ECONOMIC MEMO

DANMARKS NATIONALBANK

3 JULY 2020 — NO. 11

Pressure on the Danish krone in times of crisis

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Pressure on the Danish krone in times of crisis

- The Danish krone was under weakening pressure in March 2020 following the outbreak of covid-19, the corona crisis. The Danish krone has previously been under pressure during financial and economic crises. Pressure on the Danish krone may emerge unexpectedly, be weakening or strengthening, and be driven by various underlying factors.

- Contrary to earlier episodes, the pressure in March 2020 was not affected by speculation about whether Danmarks Nationalbank would be able to maintainthe Danish fixed exchange rate policy or about a break-up of the euro area. The pressure during the corona crisis was driven by domestic institutional investors who sold kroner in response to losses on their foreign exchange assets. The underlying motive for the sale of kroner was *inter alia* to maintain their foreign exchange hedge ratio.

- Similar to previous incidents, the Danish insurance and pension sector played a major role. The sector's large financial balance sheet and foreign exchange assets imply that transactions in foreign currency, market fluctuations and small adjustments of the investment behaviour may lead to significant purchases or sales of kroner, potentially affecting the exchange rate.

The krone pressure in March 2020 was the largest pressure towards a weakening of the krone since the financial crisis in the autumn of 2008. Historically, the krone has often been under weakening pressure. The first incident of a strengthening pressure was during the European sovereign debt crisis in 2011-12. The krone was also under significant strengthening pressure in early 2015.

Due to their large balance sheets, the Danish insurance and pension sector, IP, play an important role in the market for Danish kroner. During the financial crisis in 2008, IP bought kroner, offsetting the weakening pressure on the krone. During the European sovereign debt crisis, IP bought German government bonds. Seen in isolation, this led to krone sales, again countering the pressure on the krone. However, there are also indications that IP at the time bought kroner in the forward market.

In 2015, IP was also a key player. The strengthening pressure was partly due to IP *increasing* the hedge ratio of their euro exposure. During the corona crisis, the pressure was partly driven by a wish to *maintain* the hedge ratio of the dollar exposure.

Whereas foreign investors did not contribute to the pressure in March 2020, they did contribute during both the financial crisis, the sovereign debt crisis and in 2015.

This Economic Memo compares the recent episodes of krone pressure. First, episodes of pressure are identified and the magnitude of the pressures is compared. Afterwards the individual incidents are examined. Some key characteristics of the incidents are summarised in Table 1.

Episodes of krone pressure

Table 1

	Financial crisis	European sovereign debt crisis	The krone under pressure	Corona crisis
Period	Sep – Nov 2008[1]	Aug 2011 – Jun 2012	Jan – Feb 2015	Mar 2020[2]
Background	International financial crisis with general pressure on small currencies and speculation about whether the fixed exchange rate policy could be maintained	Sovereign debt crisis in the euro area with speculation about a break-up of the euro area and a strengthening of the krone beyond the ERM2 band	The Swiss central bank abandoned the ceiling for how strong the Swiss franc could be vis-à-vis the euro and expectations about monetary policy easings by the ECB led to speculation about a strengthening of the krone beyond the ERM2 band	International crisis where IP's and investment funds, IF's, capital losses on foreign exchange assets drove the sale of kroner
Direction of the pressure	Weakening	Strengthening	Strengthening	Weakening
Change in monetary policy spread, per cent	+1.90[3]	-0.65	-0.70	+0.15
Foreign exchange interventions (kr. billion)	-65[4]	+91	+275	-65
Government debt policy initiatives to support the exchange rate regime	Issuance of 30-year bond	-	Temporary stop for issuance	-
Krone transactions contributing to the pressure[5]	-	-	Foreign investors, IP, and IF bought kroner	IP and IF sold kroner in the forward market
Capital flows contributing to the pressure	Foreign investors sold Danish mortgage bonds	Foreign investors bought Danish securities	Foreign investors bought Danish bonds	IP bought foreign securities
Foreign exchange hedging contributing to the pressure[6]	-	-	IP increased their foreign exchange hedge ratio of euro (bought kroner)	IP and IF bought foreign exchange and sold kroner in the forward market to maintain foreign exchange hedge ratio

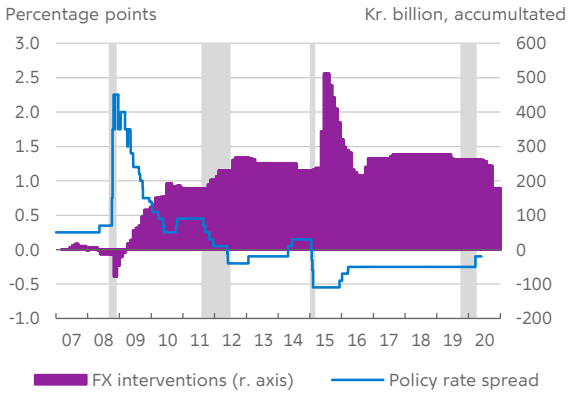
Note: Periods of krone pressure are reported in whole months.

1. Danmarks Nationalbank offset the krone pressure by selling foreign exchange in September and October 2008 and by increasing the certificates of deposit rate in October 2008. In the following months, Danmarks Nationalbank bought foreign exchange and lowered the certificates of deposit rate, but the financial stress continued. Hence, the period considered is September to November 2008.
2. Danmarks Nationalbank also conducted foreign exchange intervention sales worth kr. 19 billion from October 2019 to February 2020.
3. Change in September-October 2008. The policy rate spread is the spread between Danmarks Nationalbank's certificates of deposit rate and the ECB interest rate on main refinancing operations until 14 October 2008 and afterwards the ECB deposit facility rate.
4. Foreign exchange interventions in September-October 2008.
5. From the data on purchases and sales of kroner, cf. Appendix 1. Danmarks Nationalbank has computed domestic and foreign sectors' net purchases of kroner by different sectors and instruments since 2015.
6. From data on purchases and sales of kroner, cf. Appendix 1.

How large was the pressure?

Denmark's fixed exchange rate policy implies that pressure on the krone only to a very limited extent is visible in the exchange rate vis-à-vis the euro. The exchange rate was almost unchanged in March 2020, despite a weakening pressure on the krone, initiated by the outbreak of covid-19 and the measures to contain the virus. Instead, exchange market pressure is revealed by Danmarks Nationalbank's use of foreign exchange interventions and the monetary policy spread to the euro area, acting as a seismograph for krone pressure, cf. Chart 1. An overall indicator of krone pressure is the so-called Exchange Market Pressure (EMP) index, which can be used to compare pressure across time periods and countries. The EMP includes exchange rate changes, foreign exchange interventions and interest rate changes, cf. Box 1.

Krone pressure revealed by FX interventions and the interest rate spread to ECB Chart 1



Note: Accumulated foreign exchange intervention purchases of foreign currency. The policy rate spread is the spread between Danmarks Nationalbank's certificates of deposit rate and the ECB interest rate on main refinancing operations until 14 October 2008 and afterwards the ECB deposit facility rate. Grey areas are September-November 2008, August 2011-June 2012, January-February 2015 and October 2019-March 2020. Observations until May 2020.
Source: Danmarks Nationalbank.

What are Exchange Market Pressure indices? Box 1

The intuition behind the Exchange Market Pressure, EMP, index is clearly illustrated by the Danish fixed exchange rate regime. Due to the fact that Danmarks Nationalbank actively keeps the krone exchange rate close to the central rate, the exchange rate does not contain any material information about krone pressure. This, however, can be deduced from Danmarks Nationalbank's use of monetary policy instruments to defend the krone, foreign exchange interventions and interest rate changes. The EMP index makes it possible to summarise exchange rate changes, foreign exchange interventions and interest rate changes in one metric. Hence, the EMP index provides a complete picture of currency pressures that can be compared across exchange rate regimes. There are more or less sophisticated versions of the EMP index. This memo uses the EMP index from Goldberg and Krogstrup (2019). This index is defined as:

$$EMP_t \equiv \frac{de_t}{e_t} + \frac{\pi_{i,t}}{\pi_{e,t}} di_t - \frac{1}{\pi_{e,t}} FXI_t$$

In the EMP index, e_t denotes the exchange rate, i_t denotes the interest rate and FXI_t is foreign exchange interventions. Differences are denoted by d. The factors $\pi_{i,t}$ and $\pi_{e,t}$ convert interest rate changes and foreign exchange interventions to exchange rate equivalents.

$$\pi_{e,t} = e_t NX' + \frac{NFL_t^d}{e_{t-1}} \epsilon_e^{NFL} - NFA_t^{fx} \epsilon_e^{NFA}$$

$$\pi_{i,t} = \frac{NFL_t^d}{e_{t-1}} \epsilon_i^{NFL} - NFA_t^{fx} \epsilon_i^{NFA}$$

NX' denotes the change in net exports, NFL_t^d is net foreign liabilities in domestic currency, NFA_t^{fx} is net assets in foreign currency and ϵ_z^x denotes the elasticity of x w.r.t. z.

The EMP index cannot capture underlying motives for the use of interventions and interest rate changes. After the strengthening pressure on the krone in January-February 2015, there appears to have been great weakening pressure on the krone, cf. Chart 2. This is mainly due to normalisation of the foreign exchange reserve, which was significantly expanded during the krone pressure in early 2015. Similarly, a build-up of the foreign exchange reserve occurred after the financial crisis, which appears to be a strengthening pressure on the krone in the EMP index.

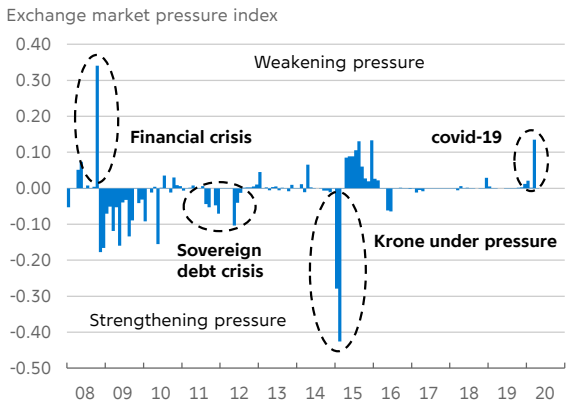
Based on the EMP index, the weakening pressure on the krone in March 2020 was the largest since the financial crisis, cf. Chart 2. The remaining spikes in the EMP index occurred during the financial crisis in 2008, the European sovereign debt crisis in 2011-12 and when the krone was under pressure at the beginning of 2015, cf. Chart 2.

When uncertainty is elevated, risk aversion typically increases as well. This might cause investors to reduce their exposure towards small currencies for the benefit of safe havens, such as the Swiss franc and the US dollar. Like Danish kroner, both Norwegian and Swedish kroner were under a weakening pressure vis-à-vis the euro during the financial crisis and the corona crisis, cf. Chart 3. Conversely, the Swiss franc tended to strengthen during both crises.

Unlike the remaining incidents of krone pressure, overall market conditions were relatively calm in 2015, and the pressure was unique for the krone and the Swiss franc. The pressure on the krone started as the Swiss National Bank abandoned its ceiling on how strong the Swiss franc was allowed to be against the euro. This made market participants speculate about whether Danmarks Nationalbank would make a similar move and abandon the fixed exchange rate policy. The speculations were e.g. reflected in the market for currency options, cf. later.

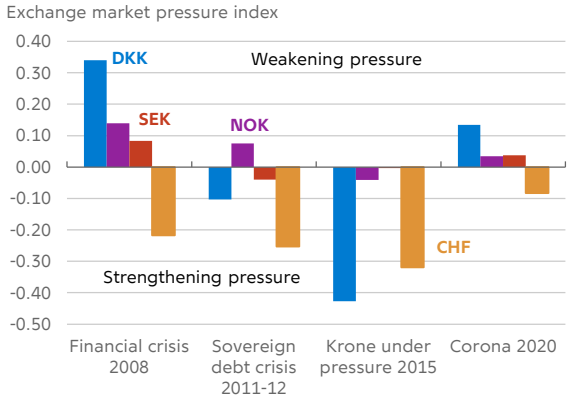
The EMP index summarises the episodes of pressure on the krone. The following sections examine the underlying drivers of the individual incidents in detail. For example, the capital flows causing the pressures are examined.

Krone pressures during crises Chart 2



Note: Exchange Market Pressure index for the krone vis-à-vis the euro. Based on Goldberg and Krogstrup (2019). Observations until April 2020.
Source: Own calculations.

The krone pressure in 2015 was unique Chart 3



Note: Exchange Market Pressure index for the Danish krone, the Swedish krone, the Norwegian krone and the Swiss franc (all vis-à-vis the euro) based on Goldberg and Krogstrup (2019). The chart shows the biggest monthly pressure for each exchange rate in each period. The financial crisis is the year 2008. The sovereign debt crisis 2011-12 is August 2011 to June 2012. Krone under pressure 2015 is January and February 2015. Corona is March and April 2020.
Source: Own calculations.

The corona crisis

Like the financial crisis, the corona crisis is a worldwide crisis. There are several commonalities between the market development during the two crises, for instance large falls in prices on financial assets, elevated risk premia, and high volatility. The VIX index increased to similar high levels during the financial crisis and the corona crisis, cf. Chart 4. The VIX index illustrates that the krone earlier has been subject to pressure during global crises, where uncertainty is high.

During the krone pressure in March 2020, Danmarks Nationalbank sold foreign exchange reserves worth kr. 65 billion and hiked the certificates of deposit rate by 0.15 percentage points to minus 0.60 per cent. During the financial crisis in 2008, the foreign exchange interventions were of similar magnitude, but the certificates of deposit rate was hiked by 0.90 percentage points and the monetary policy interest rate spread to the ECB increased by 1.90 per cent, cf. Chart 5.

It should be noted that prior to the large pressure in March, Danmarks Nationalbank also intervened in the foreign exchange market and sold foreign exchange equal to kr. 19 billion from October 2019 to February 2020.

Domestic investors sold kroner

The weakening pressure in March was primarily driven by krone sales from domestic institutional investors, i.e. IP and investment funds, IF, cf. Chart 6. During the financial crisis, foreign investors were the ones selling kroner.[1]

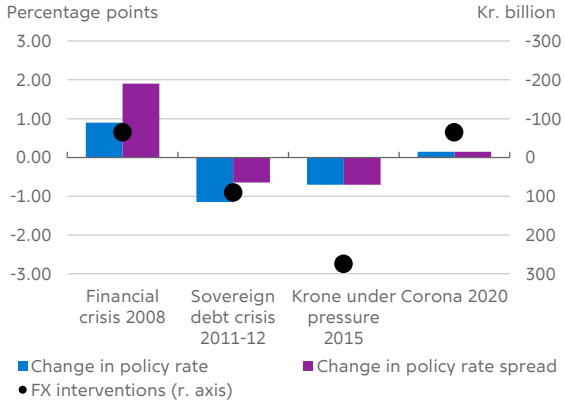
IP and IF sold 55 billion worth of kroner in March 2020, cf. Chart 7. The domestic institutional investors also played a key role in the pressure in 2015, cf. later.

[1] Spange and Sørensen (2016) describe how foreign exchange transactions affect the krone exchange rate.

VIX index on a level similar to the one during the financial crisis Chart 4

Note: Grey areas are September-November 2008, August 2011-June 2012, January-February 2015 and October 2019-March 2020. Daily observations until May 2020.
Source: Refinitiv Datastream and Eikon.

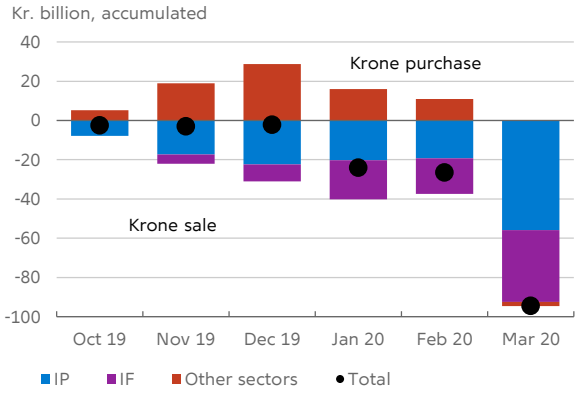
Larger use of policy rate changes during the financial crisis Chart 5



Note: Reverse scale for Denmarks Nationalbank's foreign exchange intervention (right hand axis). Change in policy rate is changes in the certificates of deposit rate. Change in policy rate spread is changes in the spread between Danmarks Nationalbank's certificates of deposit rate and the ECB interest rate on main refinancing operations until 14 October 2008 and afterwards the ECB deposit facility rate. Financial crisis 2008 is September to October 2008, Sovereign debt crisis 2011-12 is August 2011 to June 2012, Krone under pressure 2015 is January and February 2015, and Corona 2020 is March 2020.
Source: Danmarks Nationalbank.

The insurance and pension sector and investment funds sold kroner since October 2019

Chart 6



Note: Accumulated krone purchases by IP, IF and other sectors. IP is the insurance and pension sector. IF is investment funds. Other sectors are calculated as a residual, so the sum of all sectors' krone purchases matches Danmarks Nationalbank's purchase of foreign exchange. Data for purchases and sales of kroner, cf. Appendix 1.
Source: Danmarks Nationalbank.

Less need for foreign exchange hedging causes krone sales

Currency hedging was the main driver of krone sales in March for both the IP and IF sector, cf. Chart 7. As market prices dropped in March, the foreign currency exposure of both sectors was accordingly significantly reduced, which led to a fall in the need for foreign exchange hedging. The two sectors responded by cutting their currency hedging, implying net sales of kroner worth kr. 36 billion.

The net krone sales related to IP's foreign exchange hedging mask large opposite movements. IP's reduction of dollar hedging caused krone sales worth kr. 61 billion.[2] On the other hand, the sector increased its hedging from euro to kroner by kr. 51 billion. Seen in isolation, this reduced the pressure on the krone. The increased hedging of the euro exposure was also the case in 2015. However, in 2015 IP's increased euro hedging contributed to the pressure on the krone.

IP's relatively modest net purchases of kroner via currency hedging in March are also related to the fact that the sector is hedging a large part of its dollar exposure to euro.[3] These transactions do not affect the demand for kroner.

Overall, IP maintained roughly the same hedging ratio for dollar assets end-March compared with end-February. The hedging ratio increased temporarily in March.

Margin calls led to additional krone sales

Due to losses on exchange traded derivatives, IP had to conduct margin payments in foreign exchange. This resulted in krone sales worth kr. 11 billion, cf. Chart 7.

IF reduced their foreign exchange loans, which in isolation implies a sale of kroner. Part of the reduction was due to losses on leveraged investments. The losses on the assets implied a larger share of debt financing, i.e. higher leverage. In order to maintain the leverage ratio, foreign currency loans were reduced.

Foreign investors continued to buy Danish mortgage bonds

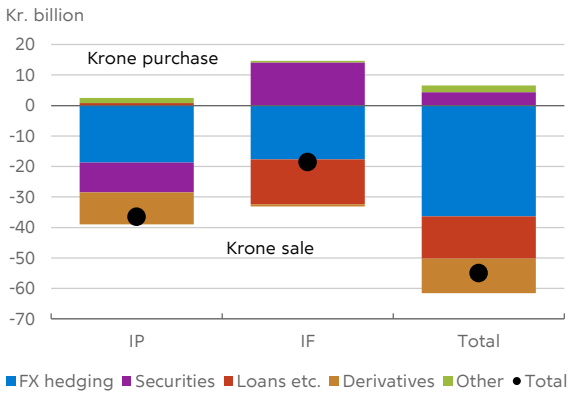
Overall, the krone sales in March were largely driven by falls in global stock prices. As stock markets stabilised, the weakening pressure on the krone disappeared. There is no indication that foreign investors have pulled out of kroner during the corona crisis. Instead, foreign investors continued to buy e.g. Danish mortgage bonds in March. Conversely, many investors fled from small currencies during the financial crisis in 2008.

[2] For a more detailed explanation of how IP's dollar hedging affects the krone market, see Box 3 in Danmarks Nationalbank (2020).

[3] The Danish fixed exchange rate regime implies that euro and Danish kroner to a large extent are used as substitutes, see Olsen and Risbjerg (2019).

Foreign exchange hedging and derivatives drove krone sales in March

Chart 7



Note: Net krone purchases in March 2020. Hedging is net krone purchases due to foreign exchange hedging. Securities are net krone purchases related to purchases of securities in foreign exchange. Loans etc. is the net krone purchase related to deposits and loans in foreign exchange. Derivatives etc. is the net krone purchase from settlement on derivatives contracts. Other covers net krone purchases from issuing of e.g. bonds as well as coupon and dividend payments. Data for purchases and sales of kroner, cf. Appendix 1.
Source: Danmarks Nationalbank.

Large balance sheets mean large purchases and sales of kroner

The large krone sales due to capital losses on foreign exchange assets in March reflect the large holdings of foreign exchange assets by the IP and IF sectors. Combined, the two sectors have foreign exchange assets worth kr. 3,000 billion, primarily in euro and dollar. The foreign exchange assets have just about tripled since 2008. Because of the assets' substantial size, losses or gains have a potential to materialise into significant sales or purchases of kroner if the companies wish to keep the hedge ratio unchanged. Similarly, even minor changes in investment or hedging strategy, for instance due to increased uncertainty or risk aversion, may potentially imply large sales or purchases of kroner.

The financial crisis[4]

Elevated financial uncertainty had been present for almost a year, when the financial crisis escalated in September 2008 as Lehman Brothers went into liquidation.[5] The pressure on the krone began in September, but intensified during October 2008.

During the financial crisis, Danish banks' foreign customers[6] were the primary sellers of kroner. The currency option market prices indicated speculation by some investors about whether Danmarks Nationalbank would be able to maintain the fixed exchange rate policy. This contrasts with the pressure during the corona crisis, driven by domestic krone sales.

The point of departure was different in 2008. In 2008, a positive interest rate spread to the euro area was required to maintain the peg, and the pressure on the krone was always a weakening pressure.[7]

Different patterns of capital flows

During financial crises, investors often pull capital out from abroad. In the years leading up to the financial crisis, the capital flows to and from Denmark increased steadily, but they moderated after the crisis.[8]

Foreign investors brought down their holdings of Danish mortgage bonds during the financial crisis, cf. Chart 8. Likewise, Danish investors

4 For an extended review, see Jørgensen, Kramp, Jensen and Risbjerg (2011).
5 In August 2007, the spread between unsecured and secured money market rates widened. The expansion happened as a result of the French bank BNP ceasing to calculate the market value of investment funds exposed to the so-called subprime market. During the period August 2007-August 2008, Danmarks Nationalbank sold currency for a total of kr. 26 billion and the monetary policy spread to the euro area increased by 0.10 percentage points in July 2008.
6 See Appendix 1 for further explanation.
7 This was the case during previous crises before the euro, for example in 1998, when the krone was under pressure following the Asian crisis, Russia's debt crisis and the problems with the ETCM, and in 1992-93 during the EMS crises.
8 See Danmarks Nationalbank (2018b). The same was the case internationally, see e.g. Milesi-Ferretti and Tille (2010).

sold foreign equities, cf. Chart 9. This is evident from the balance of payments, financial account, from which capital flows affecting the krone market can be found, see Appendix 1.

Conversely, foreign investors continued to buy Danish mortgage bonds during the corona crisis. There is no evidence that Danish investors pulled out of foreign assets.

Foreign investors sold kroner

Seen in isolation, foreign investors sold kroner worth kr. 21 billion during the financial crisis due to security transactions and loans in kroner, cf. Chart 8. The banks' currency transactions also indicate that foreign customers sold kroner, which confirms the picture of foreign investors selling kroner.

The banks' foreign customers sold kroner for a significantly larger amount than suggested by the capital flows alone. One explanation might be that the krone sales by the banks' foreign customers were actually krone sales by domestic investors *via* foreign banks, cf. Appendix 1. Another explanation might be that foreign investors sold kroner in the forward market to hedge the krone exposure or to bet on a krone depreciation.

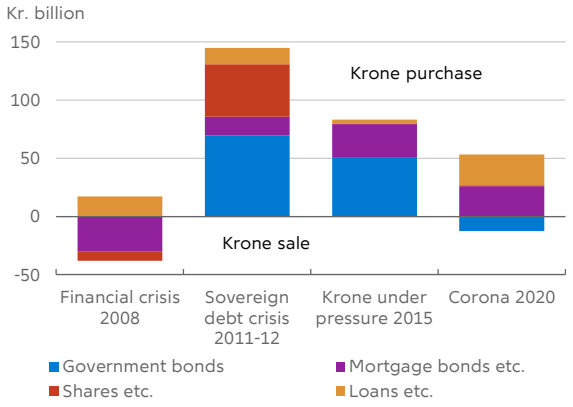
The insurance and pension sector purchased kroner

Domestic investors, IP in particular, bought kroner during the financial crisis, through sales of foreign equities and increased borrowing in foreign currency, cf. Chart 9.

IP raised large currency loans (mostly in euro) worth kr. 70 billion in October and November 2008. Viewed in isolation, this increased the demand for kroner, cf. Chart 10. The banks' foreign exchange transactions confirm that IP bought kroner. Thus, overall IP's transactions contributed to the stabilisation of the krone.

Foreign investors sold Danish mortgage bonds during the financial crisis

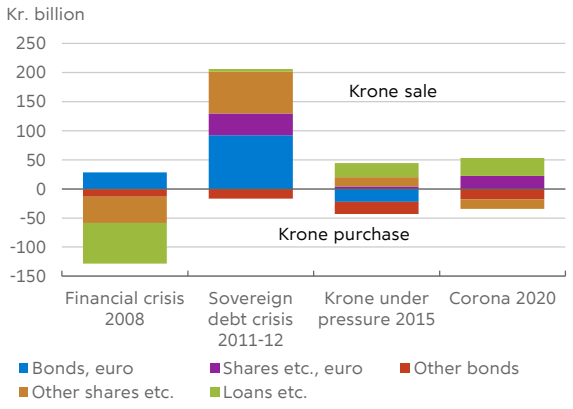
Chart 8



Note: Foreign investors' purchases of assets in Danish kroner from the balance of payments, financial account, see Appendix 1 for further details. Financial crisis 2008 is September to October 2008, Sovereign debt crisis 2011-12 is August 2011 to June 2012, Krone 2015 is January and February 2015, and Corona 2020 is March 2020. Mortgage bonds etc. include all other bonds except from government bonds.
Source: Danmarks Nationalbank.

Domestic investors sold foreign equities during the financial crisis

Chart 9

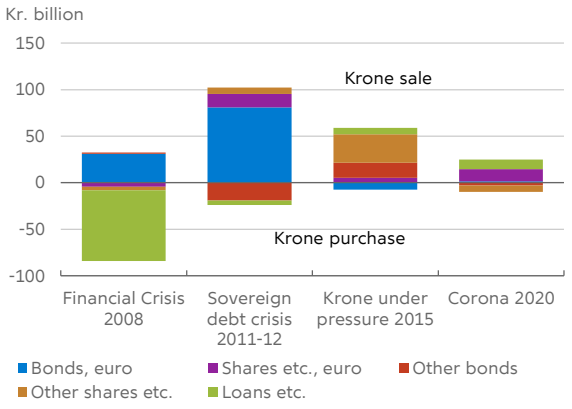


Note: Domestic purchases of foreign exchange assets and foreign exchange lending to foreigners from balance of payments, financial account, see Appendix 1 for further details. Financial Crisis 2008 is September to October 2008, Sovereign debt crisis 2011-12 is August 2011 to June 2012, Krone 2015 is January and February 2015, and Corona 2020 is March 2020.
Source: Danmarks Nationalbank.

During the Financial crisis, the Treasury supported the krone by introducing a new 30-year bond in November 2008. The bond was in high demand by the Danish pension sector. IP's purchase of the 30-year government bond supported the krone to the extent that it led IP to sell foreign bonds (or refrained from buying them). IP purchased Danish government bonds to a large extent in November and December 2008. However, they continued to buy foreign bonds, German government bonds in particular, cf. Chart 10.

The insurance and pension sector raised large foreign currency loans during the financial crisis

Chart 10



Note: The Danish insurance and pension sector's purchase of foreign exchange assets and foreign exchange lending to foreigners from the balance of payments, financial account, see Appendix 1 for further details. Financial Crisis 2008 is September to October 2008, Sovereign debt crisis 2011-12 is August 2011 to June 2012, Krone 2015 is January and February 2015, and Corona 2020 is March 2020.
Source: Danmarks Nationalbank.

The European sovereign debt crisis[9]

During the European sovereign debt crisis, the sustainability of sovereign debt in some southern European countries was questioned. This is illustrated by an elevated interest rate spread between Italy and Germany, cf. Chart 11. The uncertainty regarding the euro contributed to a strengthening pressure on the krone. During the corona crisis, there has also been some focus on debt sustainability in the euro area. The interest rate spreads widened, but far less compared with 2011-12.

The krone pressure during the sovereign debt crisis was unusual compared with previous incidents of pressure. Since the introduction of the fixed exchange rate policy in the early 1980s, financial turmoil typically leads to a weakening pressure on the krone relative to the anchor currency.

The interest rate spread to the euro area was gradually reduced following the financial crisis, and in May 2012, the monetary policy interest rate spread to the euro area became negative. Continued large current account surpluses and the build-up of large net foreign assets may have contributed to the negative interest rate spread. The savings surplus abroad may have contributed a demand for kroner, so far as residents did not want the accompanying currency exposure and a lower interest rate spread was needed to prevent a strengthening of the krone.[10]

Speculation regarding euro area break-up
Due to the fixed exchange rate policy, some investors considered investments in kroner as an opportunity to hedge the risk of a break-up

[9] For a more detailed review see Jørgensen, Larsen and Risbjerg (2013). Already in November 2009, a sovereign debt crisis in Dubai raised concerns about the debt levels in some euro area countries. The end of the sovereign debt crisis is set for June 2012, when the former President of the ECB Mario Draghi stated that within its mandate, the ECB would do "whatever it takes to preserve the euro".
[10] See Autrup, Kramp Pedersen and Spange (2015).

of the euro area. In this scenario, the krone was expected to be strengthened and linked to the strong part of the euro with German participation, given that the krone had previously been pegged to the D-mark.

These speculations were reflected in the currency option market for kroner against euro. There was increased demand for options giving the owner the right to buy kroner at a favourable price in case the krone strengthened. This caused the price of risk reversals to rise, see Box 2. This indicates that market participants considered a significant strengthening of the krone more probable than a significant weakening, cf. Chart 12. The price of risk reversals also increased significantly during the krone crisis in early 2015. Since the sovereign debt crisis, the price of risk reversals has indicated expectations about a strengthening of the krone.

During the financial crisis, the currency option market indicated expectations about a weakening of the krone. Uncertainty about the euro has been renewed during the corona crisis. However, the price of risk reversals was almost unchanged.

Insurance and pension sector bought German sovereign bonds

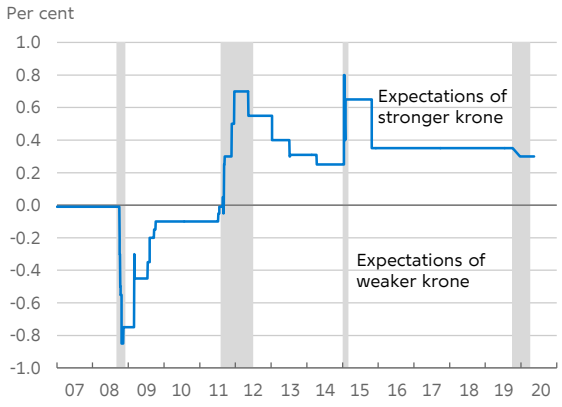
The balance of payments, financial account, shows that foreign investors bought Danish securities to a large extent during the sovereign debt crisis in 2011-12, cf. Chart 8, which seen in isolation contributed to a demand for kroner. This, together with the tendency for the krone to strengthen, was the reason why the krone was mentioned as a safe haven during the sovereign debt crisis.

Conversely, domestic investors, mostly IP, bought foreign currency assets, in particular German government bonds, cf. Chart 10. This worked in the opposite direction, offsetting the strengthening pressure on the krone.

Italy's sovereign spread to Germany increased during the sovereign debt crisis Chart 11

Note: 10-year government bond spread. Grey areas are September-November 2008, August 2011-June 2012, January-February 2015 and October 2019 - March 2020. Daily observations until May 2020.
Source: Refinitiv Eikon.

Expectations of a strengthening of the krone during the sovereign debt crisis Chart 12



Note: Risk reversal for 25 delta 3-month options on the exchange rate between kroner and euro. The exchange rate is euro per kroner and an increase reflects krone strengthening. In foreign exchange markets, the rate is quoted as kroner per euro. Market quotes for risk reversals thus exhibit the opposite sign. Grey areas are September-November 2008, August 2011-June 2012, January-February 2015 and October 2019 - March 2020. Daily observations until May 2020.
Source: Nordea Analytics.

Purchases of euro assets may have a greater effect on the krone exchange rate, because the currency hedging of euro assets is usually lower than for other currency assets.

The purchase of German government bonds reflected that domestic investors preferred safe assets. IP's incentive to buy e.g. German government bonds instead of Danish government bonds increased in December 2011 as the discount curve for pension liabilities was adjusted. Prior to the adjustment, IP had an incentive to sell German government bonds and buy Danish government bonds, which potentially could result in self-reinforcing dynamics where increasing liabilities would force IP to buy Danish government bonds.[11]

Contrary to the financial account of the balance of payments statistics, the data from Danish banks' currency transactions[12] suggest that domestic IP bought kroner, whereas foreign investors sold kroner, i.e. the completely opposite picture.

One explanation for this difference might be that the sales of kroner by banks' foreign customers cover IP sales via foreign banks, see Appendix 1 for further explanation.

Another possible explanation is that IP increased its hedging of currency exposure through purchases of kroner in the forward market. This is shown in the data for banks' currency transactions but not in balance of payment statistics. The speculation about a break-up of the euro could have given rise to an increase in the hedging of the euro exposure.

Risk reversals and expectations regarding the exchange rate Box 2

A risk reversal is an option strategy based on call and put options. A currency call option gives the owner the right (but not the obligation) to buy one currency against another currency (e.g. kroner for euro) in the future (e.g. in 3 months) to a pre-specified exchange rate (strike price). A put option, on the other hand, gives the owner the right to sell at the pre-specified exchange rate. A risk reversal means simultaneously buying a call option and selling a similar put option written on the same currency pair.

Risk reversals indicate whether the participants in the options market have asymmetric expectations regarding the future exchange rate. A risk reversal with a positive value means that the call is worth more than the similar put option. This would be the case, if market participants expect a strengthening of the currency to be more likely than a weakening. Hence, risk reversals can indicate future pressures.

The price of options is typically quoted by the implicit volatility in per cent. The price is quoted for a given delta and a given strike price. Delta denotes the probability that the option might be exercised at maturity. A delta equal to 100 means that the option certainly will be exercised at maturity (deep in-the-money). On the other hand, a delta equal to 0 implies that it will not be profitable for the holder to exercise the option at maturity (deep out-of-the-money).

Options with low deltas are often used to indicate exchange rate pressures. The reason is that these options require large exchange rate movements to be exercised. In this Economic Memo, options with deltas equal to 25 and maturity of 3 months are used.

1. For further details on currency options, see e.g. ECB (2003).

11 See Kramp, Lohff and Maltbæk (2012) and Hansen, Thamsborg and Risbjerg (2013).

12 See Appendix 1.

The krone under pressure in 2015[13]

Leading up to the krone pressure in early 2015, financial market participants expected the ECB to expand its programme for purchase of government bonds to push down euro area interest rates.

On 15 January 2015, the Swiss National Bank abandoned its temporary exchange rate ceiling for how strong the Swiss franc could be vis-à-vis the euro. Already later that day, the Danish krone appreciated against the euro due to capital inflows.

On 22 January 2015, the ECB announced a more comprehensive expansion of its asset purchasing programmes than previously expected. This too led to increased demand for kroner, implying additional pressure.

Different from the corona crisis

Contrary to the recent pressure during the corona crisis, the pressure in 2015 was a strengthening pressure. The pressure in 2015 was not linked to global financial crises or sovereign debt issues in the euro area.

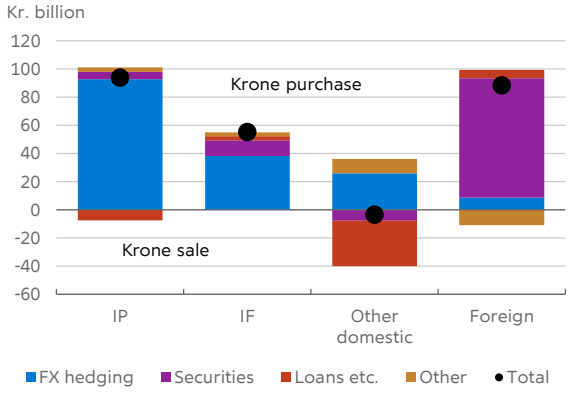
The large demand for kroner in 2015 came from multiple angles. Following the announcement from the Swiss National Bank, the Swiss franc appreciated roughly 20 per cent vis-à-vis the euro in a few days. Some foreign investors bought kroner, anticipating a similar gain if Danmarks Nationalbank were to abandon its fixed exchange rate policy, and the krone subsequently appreciated.

A large part of the krone pressure came from domestic investors, most notably insurance companies and pension funds, cf. Chart 13. They bought kroner to lower their foreign currency exposure, in particular in euro. In January 2015 alone, IP increased its hedge ratio of their euro exposure by 5 percentage points. The hedge ratio of the euro exposure has also increased during the corona crisis, although the pressure went in the opposite direction.

After the first months of 2015, IP's hedge ratio of the euro exposure was normalised as forward contracts expired, leading to krone sales. Foreign investors also sold some of their acquired assets in kroner.

As in 2008, the government debt policy supported the krone in 2015. Whereas a new 30-year bond was introduced in 2008, the Treasury stopped issuing government debt on 20 January 2015 following recommendations from Danmarks Nationalbank.

Domestic and foreign investors bought kroner in 2015 Chart 13



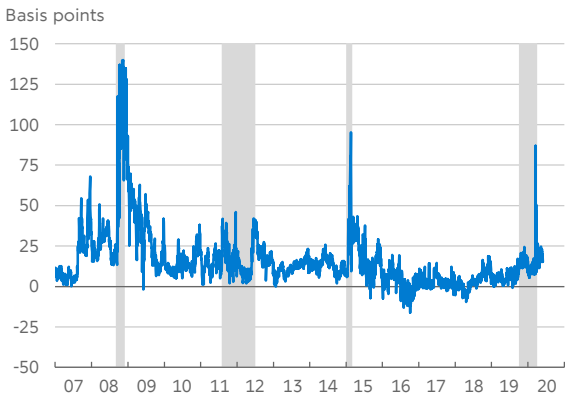
Note: Total net krone purchases in January and February 2015. Hedging is net krone purchases due to FX hedging. Securities are net krone purchases related to purchases of securities in foreign exchange. Loans etc. is the net krone purchase related to deposits and loans in foreign exchange. Derivatives etc. is the net krone purchase from settlement on derivatives contracts. Other covers net krone purchases from issuing of e.g. bonds as well as coupon and dividend payments. Data for purchases and sales of kroner, cf. Appendix 1.
Source: Danmarks Nationalbank.

[13] For a more detailed review, see Danmarks Nationalbank (2015) and Raffnsøe, Jensen and Larsen (2016).

Signs of krone pressure in the forward market

A large part of the euro hedging during the krone crisis came through purchases of kroner against euro in the forward market. The increased demand made it more expensive to buy kroner in the forward market. This was reflected by the implicit interest rate spread in the forward market which turned significantly more negative than the interest rate spread between Denmark and the euro area, cf. Chart 14 and Box 3.

Signs of large demand for kroner in the forward market in 2015 Chart 14



Note: Deviation from the covered interest rate parity. Difference between the interest rate spread and the implicit interest rate spread from 3-month forward contracts on kroner and euro. The interest rate spread between kroner and euro is based on OIS swaps. Grey areas are September-November 2008, August 2011-June 2012, January-February 2015 and October 2019-March 2020.
Source: Refinitiv Eikon.

Deviations from the covered interest rate parity Box 3

The payoff from borrowing euro and placing the funds in kroner is the interest rate spread between kroner and euro. A similar strategy is to buy euro against kroner in the spot market and sell euro versus kroner in the forward market. The payoff from the latter strategy is the difference between the forward and spot exchange rate, which is called the forward spread or the implicit interest rate spread. According to the covered interest rate parity, the two strategies should yield the same payoff in the absence of arbitrage. Formally, it is expressed:

$$r_t^{DKK} - r_t^{EUR} = \frac{F_t - S_t}{S_t}$$

where r_t^{DKK} and r_t^{EUR} are the interest rates in kroner and euro, S_t is the spot exchange rate, and F_t is the forward exchange rate, both quoted as kroner per euro.

The interest rates in the covered interest rate parity should reflect the actual borrowing and deposit rates faced by the actors, which are the alternative to spot and forward transactions in the foreign exchange market. Besides, the credit risk should be similar.

The forward exchange rate can be affected by supply and demand in the market. During the financial crisis, US dollars and, to some extent, euros were scarce. For instance, borrowing dollars in the lending market became difficult and the foreign exchange market was used to fund dollars. This led to an increase in the price of dollars and the implicit interest rate spread from the foreign exchange market fell below the interest rate spread, resulting in a large deviation from the covered interest rate parity.

Other factors may cause deviations from the covered interest rate parity. OIS swaps are based on the overnight rate, having minimal credit risk. The OIS swap rates do not necessarily reflect actual funding and deposit rates. Instead, these could be unsecured loans with larger credit risk or repos, where the interest rate depends on the collateral.

Deviations from the covered interest rate parity may also be present if market participants do not exploit the arbitrage opportunity. Increased regulation has lowered banks' balance sheet capacity to do arbitrage.

2. $r_t^{DKK} - r_t^{EUR}$ is an approximation for $\frac{1+r_t^{DKK}}{1+r_t^{EUR}} - 1$. $\frac{F_t - S_t}{S_t}$ is the annualised forward spread, which is comparable to interest rates.

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Appendix 1. What do we know about purchases and sales of kroner?

Danmarks Nationalbank has extensive data for various players' purchases and sales of kroner, e.g. from balance of payments statistics, securities statistics, certain sector reports on currency hedging and banks' reports on currency transactions.

Data for banks' currency transactions
It is a criterion for Danmarks Nationalbank's assessment of counterparties in currency transactions in Danish kroner that currency turnover in kroner is reported on a daily basis. Counterparties, which are banks in Denmark, account for the vast majority of foreign exchange trading in Denmark. Information is available about banks' net purchases in spot and forward transactions broken down by insurance and pension companies, other domestic customers and foreign customers. Here it is possible to get an overview of which of the banks' customers that bought kroner. However, the insurance and pension sector's purchases of Danish kroner from banks is not necessarily the sector's total purchases, as it can also buy kroner from e.g. foreign banks that have bought kroner from banks in Denmark. Thus, krone purchases from foreign customers, such as banks, can cover demand from domestic sectors. This is also the case, for example, if a Danish company's subsidiary abroad purchases kroner from a foreign bank, which buys the kroner from a bank in Denmark. The data from the banks is not part of Danmarks Nationalbank's official statistics and is not published.

Data from the balance of payments statistics
The balance of payments' financial account provides an overview of the financial transactions between Denmark and abroad which affect the demand for the krone. If foreign investors buy Danish securities in kroner (which are not hedged) or increase lending in kroner to Danish residents, this gives rise to krone purchases. Conversely, if domestic investors buy securities from abroad in foreign currencies (which are not hedged), this gives rise to sales of kroner. Similarly, lending in foreign currency by Danish residents to other countries can lead to sales of kroner.

The starting point for the impact of the balance of payments' financial items on the demand for kroner is that Danish residents' transactions in foreign currency and foreigners' transactions in kroner, in isolation, affect the demand for kroner:

Domestic residents' net krone purchases from the balance of payments' financial account =

- Net purchases of foreign assets in foreign currency

- Net lending abroad in foreign currency

Foreigners' net krone purchases from the balance of payments' financial account =

+ Net purchases of Danish assets in kroner

+ Net lending to Danish residents in kroner

In this Economic Memo, net purchases of assets include portfolio investments and equity investments from direct investments. Net lending includes loans and deposits and remaining other investments, inter-company loans etc. and financial derivatives. It is the actual payments from the financial items that have a bearing on the krone purchases. Actual payments do not include reinvested earnings that are included in the balance of payments statement but not in net purchases of kroner.

Here, Danish residents do not include Danmarks Nationalbank and the government. In order to minimise noise in the calculation of net purchases of kroner, banks' and mortgage banks' transactions in foreign currency and

cross-border inter-company loans in kroner are also disregarded. These transactions are substantial, but the institutions hedge currency to a very large extent, so that the overall effect on the demand for the krone is limited.

Kroner purchases and sales from derivatives transactions, e.g. currency forward transactions for hedging, are not included in the balance of payment statistics. Foreign purchases of Danish bonds thus, in isolation, give rise to foreign purchases of kroner, but if the purchase is hedged, this will lead to a corresponding sale of kroner, so that there is no overall demand for kroner.

Data for purchases and sales of kroner
On the basis of balance of payments statistics, securities statistics, currency dealers' reports and currency hedge reports from IP and IF, Danmarks Nationalbank has determined the purchases and sales of kroner from various domestic sectors and from abroad since 2015, the krone flows.

In addition to the balance of payments' financial accounts, the krone flows include transactions from the current account surplus, including interest and dividend payments, and transactions in domestic issues of assets in foreign currency from the securities statistics and domestic loans in foreign currency from the banking and mortgage statistics.

Data for reporting of currency hedging is also included for the insurance and pension sector and the investment fund sector, as are Danish non-financial corporations and foreign investors' currency hedging via Danish banks. See also Danmarks Nationalbank (2018a).

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