

PASS-THROUGH FROM DANMARKS NATIONALBANK'S INTEREST RATES TO THE BANKS' INTEREST RATES

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INTRODUCTION AND SUMMARY

Danmarks Nationalbank sets its interest rates in accordance with the fixed exchange rate policy against the euro. Monetary policy rates are fully passed through to money market rates, which determine the exchange rate of the krone.

Danmarks Nationalbank's interest rates also have a marked impact on bank interest rates to households and the corporate sector. As regards bank lending rates, the pass-through from Danmarks Nationalbank was reduced significantly in connection with the financial crisis in the autumn of 2008, when bank lending rates were slow to follow the sizeable reductions of Danmarks Nationalbank's interest rates in the following months. The pass-through was relatively quickly restored, however.

The banks determine their lending rates on the basis of the costs of funding the loans and the risk on the loans. When bank funding costs are taken into account in the explanation of the pass-through from the rate of interest on certificates of deposit, there is no notable difference in the pass-through to lending rates before and after the financial crisis. Thus, the banks did not fundamentally change their setting of lending rates in connection with the financial crisis. The lending rates are set in the same way, irrespective of whether Danmarks Nationalbank's interest rates are positive or negative.

The pass-through from Danmarks Nationalbank's interest rates to bank corporate and household deposit rates has been reduced due to the low level of interest rates. The banks have

been hesitant to pass on Danmarks Nationalbank's negative rate of interest to small firms and especially to households, which have been exempt from negative deposit rates.

The first section provides a brief outline of the link between Danmarks Nationalbank's interest rates and bank interest rates. The pass-through from Danmarks Nationalbank's interest rates to bank interest rates for households and non-financial corporations is then estimated. In the final section, bank funding costs are taken into account in the estimation of the pass-through.

MONETARY POLICY TRANSMISSION

The fixed exchange rate policy against the euro means that Danmarks Nationalbank's interest rates are solely used to manage the exchange rate of the krone vis-à-vis the euro. For the banks, monetary policy rates function as alternatives to the interest rates on loans and placements in the money market, whereby monetary policy rates determine money market rates, which are key to the exchange rate of the krone.

Money market rates are determined by Danmarks Nationalbank's deposit rate, i.e. the rate of interest on certificates of deposit, CD rate, when the monetary policy counterparties need to deposit substantial funds with Danmarks Nationalbank. Banks and mortgage banks can invest liquidity in certificates of deposit or deposit funds in current accounts with Danmarks Nationalbank. At times of negative CD rate, the current account limits for the banks ensure that an increase in to-

tal deposits with Danmarks Nationalbank will earn interest at the CD rate, which then becomes key for money market rates.

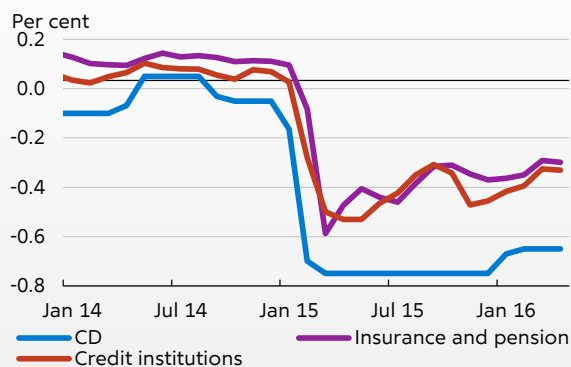
Negative deposit rates are widespread for pension and insurance companies, as their alternatives to bank deposits are placement on money market-like terms. The pressure on the krone at the beginning of 2015 was driven by the

demand from insurance and pension companies and foreign investors for placements in kroner. The latter could place their krone funds via credit institutions. Bank deposit rates for insurance and pension companies and credit institutions have been clearly negative, cf. Chart 1.

Monetary policy rates and money market rates also determine bank interest rates for households and non-financial corporations. For the individual banks, money market placements and loans offer an alternative to bank retail lending and deposits.

CD rate, bank deposit rates for insurance and pension companies and credit institutions

Chart 1



Note: Monthly averages. Rate of interest on deposits in kroner from non-affiliated credit institutions, MFIs, and Danish insurance and pension companies.
Source: Danmarks Nationalbank.

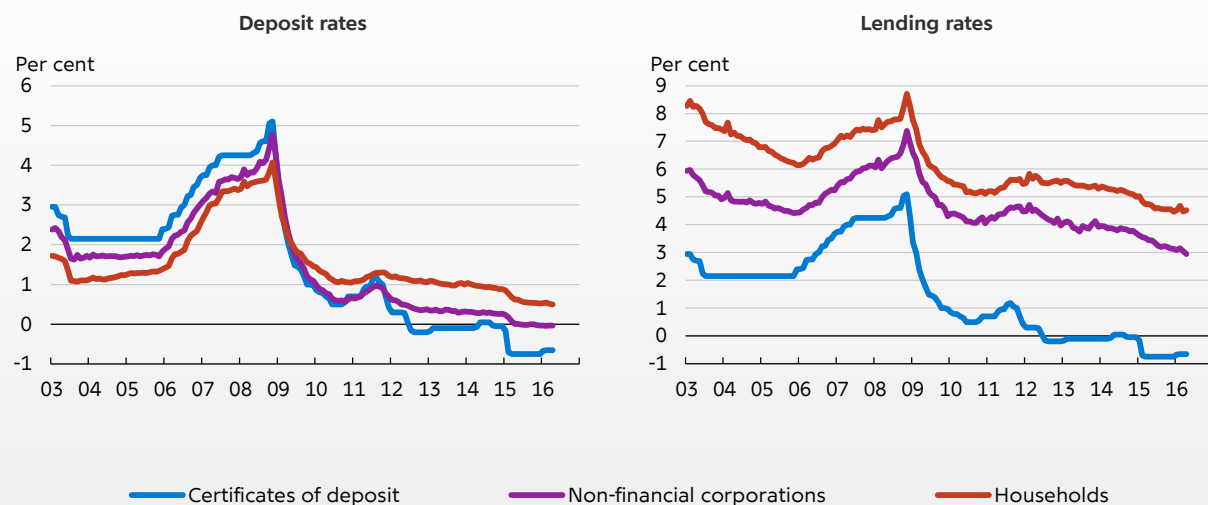
THREE EPISODES OF FALLING INTEREST RATES

Interest rates in the economy have fallen to an extraordinarily low level, cf. Chart 2. Overall, there are three episodes of falling interest rates associated with the following events: the financial crisis, the sovereign debt crisis in a number of euro area member states and the pressure on the krone in early 2015. Interest rates declined already prior to the pressure on the krone in the light of low inflation in the euro area and the European Central Bank's, the ECB's, easing of monetary policy.

In general, bank interest rates to households and non-financial corporations did not fully mirror the fall in the CD rate during the three episodes, with the exception of the lending rate during the latest interest rate decline, cf. Chart 3. The development is reflected in interest margins, which widened espe-

Danmarks Nationalbank's CD rate and bank interest rates for non-financial corporations and households

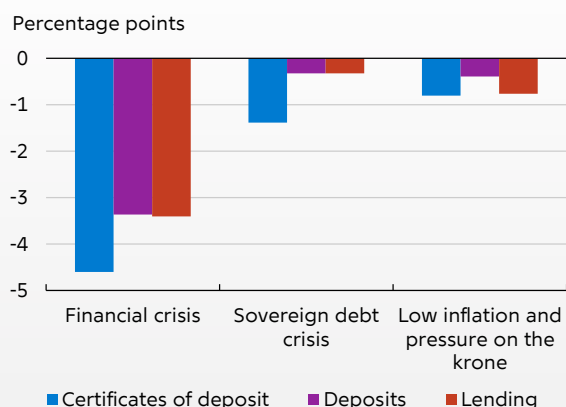
Chart 2



Note: Monthly averages. Rate of interest on outstanding deposits and lending in kroner to households etc. and non-financial corporations.
Source: Danmarks Nationalbank.

Change in the CD rate and deposit and lending rates during three episodes of falling interest rates

Chart 3

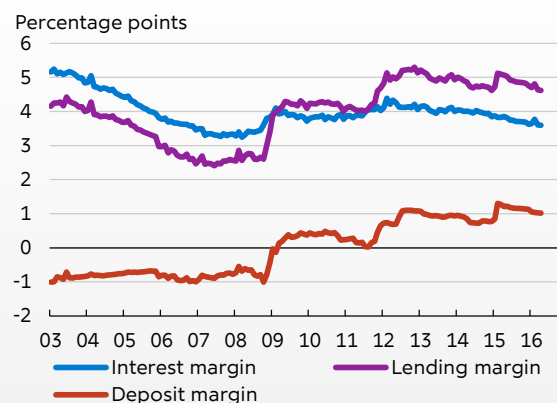


Note: Bank deposit and lending rates in kroner for non-financial corporations and households taken as one. Change November 2008-September 2010, August 2011-December 2012 and August 2014-December 2015.

Source: Danmarks Nationalbank.

Interest margins

Chart 4



Note: The interest margin is the spread between lending and deposit rates in kroner for households and non-financial corporations taken as one. The lending margin is the spread between the lending rate and the CD rate. The deposit margin is the spread between the deposit rate and the CD rate.

Source: Danmarks Nationalbank.

cially in connection with the financial crisis, but also during the sovereign debt crisis, cf. Chart 4.

On the deposit side, one potential explanation is the intensified competition for deposits, fuelled by liquidity problems in the banking sector in connection with the financial crisis. Many banks tried to raise liquidity by maintaining high deposit rates despite the declining monetary policy rates.

Until the financial crisis, deposit rates for households and the corporate sector were lower than the CD rate. During the interest rate drop in connection with the financial crisis, deposit rates crossed the CD rate and have since then generally been higher than the CD rate. The main driver of this development is the low level of monetary policy rates since 2010. The prevalence of negative deposit rates is limited for households and non-financial corporations – households are exempt and around 30 per cent of deposits from non-financial corporations have negative interest rates. The banks' hesitation to introduce negative deposit rates for households probably reflects that negative interest rates could induce some households to cash in their bank deposits. Handling large cash amounts would entail substantial costs for banks, as their facilities are not designed for a large increase in cash positions, and higher insurance payments would also be required, cf. Jensen and Spange (2015). Moreover, unless all

banks introduce negative interest rates at the same time, this would prompt customers to switch banks.

Heightened risk is an important reason why lending rates did not mirror the fall in the CD rate during the financial crisis and the sovereign debt crisis. The banks' expected losses related to credit risk on borrowers constitute a lending cost for which the banks must be compensated. The compensation is in the form of an interest premium added to funding costs and other lending costs, cf. Abildgren and Kuchler (2013).

MEASURING PASS-THROUGH

Changes in bank interest rates may occur with some lag, e.g. due to incomplete competition and adjustment costs, and it is relevant to decompose the pass-through from the CD rate into an immediate short-term effect and a total long-term effect. Finally, it is relevant to find out how quickly the total adjustment happens. This is possible to assess by estimating an error correction model, cf. Box 1. The model is also used to estimate the average spread between bank interest rates and monetary policy rates as an expression of the average deposit or lending margin in the estimation period. The model is estimated on monthly

For measurement of the pass-through, an error correction model is estimated, described by the following equation:¹

$$\Delta br_t = \alpha \Delta pp_t + \gamma [br_{t-1} - \mu - \beta pp_{t-1}] + e_t$$

where Δ denotes the change from one period to the next, br is bank deposit or lending rates, and pp is the monetary policy rate (CD rate). The short-term pass-through from the monetary policy rate to bank interest rates is given by the coefficient α . If the model is estimated on monthly data, the coefficient gives the pass-through in the same month. β is the long-term total pass-through from the long-run relation:

$$br_{t-1} = \mu + \beta pp_{t-1}$$

μ is a constant denoting the average spread between the bank's interest rate and the monetary policy rate, i.e. the deposit and lending margin. γ is an expression of the monthly adjustment to the total pass-through after the short-term pass-through. The average number of months, after the adjustment in the first month, it takes to reach the total pass-through to bank interest rates can be given as $(\beta - \alpha)/(-\gamma)$.

In order to ensure a stationary relationship between the lending rate and the monetary policy rate, the following must apply: $\gamma < 0$ (and $\gamma > -2$) and $\beta > 0$. If γ is not lower than zero, the lending rate will rise when it is higher than its long-term value.

Impact of the financial crisis

There are clear indications of structural changes in the pass-through from the CD rate in connection with the financial

crisis, especially for lending rates. In order to assess whether the pass-through has changed in connection with the financial crisis, the period since 2003 is divided into three sub-periods: pre-financial crisis (January 2003-August 2008), the intensive part of the financial crisis (September 2008-December 2008) and post-financial crisis (January 2009-). By means of dummy variables the model parameters are allowed to be different in the three periods, and the estimates before and after the financial crisis are compared.

As a robustness check, estimations are made for an extended financial crisis period including the first three months of 2009 and the full year 2009. After the peak of the financial crisis in September and October 2008, the focus was on the global slowdown until March 2009, followed by signs of stabilisation, cf. BIS (2009). ECB (2011) and Avouyi-Dovi (2015) operate with a financial crisis period from September 2009 to December 2009, after which time the ECB began to phase out its crisis-related measures.

Impact of a negative CD rate, sovereign debt crisis and pressure on the krone

In the post-financial crisis period we also test whether the estimates change in the periods related to the sovereign debt crisis in the euro area (July 2011-July 2012), a negative CD rate (July 2012-April 2014 and September 2014-) and the pressure on the krone and subsequent low interest rate level (January 2015-February 2016).

1. See de Bondt (2002) and Avouyi-Dovi et al. (2015) for use of a similar model. The model is estimated using the ordinary least squares method on the basis of the regression equation $\Delta br_t = \alpha_1 + \alpha_2 \Delta pp_t + \beta_1 br_{t-1} + \beta_2 pp_{t-1} + e_t$, where $\gamma = \beta_1$, $\mu = -\alpha_1 / \beta_1$, $\beta = -(\beta_2 / \beta_1)$ and $\alpha = \alpha_2$.

observations of deposit and lending rates in the period January 2003-February 2016.

In general, the pass-through can be affected by different characteristics of bank interest rates and monetary policy rates, such as maturity. The analysis is performed for interest rates on outstanding loans and deposits rather than new business, as there is less noise in outstanding loan series. Interest rates on new lending may be sensitive to customer and product structures. The pass-through to outstanding loans may be affected by the administrative adjustment of retail interest rates with some lag. However, lending consists primarily of variable rate loans, while deposits are

mostly demand deposits. As a result, interest rate changes will still be passed through, even if it is not solely new business.¹

Estimations are made for the whole period, i.e. the pre-financial crisis period (January 2003-August 2008), and the post-financial crisis period (January 2009-February 2016). As a robustness check, estimation is also performed of the pass-through in the low interest rate environment from 2010 (January 2010-February 2016). The results are summarised in Table 1.

For the post-crisis period, it is examined whether the pass-through differs between months with a negative and positive CD rate. Furthermore, it

1 See Carlsen and Fæste (2007) for a description of statistics for deposit and lending rates. Carlsen and Fæste (2007) and Drejer et al. (2011) also perform estimations of the pass-through from monetary policy rates to the banks' retail interest rates.

Pass-through from Danmarks Nationalbank's interest rates to bank deposit and lending rates

Table 1

	Post-financial crisis 2009-16	In low interest rate environment 2010-16
Deposit rates	Pass-through lower than pre-crisis level	Pass-through lower than pre-crisis level
Lending rates	Pass-through lower than pre-crisis level ¹	Pass-through close to pre-crisis level

1. The pass-through to lending rates after the financial crisis is roughly the same after including funding costs in the estimations, cf. the section "Lending rates, risk and funding costs".

is examined whether the pass-through changed after the pressure on the krone in early 2015 and the subsequent clearly negative CD rate. Finally, it is examined whether the pass-through changed in connection with the sovereign debt crisis in a number of euro area member states.

PASS-THROUGH TO DEPOSIT RATES

As expected, the banks' restraint in following the decline in the CD rate in connection with the financial crisis and not introducing negative deposit rates for households in particular caused the pass-through to deposit rates to fall, cf. Table 2. After the financial crisis, the pass-through was around half, or less, of the pre-crisis level.

Before the financial crisis, full total pass-through was seen from the CD rate to both corporate and household deposit rates. The coefficient on total pass-through was practically 1, while the short-term pass-through was 0.6 for both the corporate sector and households. The adjustment to total pass-through happened quickly for corporate deposit rates. After the initial adjustment of 0.6 in the first month, the gap was further reduced by 0.4 in the following month. The adjustment to total pass-through thus took about two months. It took a little longer for households – about three months.

Estimation of pass-through from the CD rate to deposit rates for the whole period, pre-financial crisis, post-financial crisis and change in the pass-through

Table 2

	Whole period		Pre-crisis		Post-crisis		Change	
<i>Non-financial corporations</i>								
Spread between deposit rate and CD rate	0.20	*	-0.40	***	0.34	***	0.74	***
Short-term pass-through	0.61	***	0.63	***	0.25	***	-0.38	***
Total pass-through	0.82	***	0.97	***	0.52	***	-0.45	***
Adjustment to total pass-through	0.09	**	0.43	***	0.24	***	-0.19	*
<i>Households</i>								
Spread between deposit rate and CD rate	0.32		-1.16	***	0.93	***	2.09	***
Short-term pass-through	0.48	***	0.55	***	0.19	***	-0.35	***
Total pass-through	0.95	*	1.09	***	0.32	***	-0.77	***
Adjustment to total pass-through	0.01		0.21	***	0.20	***	-0.01	

Note: Estimated on monthly data for interest rates on outstanding domestic loans in kroner from January 2003 to February 2016. The pre-crisis period is January 2003-August 2008. The post-crisis period is January 2009-February 2016. Change is the difference between pre-crisis and post-crisis estimates. *, ** and *** denote levels of significance of 10, 5 and 1 per cent, respectively, based on Newey-West standard errors.

Change in pass-through to deposit rates during the episodes of negative CD rate, sovereign debt crisis and pressure on the krone in early 2015

Table 3

	Negative CD rate		Sovereign debt crisis		Pressure on the krone	
<i>Non-financial corporations</i>						
Spread between deposit rate and CD rate	0.09	*	0.05		-0.13	***
Short-term pass-through	-0.19	***	0.03		-0.28	***
Total pass-through	-0.05		-0.04		-0.19	***
Adjustment to total pass-through	-0.11		0.19	*	0.29	***
<i>Households</i>						
Spread between deposit rate and CD rate	0.01		0.20	***	-0.17	***
Short-term pass-through	0.08		-0.14	**	0.00	
Total pass-through	0.63	***	-0.10		0.21	***
Adjustment to total pass-through	-0.19	**	0.41	***	0.14	***

Note: Estimated on monthly data for interest rates on outstanding domestic loans in kroner from January 2009 to February 2016. Negative CD rate is the period July 2012-April 2014 and September 2014-February 2016. Sovereign debt crisis is the period July 2011-July 2012. Pressure on the krone is the period January 2015-February 2016. *, ** and *** denote levels of significance of 10, 5 and 1 per cent, respectively, based on Newey-West standard errors.

Deposit rates during the episodes of negative CD rate, sovereign debt crisis and pressure on the krone

Deposit rates did not mirror the CD rate either during the sovereign debt crisis or during the episode of pressure on the krone in early 2015, cf. Chart 5. As expected, the lower level of interest rates reduced the pass-through to corporate deposit rates, especially during the pressure on the krone, cf. Table 3.

Conversely, the total pass-through for households increased during the pressure on the krone. This reflects more stickiness in household deposit rates in response to the changes in the CD rate in the period up to the pressure. Especially the time deposit rate fell in connection with the pressure on the krone, while the pass-through for demand deposits did not change to any significant degree. The fall was most pronounced for deposit rates in medium-sized banks. Medium-sized banks typically have poorer access to market-based funding sources such as bond issuance than large banks, which gives

them a greater incentive to retain depositors. Moreover, time deposits or deposits redeemable at notice make up a large share of their deposits. The need to attract funding via time deposits thus seems to have diminished.

PASS-THROUGH TO LENDING RATES

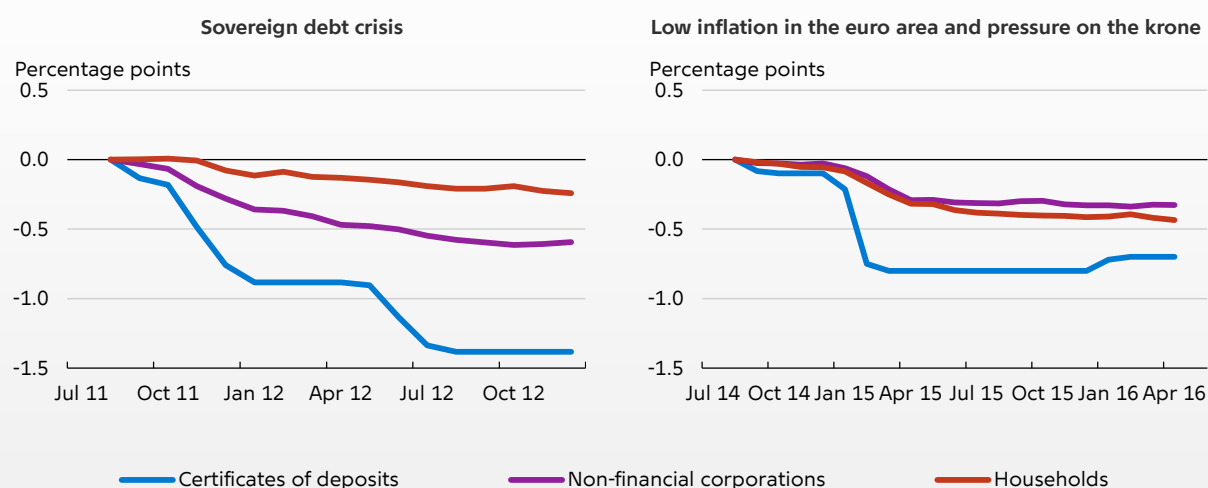
Before the financial crisis, there was close to full total pass-through to lending rates for both non-financial corporations and households, cf. Table 4. During the period of falling interest rates in connection with the financial crisis, bank lending rates did not mirror the CD rate all the way down. Consequently, the pass-through was reduced considerably in the period of strongly heightened financial and economic risks.

In the period after the financial crisis, the strength of the pass-through depends on the estimation period chosen. Measured in the period from immediately after the intensive part of the financial crisis, the total pass-through for non-financial corporations was reduced after the financial crisis.² If the financial crisis period is extend-

2 If the financial crisis period is extended to include the first three months of 2009, the change is not statistically significant either for households or for non-financial corporations.

Accumulated changes in deposit rates on reduction of the CD rate in connection with the sovereign debt crisis and low inflation in the euro area and pressure on the krone

Chart 5



Note: Monthly observations. Deposits in kroner. Left-hand chart: accumulated changes August 2011-December 2012. The period of sovereign debt crisis begins in July 2011, but the CD rate is not lowered until August 2011. Right-hand chart: accumulated changes from August 2014-April 2016.

Source: Danmarks Nationalbank.

Pass-through from the CD rate to lending rates for the whole period, pre-financial crisis, post-financial crisis and change in the pass-through

Table 4

	Whole period		Pre-crisis		Post-crisis		Change	
<i>Non-financial corporations</i>								
Spread between lending rate and CD rate	3.54	***	2.73	***	3.84	***	1.11	***
Short-term pass-through	0.42	***	0.18	**	0.35	***	0.17	
Total pass-through	0.67	***	0.86	***	0.61	***	-0.25	**
Adjustment to total pass-through	0.07	*	0.14	***	0.16	***	0.03	
<i>Households</i>								
Spread between lending rate and CD rate	4.90	***	3.36	*	5.13	***	1.76	
Short-term pass-through	0.54	***	0.29	***	0.47	***	0.17	
Total pass-through	0.70	***	1.17	**	0.30		-0.87	
Adjustment to total pass-through	0.05	***	0.05	*	0.07	**	0.03	

Note: Estimated on monthly data for interest rates on outstanding domestic loans in kroner from January 2003 to February 2016. The pre-crisis period is January 2003-August 2008. The post-crisis period is January 2009-February 2016. Change is the difference between pre-crisis and post-crisis estimates. *, ** and *** denote levels of significance of 10, 5 and 1 per cent, respectively, based on Newey-West standard errors.

ed to include the full year 2009, the difference in total pass-through before and after the financial crisis is neither particularly large nor statistically significant. Given this delineation, there is no significant difference between the short-term pass-through before and after the financial crisis either. This applies to both households and non-financial corporations. Thus, the pass-through from Danmarks Nationalbank's interest rates to lending rates was restored relatively quickly after the financial crisis, and there was close to full pass-through both in the pre-crisis period and in the low interest rate environment from 2010.

Lending rates during the episodes of negative CD rate, sovereign debt crisis and pressure on the krone

A negative CD rate did not as such imply a lower pass-through from the CD rate to lending rates, cf. Table 5.

In connection with the sovereign debt crisis, lending rates followed the CD rate down only to a limited extent, cf. Chart 6 (left). The sovereign debt crisis led to a larger average spread between lending rates and the CD rate, i.e. the lending

margin, for both non-financial corporations and households in the light of the heightened financial and economic risk.

In the period of pressure on the krone, corporate lending rates did not fall immediately, but matched the fall in the CD rate over time, cf. Chart 6 (right). This may reflect that the banks did not lower their lending rates until it was clear that the interest rate reduction was more prolonged. Since then, the ECB lowered its key interest rates further due to a weak growth and inflation outlook in the euro area, and the market expects interest rates to remain low for a long time. In general, the fixed exchange rate policy against the euro means that Danmarks Nationalbank adjusts its interest rates in step with the ECB's key interest rates in a calm foreign exchange market. In situations with upward or downward pressure on the krone, Danmarks Nationalbank unilaterally changes its interest rates in order to stabilise the krone. If the banks perceive unilateral Danish interest rate adjustments as temporary, they are less likely to pass on the adjustments to retail rates. The estimation of the pass-through shows a reduction in the short-term pass-through for corporate lending,

Change in pass-through to lending rates during the episodes of negative CD rate, sovereign debt crisis and pressure on the krone in early 2015

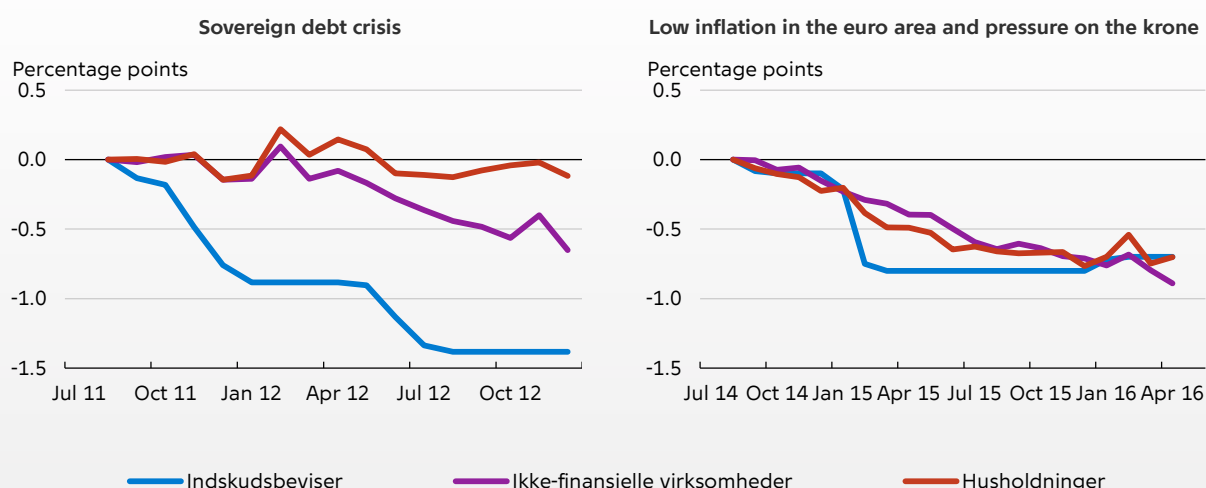
Table 5

	Negative CD rate	Sovereign debt crisis	Pressure on the krone
<i>Non-financial corporations</i>			
Spread between lending rate and CD rate	-0.03	0.62 ***	-0.68 ***
Short-term pass-through	-0.11	-0.03	-0.33 ***
Total pass-through	0.61 **	-0.37 **	-0.29
Adjustment to total pass-through	-0.05	0.43 *	-0.03
<i>Households</i>			
Spread between lending rate and CD rate	-0.11	0.79 ***	0.02
Short-term pass-through	-0.11	-0.15	0.01
Total pass-through	0.91	-0.14	0.81 ***
Adjustment to total pass-through	-0.08	0.66 ***	0.29 **

Note: Estimated on monthly data for interest rates on outstanding domestic loans in kroner from January 2009 to February 2016. Negative CD rate is the period July 2012-April 2014 and September 2014-February 2016. Sovereign debt crisis is the period July 2011-July 2012. Pressure on the krone is the period January 2015-February 2016. *, ** and *** denote levels of significance of 10, 5 and 1 per cent, respectively, based on Newey-West standard errors.

Accumulated changes in lending rates on reduction of the CD rate in connection with the sovereign debt crisis and low inflation in the euro area and pressure on the krone

Chart 6



Note: Monthly observations. Lending in kroner. Left-hand chart: accumulated changes August 2011–December 2012. The period of sovereign debt crisis begins in July 2011, but the CD rate is not lowered until August 2011. Right-hand chart: accumulated changes August 2014–April 2016.

Source: Danmarks Nationalbank.

while the change in the long-term pass-through was not statistically significant.

The total pass-through to lending rates for households increased significantly during the pressure on the krone. This may reflect the lower pass-through during the preceding period of a generally higher risk level.

LENDING RATES, RISK AND FUNDING COSTS

When setting lending rates, the banks take into account that they may incur losses on lending and that they have to raise funds for lending. Consequently, the final interest rate that the banks offer their customers is influenced by the risk on lending and the price of funding.

The banks raise funding, inter alia, via deposits from households and firms, borrowing in the money market, debt issuances and by increasing equity. In the literature, money market rates are often used to express marginal bank funding costs, because the individual bank is able to raise funding in the money market immediately and at its own initiative.

It is standard practice to use the overnight interest rate in pass-through studies, since this rate is the operational monetary policy target, cf.

Gambacorta et al. (2014). On average, the overnight rate closely mirrors monetary policy rates. Overnight loans in the money market with limited risk and a certain trading activity account for only a very limited share of bank funding.

Funding via deposits has accounted for just under 80 per cent on average of Danish banks' balance sheets since 2003. Moreover, since 2003 the banks have, on average, raised 8 per cent of their funding via equity, while the remainder comes from debt instruments.

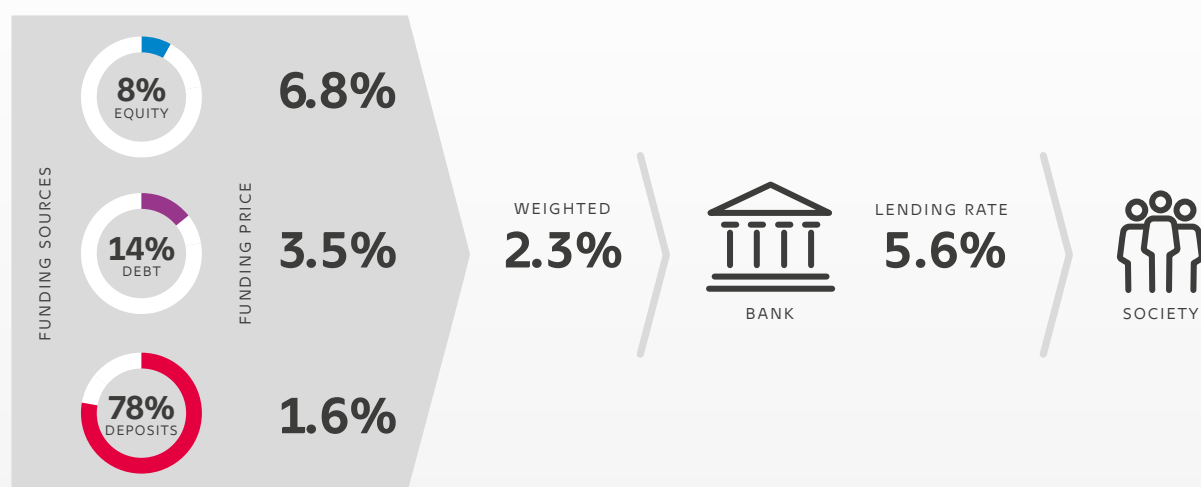
Although a bank can raise very short-term funding for a loan via the margin, it cannot do so on average for the entire balance sheet. It is thus relevant to take the average cost into account when examining a bank's funding costs. Box 2 outlines the development in an index for banks' average funding costs.

The funding index followed the development in Danmarks Nationalbank's CD rate closely until the financial crisis escalated in the autumn of 2008, cf. Chart 7 (left).

The financial crisis gave rise to a gap between the CD rate and the funding index. The gap arose because of the market perception of increasing total risk on banks and was evidenced by two factors. It became very expensive – if not impossible – for the banks to issue equity in the form of

Index for bank funding costs

We derive an average shadow price for bank funding based on data on the banks' use of the various funding sources and derived market prices for the funding sources.



Note: The figures are examples of actual averages for 2003-15.

The funding index is based on a breakdown of the banks' total balance sheets by deposits, debt funding and equity funding. A price is derived for each of the three funding sources, and on the basis of the prices a weighted price for bank funding is calculated – 2.3 per cent in the above illustration. It is important to apply an average approach, taking into account both volumes and prices of funding sources, as a change in e.g. the equity share could, all else equal, have an impact on the price of equity funding and debt funding.

The three components are derived as:

- **Deposits:** The rate of interest on deposits from households and non-financial corporations is calculated as the average of new time deposits and outstanding demand deposits. The interest rate on deposits from financial corporations is the overnight money market rate.

- **Debt:** The cost of debt issuance varies with the credit quality of the issuing bank. The proxy for the cost of debt funding is the 5-year swap rate (against 6-month Cibur) plus the 5-year CDS spread for senior debt issued by Danske Bank. This means that the proxy is most representative for uncollateralised debt issuances.
- **Equity:** The implied required return derived from bank share prices is used as the proxy for the cost of equity funding. It has been calculated indirectly by deriving a share risk premium for Euro Stoxx 600 and a loading factor ("CAPM beta") for a Danish bank stock index (Nasdaq OMX Copenhagen Banks) relative to Euro Stoxx 600. This has formed the basis for calculation of the expected implied required return on the Danish bank stock index, cf. the method described in Danmarks Nationalbank (2016).

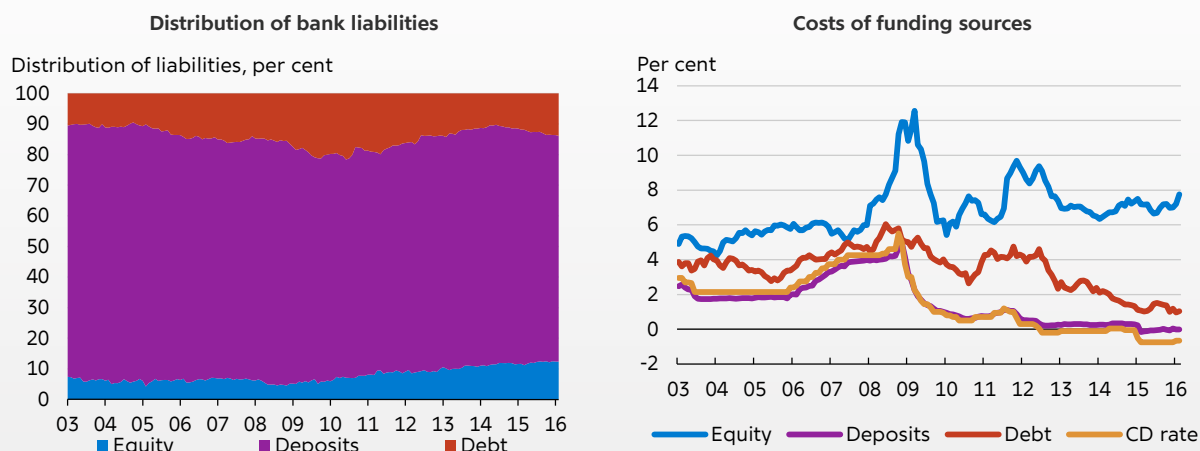
shares, and the spread between the CD rate and the debt funding rate widened.³ Lending risks are incorporated into the funding rate to the extent that depositors and purchasers of the banks' debt issuances and shares as well as creditors and shareholders take the risk into account in the pricing of funding. On average, the required returns

on both equity and debt are lower for banks with better capitalisation, cf. Danmarks Nationalbank (2016). A high level of equity enables the banks to suffer large losses without becoming distressed.

The funding index has declined in recent years, pushed down by falling prices for debt and deposit funding.

³ The funding index does not take into account that Bank Rescue Package 2 enabled the banks to raise equity funding via Additional Tier 1 capital from the government and to issue government-guaranteed bonds. However, the final interest rate on Additional Tier 1 capital and issuance with government guarantee did not differ materially from the derived implied price based on market information.

Components of the funding index

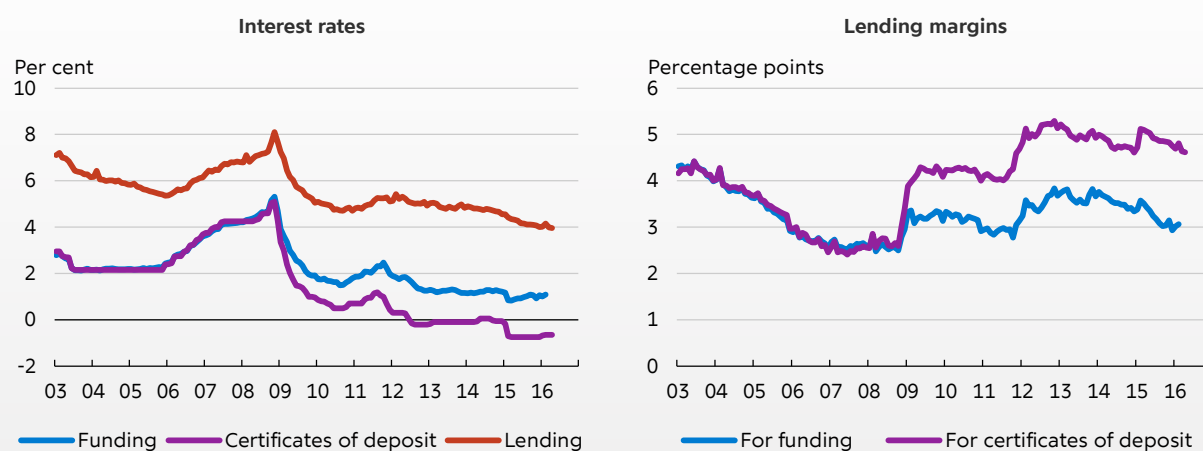


Note: Left-hand chart: Other balance sheet items and derivatives are disregarded.

Source: Danmarks Nationalbank, Thomson Reuters Datastream, Bloomberg and own calculations.

Funding index, CD rate and bank deposit rates and lending margins to the funding index and certificates of deposit, respectively

Chart 7



Note: Average monthly interest rates. Rate of interest on lending to households and non-financial corporations taken as one. The interest margin is the spread between the lending rate and the funding index and the CD rate, respectively.

Source: Danmarks Nationalbank.

The interest margin calculated as the spread between the lending rate and the weighted funding rate is more stable over the period 2003-16 than the interest margin calculated as the spread between the lending rate and the CD rate, cf. Chart 7. The different developments in the two margins

are particularly pronounced around the financial crisis in 2008-09 and the sovereign debt crisis in the euro area in 2011-12.

If the spread between the funding index and the CD rate is included in the pass-through model, the long-term pass-through increases, measured

Pass-through from the CD rate to the lending rate for households and non-financial corporations taken as one with and without a funding index

Table 6

	Entire period		Pre-crisis		Post-crisis		Change	
<i>Without funding index</i>								
Spread between lending rate and CD rate	4.46	***	3.65	***	4.66	***	1.01	*
Short-term pass-through	0.47	***	0.22	**	0.40	***	0.19	
Total pass-through	0.63	***	0.86	***	0.40	***	-0.46	**
Adjustment to total pass-through	0.07	**	0.09	***	0.10	***	0.01	
<i>With funding index</i>								
Spread between lending rate and CD rate	2.51	*	3.71	***	3.19	***	-0.52	
Short-term pass-through	0.60	***	0.45	***	0.45	***	-0.01	
Total pass-through	1.18	**	0.81	***	0.77	***	-0.03	
Adjustment to total pass-through	0.05	**	0.07	***	0.12	***	0.05	

Note: Rate of interest on total outstanding lending to households and non-financial corporations taken as one. The estimation without funding index includes only the CD rate as an explanatory variable. The estimation with funding costs also includes the spread between the funding index and the CD rate as an explanatory variable. Estimated on monthly data for interest rates on outstanding domestic loans in kroner from January 2003 to February 2016. The pre-crisis period is January 2003-August 2008. The post-crisis period is January 2009-February 2016. *, ** and *** denote levels of significance of 10, 5 and 1 per cent, respectively, based on Newey-West standard errors

over the entire period, cf. Table 6.⁴ Neither the short-term nor the total pass-through is statistically different before and after the financial crisis. As expected, the margin between lending rates and the CD rate is also reduced, and, moreover, it is roughly the same size before and after the financial crisis. Funding costs thus contribute to explaining the change in the lending margin level in connection with the financial crisis.

⁴ See Illes et al. (2015) for calculation of funding costs and pass-through to lending rates for non-financial corporations.

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