obtain the necessary volume of loans, the broad access to the instruments and the depth of collateral gave the banks a high degree of flexibility in terms of obtaining the liquidity they demanded.

The crisis revealed that if the krone is under pressure, larger amounts may be needed for intervention purposes than warranted by previous experience. Danmarks Nationalbank more than doubled the foreign-exchange reserve in relation to the situation before the pressure on the krone really set in.

The banks' dependence on funding in dollars and euro also showed that it may become necessary for Danmarks Nationalbank to provide loans in foreign currency from the foreign-exchange reserve.

During the crisis, however, Danmarks Nationalbank primarily provided loans in foreign currency via swap lines with the Fed and the ECB and only to a limited extent from the foreign-exchange reserve. The regression analyses illustrate the efficiency of those swap lines in terms of improving liquidity conditions in dollars and euro. This reflects that market participants were reassured by the support of the Fed and the ECB for dollar and euro funding. The swap lines reduced the deviation from the covered interest-rate parity between kroner and dollars by 70 basis points, while the reduction of the deviation from the covered interest-rate parity between kroner and euro amounted to around 60 basis points. The results are in line with similar studies for other countries.