

STAFF MEMO

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RAGNA ALSTADHEIM,
KJELL BJØRN
NORDAL, OLAV B.
SYRSTAD, SASKIA
TER ELLEN, MAY-IREN
WALSTAD WASSÅS



NORGES BANK

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BOND MARKET FIRE SALES AND TURBULENCE IN THE NORWEGIAN FX MARKET IN MARCH 2020 *

RAGNA ALSTADHEIM, KJELL BJØRN NORDAL, OLAV SYRSTAD,
SASKIA TER ELLEN AND MAY-IREN WALSTAD WASSÅS

Norges Bank
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Abstract

The world witnessed a meltdown in financial markets in March 2020 as the Covid-19 pandemic hit the global economy. In this memo we document how the turbulence affected Norwegian financial markets. We describe possible mechanisms behind the stress in the Norwegian foreign exchange and bond markets, and how policy measures were used by Norges Bank to alleviate market frictions.

*The views and conclusions expressed in this publication are the authors own and do not necessarily reflect those of Norges Bank. This paper should not be reported as representing the views of Norges Bank. We thank Alexander Flatner, Karsten Gerdrup, Charlotte Høeg Haugen, Torbjørn Hægeland, Thore Kockerolls, Ylva Søvik, Sindre Weme and Per Atle Aaronsen for comments. Any remaining omissions and errors are the responsibility of the authors.

1 INTRODUCTION AND SUMMARY

For the past year, the Covid-19 pandemic and the drastic measures to limit its spread have had significant consequences for health and the real economy around the world. In connection with this, we witnessed a worldwide meltdown in financial markets in March 2020. Within a month, leading stock indices in Europe and the US fell by more than 30 percent and daily movements above 5 percent were not uncommon. In addition, a parallel supply shock contributed to collapsing oil prices. Not surprisingly, Norwegian markets were also hit hard. In a period of two weeks, the Norwegian krone (NOK) weakened by 25 percent against the US dollar (USD), and risk premia in Norwegian money and credit markets rose markedly.

Although it is common that in times of crisis, the Norwegian krone (as other smaller currencies) depreciates and risk premia rise, the magnitude and pace of these movements in the spring of 2020 was unprecedented. This *Staff Memo* discusses the causes and consequences of the turbulence in the Norwegian financial markets in March 2020, and the lessons learned.

Unlike previous episodes of distress, one can argue that it was non-bank financial institutions, such as mutual funds, pension and insurance companies (what we here label NBFIs), rather than the banking sector, that experienced the most severe difficulties this time. In the wake of the financial crisis of 2008-2009, major changes in regulatory requirements have strengthened the capital adequacy, liquidity buffers and the financing structure of banks. As such, the banking sector was significantly better equipped to meet financial stress in 2020 than it was in 2008. However, some have argued that these regulatory changes may have reduced banks' incentives to deploy balance sheet capacity and act as intermediaries, at a time when additional regulatory changes in collateral requirements may have increased the vulnerability of other market participants. This may have amplified some of the turmoil in financial markets that took place in March 2020. While the collateral requirements in derivative contracts have reduced counterparty risk in the financial system and thereby also tail risk, they have increased the liquidity risk of the NBFIs.

Norwegian NBFIs invest a large share of their portfolio outside Norway, and a significant part of these investments is hedged against foreign exchange risk with derivative contracts, often in the form of foreign exchange swaps. When the krone weakens, they (as buyers of NOK at a future agreed date) lose market value on their existing derivative contracts, which requires margin payments to neutralise the counterparty risk embedded in the contract. Such margin payments (collateral) are mostly settled in cash, often on a daily basis. In times of normal market volatility this is manageable. In March, however, the depreciation of the exchange rate was so large and rapid that this led to an abrupt and substantial change in the market value of foreign exchange swaps. After the NBFIs had depleted their liquidity buffers, they had to obtain cash by realising securities in order to meet the collateral requirements. There was also a "dash for cash" by other investors who were low on deposits and in need of immediate cash. This led to imbalances and high risk premia in the bond market.

In addition, the large and rapid decline in global equity markets led to a situation in which funds were suddenly overhedged, i.e. the decline in foreign portfolio value led to a much higher hedging ratio than desirable. One way to maintain a constant hedging share is to repurchase foreign currency equal to the nominal value decline and sell NOK. This rebalancing mechanism led to selling pressure on NOK, thereby further weakening an already depreciated currency. This in turn increased the collateral requirement on derivative contracts, spurring further selling pressure in the bond market.

Norges Bank initially responded to the Covid-19 crisis by lowering its policy rate. The financial market stress was furthermore addressed by increased liquidity provision to banks and FX interventions. After these measures were implemented, and as global financial markets somewhat recovered, risk premia in the bond market fell and the NOK market became more balanced.

In the following, we discuss and document the turmoil in Norwegian financial markets in the spring of 2020. The structure of the *Staff Memo* is as follows: Section 2 provides some institutional background on the financial sector in Norway. Section 3 briefly describes market developments in Norway and abroad during the spring of 2020. Section 4 describes the market stress and the policy response in Norway, while Section 5 focuses on market developments and policy measures in other countries. Section 6 provides concluding remarks.

2 INSTITUTIONAL BACKGROUND

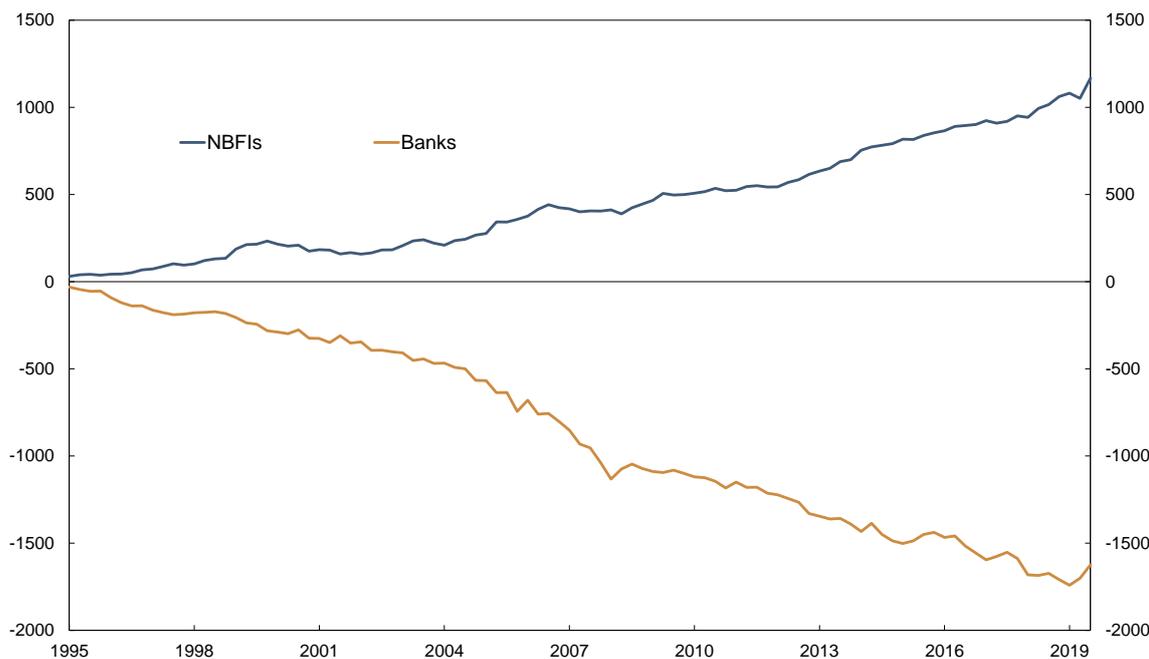
2.1 FINANCIAL INSTITUTIONS' AGGREGATE BALANCE SHEETS

Mutual funds, life insurance companies and pension funds (the NBFIs) invest a large proportion of their assets under management in foreign assets for diversification and return purposes, while banks are net borrowers in the foreign bond market (see Figure 1). This exposure creates exchange rate risk: NBFIs receive pension and insurance contributions and investment inflows in NOK, invest a large share of those inflows in foreign currency denominated assets (dominantly in USD), and subsequently disburse pensions and insurance claims and returns on investments in NOK. NBFIs are therefore exposed to FX risk during the lifetime of the investment and are worse off if the NOK appreciates. At the same time, Norwegian banks largely rely on the international bond market for funding, mainly lend to Norwegian borrowers in NOK, and have to repay their debt again in foreign currency. If they want to reduce this exchange rate risk by means of currency hedging, the banks and NBFIs are therefore natural counterparties in the FX swap market. Hence, the Norwegian asset manager's source of US dollar liquidity is typically a Norwegian or Nordic bank, as the Nordic banking market is highly interconnected.

Regulations and mandate restrictions incentivize NBFIs to reduce a part of their exchange

rate risk by means of currency hedging.¹ Global fixed-income investments are often fully hedged against currency fluctuations, while global equity investments tend to have a lower hedging ratio. In practice, a certain target hedging ratio is chosen for each fund. Asset managers' mandates prescribe different thresholds for how much the actual hedging ratio can fluctuate around a quantified target, before it requires a readjustment to the given target hedging ratio. The Norwegian banks' hedging behavior is described in detail in Appendix B on page 28, and see also Molland (2014).

Figure 1: Net financial claims on other countries. Banks and NBFIs.



Note: Billions of NOK. Positive value indicates net positive asset position of Norwegian institutions, negative value indicates net debt position. 1995 Q4 - 2020 Q2. Sources: Statistics Norway and Norges Bank.

2.2 THE FX SWAP MARKET. RISKS AND REGULATIONS

While market participants reduce their foreign exchange risk by hedging their currency exposure in the swap market, they increase their exposure to counterparty risk, rollover risk, and liquidity risk.

To limit counterparty risk, i.e. the risk of the counterparty defaulting on their contrac-

¹Although it is not mandatory for NBFIs to hedge their currency exposure, insurance companies and pension funds need to hold capital to cover interest rate and currency risk. Hedging of currency risk in mutual funds depends on the funds' mandates and charters of association.

tual obligation, regulations impose collateral requirements.² For example, a significant weakening of the krone exchange rate will result in a negative market value for existing hedging contracts for Norwegian NBFIs, and lead to collateral requirements during the lifetime of the contract. The purpose of the margin requirements is to protect the counterparty against the cost of replacing the contract in the market in the case of a default.

For FX swap and forward contracts subject to ISDA (International Swaps and Derivatives Association) agreements with CSA (Credit Support Annex), there is a requirement to post *daily* variation margins to reduce counterparty risk throughout the lifetime of the contract.³ For market participants with similar exposures, this leads to synchronized timing of margin payments in line with fluctuations in the exchange rate (see also Appendix A.3 on page 26). The effect on financial markets of such margin payments depends on the terms of the CSA agreements regarding the currency denomination and type of the collateral accepted. Margins are often settled in the form of bank deposits or other highly liquid assets. While daily margining requirements reduces counterparty risk, it increases liquidity risk for all counterparties.

Rollover risk, i.e. the risk of not being able to renew the contract at all or without significant losses, is not reduced by margining. During periods of market turbulence, it can be more challenging than usual to renew contracts or find new counterparties. When practically possible, seeking to match the duration of the swap contracts with the maturity of the underlying investments will reduce rollover risk. But on the other hand, shorter contract duration provides more flexibility when it comes to adjusting investment positions and the hedging ratio, and the market for shorter dated FX swaps is more liquid. More generally, spreading the contract maturity dates and diversifying the contract durations will mitigate the risk of needing to roll over many contracts and sizeable volumes at one turbulent point in time.

The foreign currency demand of Norwegian asset managers is not unique. Globally, the US is a particularly important recipient of asset managers' investments, which has resulted in a strong and growing demand for USD funding. In times of financial turmoil, when intermediaries are less willing or able to supply dollar funding, the cost of accessing dollars rises substantially, as discussed by Avdjiev, Eren, and McGuire (2020).⁴

²These regulations have been recommended by the Basel Committee, and have been implemented by regulators in the EU and the EEA, as well as in most other parts of the world, see Basel Committee on Banking Supervision (2019) and European Systemic Risk Board (2020). Many derivative contracts are traded with central counterparties, but FX derivatives are not. Whereas most derivative contracts require both initial and variation margin, FX forwards and swaps are currently only subject to variation margin requirements. Regulation of OTC derivatives, central counterparties and trade repositories is included in Chapter 17 in the Securities Trading Act (translated version), <https://www.finanstilsynet.no/globalassets/laws-and-regulations/laws/securities-trading-act.pdf>

³For a description of CSAs, see Molland (2011).

⁴An in-depth description of the market for USD funding is discussed in Bank for International Settlements (2020a). The US dollar has a prominent role in the global FX market not only because the US is a large net borrower and has deep domestic financial markets, but also e.g. because trade often is quoted in USD. In the NOK spot market, turnover has traditionally been highest in EUR, but in the forward market, turnover has been highest in USD. For a description of the structure of the NOK market, see Norges Bank (2020c).

3 FINANCIAL MARKETS IN MARCH 2020

With Covid-19 making its way to Europe and the US in early 2020, global financial markets started to show signs of distress. As the severity of the pandemic⁵ became clear, stock prices plunged, see Figure 2a. Oil prices fell sharply, volatility in financial markets rose, and dollars became scarce in swap and repo markets. As is common in times of crisis, small currencies depreciated, and so did the Norwegian krone, see Figure 2b.

The depreciation of the Norwegian krone that we witnessed in March 2020 was unprecedented. In a short period of time, the krone lost 25 percent of its value against the euro and the dollar. Although most smaller currencies depreciated, Figure 2b shows that the Norwegian krone weakened substantially more than comparable currencies. The weakening of the krone reached historical proportions on March 19th, after having depreciated 14 percent against the import-weighted I-44 rate in one day, to reach its weakest level in history.

Several mechanisms were at play. Besides high levels of uncertainty, which typically negatively affects small and more illiquid currencies like the Norwegian krone, the oil price had fallen sharply in response to disagreement between OPEC+ members. A pessimistic outlook for the world economy hit stock prices. The fall in global stock markets also contributed to the depreciation pressure on the Norwegian krone more directly, due to the mechanic rebalancing effects that will be discussed in more detail in the next section. Moreover, at an operational level, the sudden introduction of working-from-home practice may have reduced FX traders' willingness to undertake large volumes in already deteriorating market conditions.

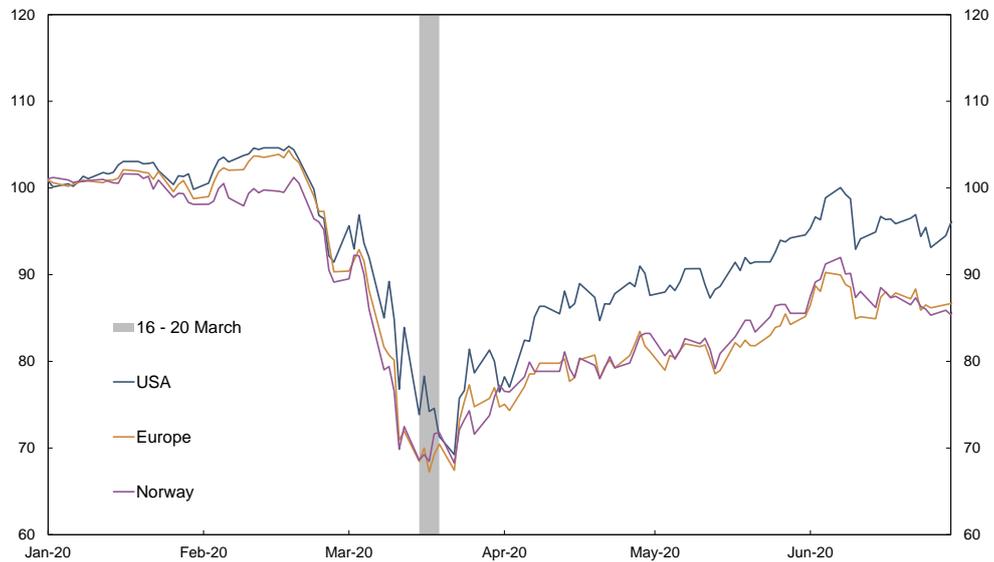
Risk premia in Norwegian bond markets rose substantially. Figure 3b shows the risk premium on five-year bonds, measured by the difference between the yield of five-year bonds and the prevailing interest rate swap, between January 2018 and December 2020. For comparison, we show risk premia for Norwegian issuers in the euro market, see Figure 3a. The stress in the Norwegian bond market seems to have been larger than in the international market.

4 MARKET FRICTIONS AND CENTRAL BANK POLICIES

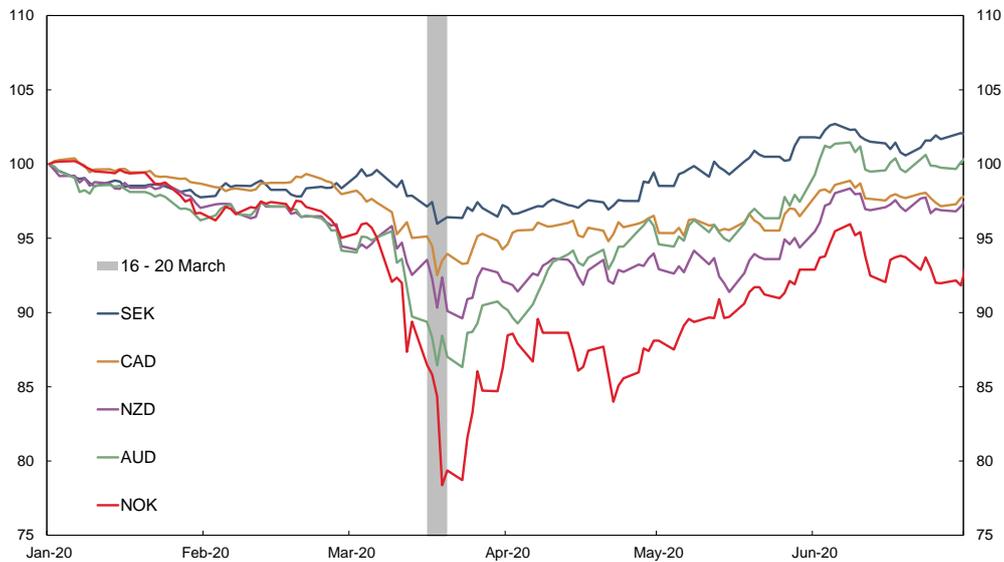
In this section, we describe in more detail how Norwegian financial markets were affected by the global events, how the institutional framework (and in particular the swap market) contributed to these effects, and how authorities responded. The stress in the Norwegian bond market in March was closely tied to the unprecedented depreciation of the NOK exchange rate, largely due to the demand for liquidity by NBFIs in order to meet their margin requirements. The depreciation itself was also impacted and exacerbated by NBFIs' rebalancing needs.

⁵On March 11th, the WHO declared that Covid-19 could be characterized as a pandemic.

Figure 2: Equity and exchange rates



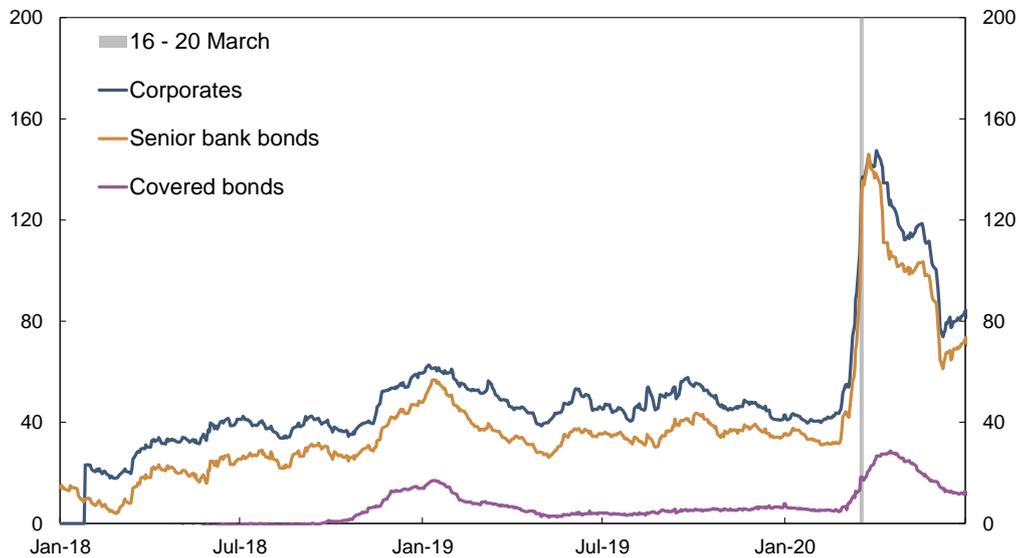
(a) Equity indices for Norway, Europe and the US



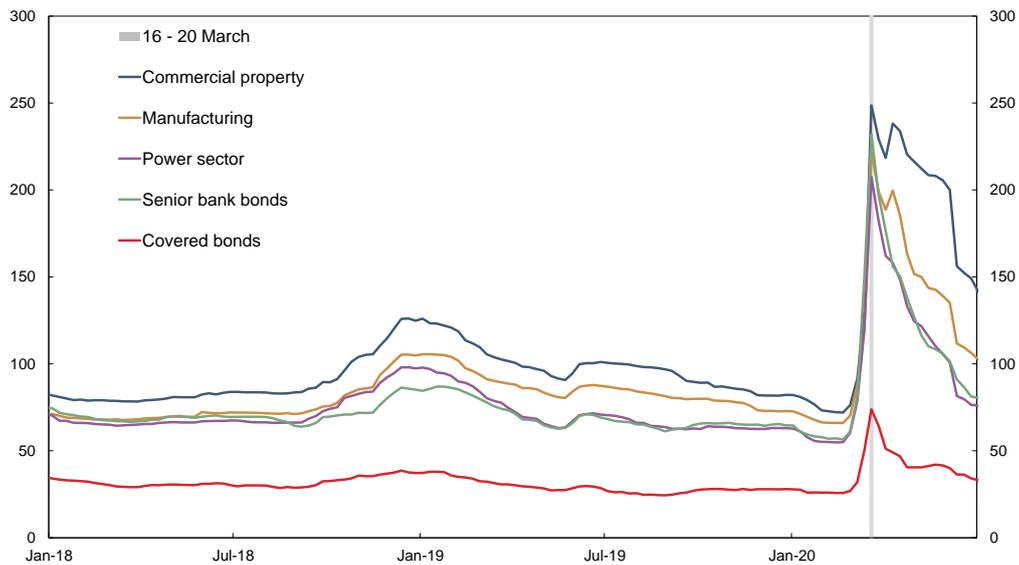
(b) Depreciation of small currencies

Note: Figure 2a shows the main equity indices for Norway, USA and Europe from January 2020 to the end of June 2020. For presentation purposes, the indices are scaled such that January 2, 2020 = 100. Figure 2b shows the effective exchange rates of five small currencies for the same time period, scaled in the same way. Lower index indicates a weaker currency. Sources: Bloomberg and Norges Bank.

Figure 3: Bond market risk premia for Norwegian issuers



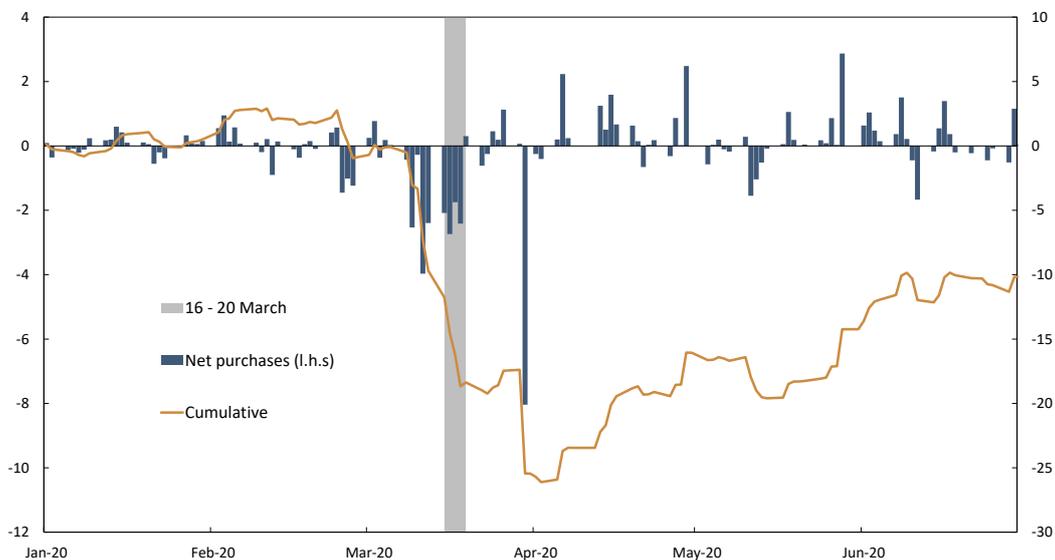
(a) Bond risk premia, Norwegian issuers in the EUR market



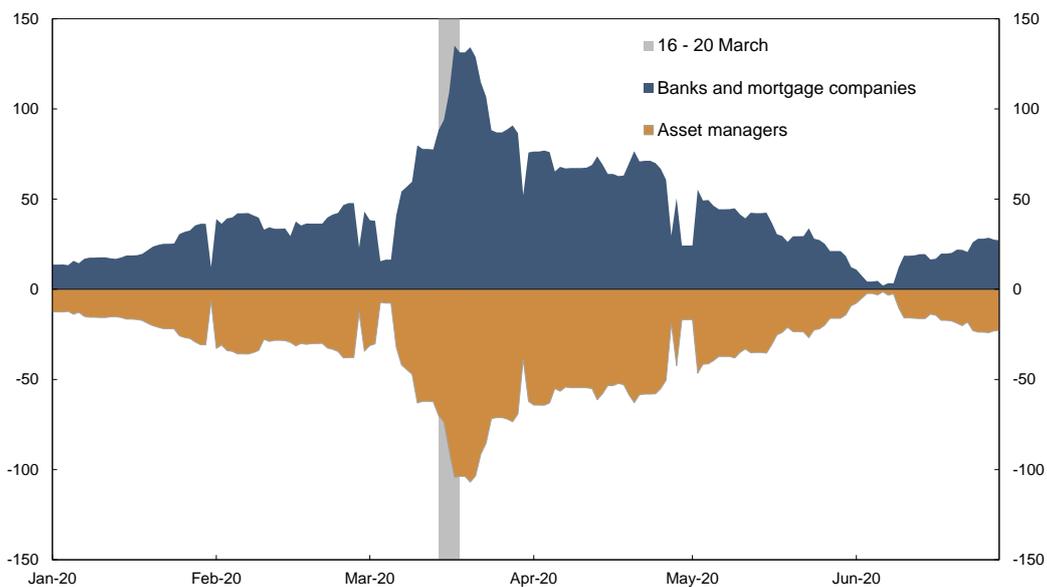
(b) Bond risk premia, Norwegian issuers in the NOK market

Note: Figure 3a shows the risk premium on five-year bonds in EUR for bonds issued by Norwegian banks and corporates. The spread is the difference between the five-year bond yield and the corresponding interest rate swap. Figure 3b shows the risk premium on five-year bonds in NOK, measured as the difference between the yield on five-year bonds and the corresponding interest rate swap. Basis points. January 2018 to June 2020. Sources: Statistics Norway, Bloomberg and Norges Bank.

Figure 4: Rebalancing and margining



(a) Krone purchases by Norwegian NBFIs



(b) Value of derivative portfolios

Note: Figure 4a displays the daily net purchase of NOK by Norwegian non-bank financial institutions (NBFIs) from January to June 2020, in billion NOK. The Foreign Exchange Transactions statistics shows that Norwegian NBFIs net sold NOK 25 billion in March 2020. Figure 4b shows the value of FX derivative portfolios between January 2020 and June 2020, as a proxy for the change in margining over this period in billion NOK. Sources: Norges Bank's statistics on Foreign Exchange Transactions (published on a weekly basis), Statistics Norway, DTCC and Norges Bank

As global stock markets started to fall in late February, and fell more sharply in March, the value of Norwegian asset managers' underlying foreign investments declined. The NOK volumes that they had purchased forward in their swap agreements in order to hedge FX exposure were now too large relative to the value of their underlying assets. They became overhedged and thus hedging a larger proportion of their foreign asset exposure than desirable, possibly to a degree that deviated significantly from the targeted hedging ratio. In order to rebalance the hedging ratio back to its target, they sold NOK proportionate to the value loss on foreign investments. This can also be seen from the Foreign Exchange Transactions statistics in Figure 4a. Under normal market conditions, the hedging ratio is adjusted when the realized hedging ratio moves outside of its targeted interval, or else by month-end. The large and abrupt movements in equity markets resulted in daily adjustments. In a market environment where share prices were spiralling downwards and the market liquidity in the FX market was poor, such frequent adjustments contributed to a rapid krone depreciation.

Meanwhile, the sharp fall in the oil price following the failing negotiations among OPEC+ countries on March 7th was an important backdrop for the depreciation of the Norwegian krone in mid-March, see Figure 13b on page 21.

The sharp depreciation of NOK led to a substantial change in market participants' portfolio value of currency swaps. This meant that they had to post variation margins, either in the form of securities as collateral or - more commonly - in the form of cash deposits.⁶ Figure 4b shows the value of derivative portfolios of various players between January and September 2020, and as such gives an approximation of the change in margining over this period.

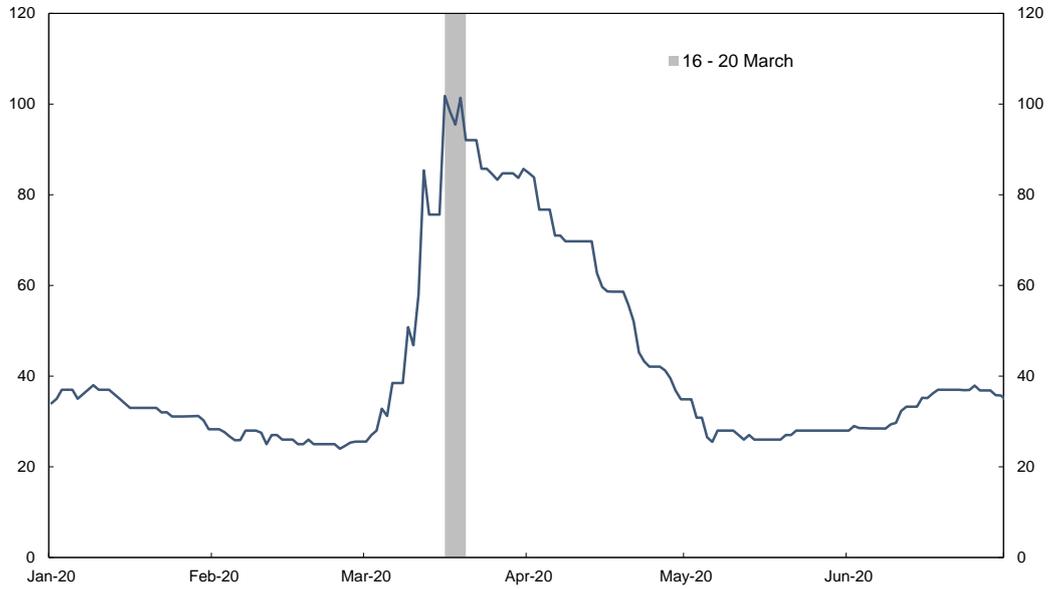
Meanwhile, the outbreak of the pandemic led to an abrupt increase in banks' money market funding costs. The most widely used reference rate in the Norwegian money market is the Nibor rate. The Nibor spread above the expected policy rate rose significantly towards mid-March in line with increasing turmoil in financial markets, as seen in Figure 5. The Nibor is closely tied to the USDNOK FX swap market due to the way Nibor is constructed and quoted. As a result, the Norwegian money market rate is directly influenced by changes in risk premia in the US money market, which also increased sharply in this period.

The turmoil was initially met with a lowering of the policy rate by 50 basis points to 1 percent on March 13th, see Figure 6. Simultaneously, Norges Bank decided to offer extraordinary loans to banks. The loans were granted against collateral at a fixed price equal to the policy rate without restrictions on the volume of the loans that the banks could obtain, and with 3-months maturity. On March 19th Norges Bank announced additional loans with maturity up to 12-months. Under ordinary circumstances, banks do not have access to loans from the central bank with such a long maturity.⁷ Moreover, Norges Bank

⁶One reason for cash being the preferred collateral may be the favourable treatment of cash collateral in the new regulatory framework for banks. For instance, cash collateral does not increase the total exposure in the calculation of Leverage Ratio, while this is not necessarily the case for securities.

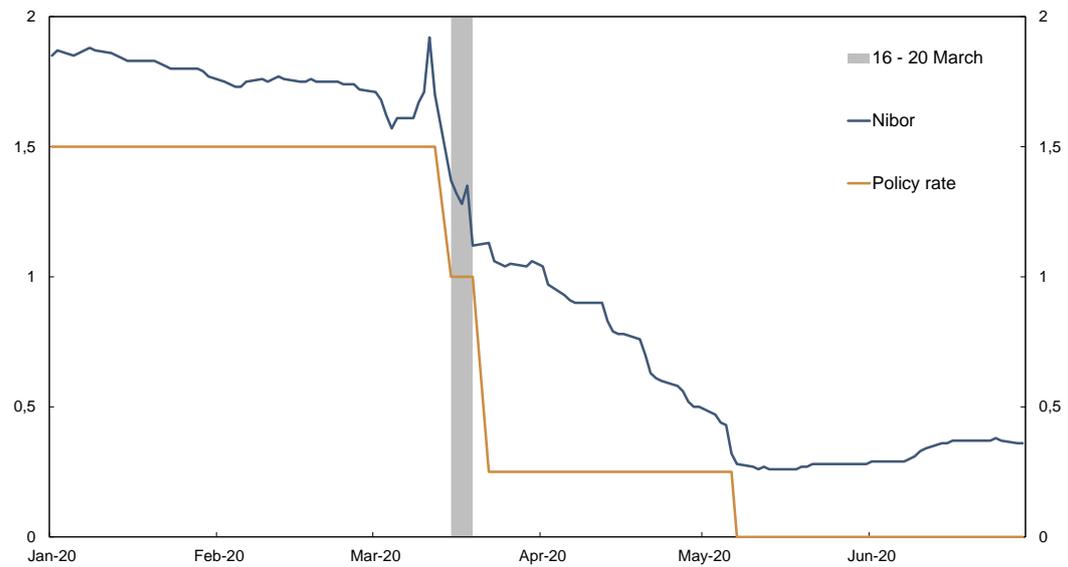
⁷Additional F-loans were offered on several occasions in the months to follow, both in NOK and USD.

Figure 5: NIBOR premium



Note: This figure shows the NIBOR premium measured as the difference between the 3-month Nibor rate and the expected policy rate estimated by Norges Bank, in basis points, between January 2020 and June 2020. Sources: Bloomberg and Norges Bank.

Figure 6: Policy rate and NIBOR



Note: This figure shows the policy rate and NIBOR between January 2020 and June 2020. Percent. Sources: Bloomberg and Norges Bank.

also temporarily relaxed the collateral requirements for loans in the central bank. The most important change to the collateral requirement was to allow banks to post up to 100 percent of a certain issuance (ISIN), compared to 20 percent in normal times. The purpose of the extraordinary loans was to ensure that the policy rate passed through to money market rates by increasing the supply of liquidity. In combination with the changes in the collateral requirements, banks also used the loans to buy back their own debt from market participants that struggled to find buyers. Figure 8 shows the F-loans to banks outstanding between December 2019 and September 2020. Money market interest rates fell, but remained high relative to the policy rate.

The effects of the market turmoil on the krone exchange rate, including the effect of asset managers' rebalancing of their hedging ratios, were of historic dimensions. The value of the Norwegian krone fell more than comparable currencies, as can be seen in Figure 2b. At one point, the uncertainty in the market was of such magnitude that certain market makers ceased to quote prices for NOK over electronic trading platforms. It was clear that the market was not functioning properly. As a proxy for market liquidity, one can look at bid-ask spreads, see Figure 7b. The more liquid and balanced a market is, the narrower the difference between quoted bid and ask prices is. As can be seen from the figure, spreads widened significantly during March 2020. Due to the extraordinary situation in the NOK-market, Norges Bank issued a statement March 19th saying that it was to continuously assess the need to intervene by purchasing Norwegian kroner. This press release was followed up by actual interventions totaling NOK 3.5 billion on March 19th and 23rd. These interventions were undertaken to address the extraordinary imbalances in the NOK market and thus support market functioning, and not to target a specific level of the exchange rate.⁸ On March 20th the policy rate was lowered further, to 0.25 percent, and finally to zero percent on May 7th.⁹

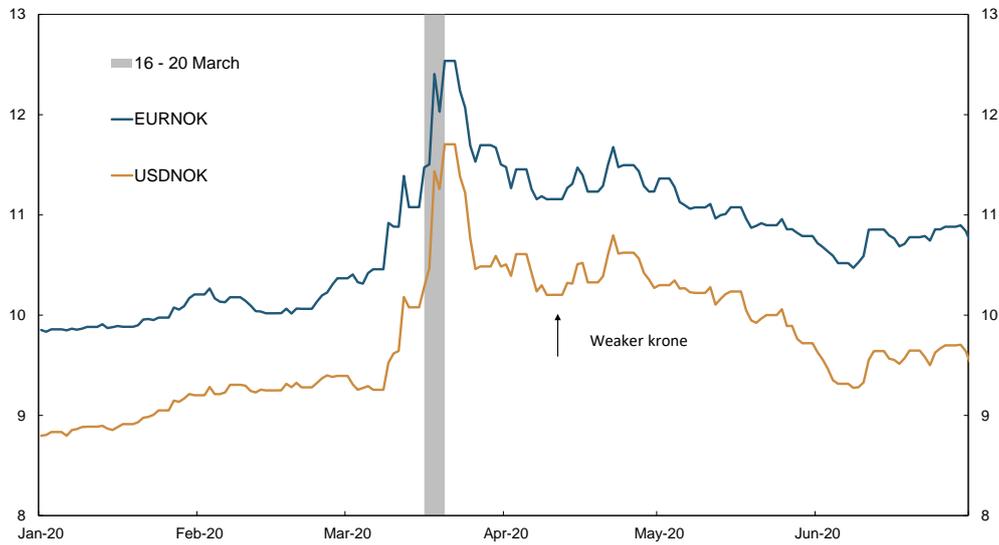
When the krone was at its weakest level, NBFIs' margining needs peaked due to the market value losses on their swap contracts, which can be seen from Figure 4b. It is challenging to assess whether the money market stress and margining needs also fed back to and impacted the foreign exchange swap market. It is clear, however, that the margining directly impacted the bond market. As a large fraction of the margins were exchanged in the form of cash deposits (in accordance with CSA agreements), NBFIs - after having tapped into their existing holdings of excess cash - were duly forced to sell securities in order to obtain more cash, see Figure 9. This led to great selling pressure in the credit securities market.¹⁰ Outflows from funds in this period probably added to the selling pressure in the bond market, see Figure 10. Much of the outflow from Norwegian funds was due to institutional investors selling fund units - and as such can at least partly be linked

⁸The actual interventions were not announced in advance, but can be read from the statistics for the banks' liquidity which are published weekly. After the introduction of inflation targeting in 1999, Norges Bank's previous regime of foreign exchange interventions ended, see Alstadheim (2016).

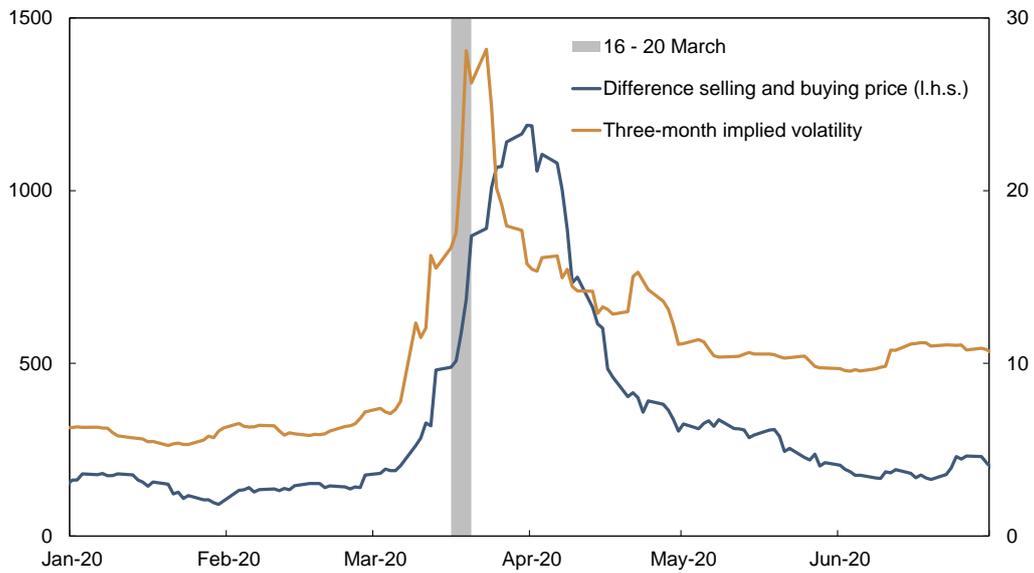
⁹The government implemented a range of measures in connection with the outbreak of the coronavirus, including a reinstatement of the Government Bond Fund. See list of measures on <https://www.regjeringen.no/en/topics/the-economy/economic-policy/economic-measures-in-norway-in-response-to-covid-19/id2703484/>

¹⁰See description of the liquidity in the Norwegian short term paper and bond market during the first six months of 2020 in Norges Bank (2020b).

Figure 7: Norwegian krone depreciation and liquidity



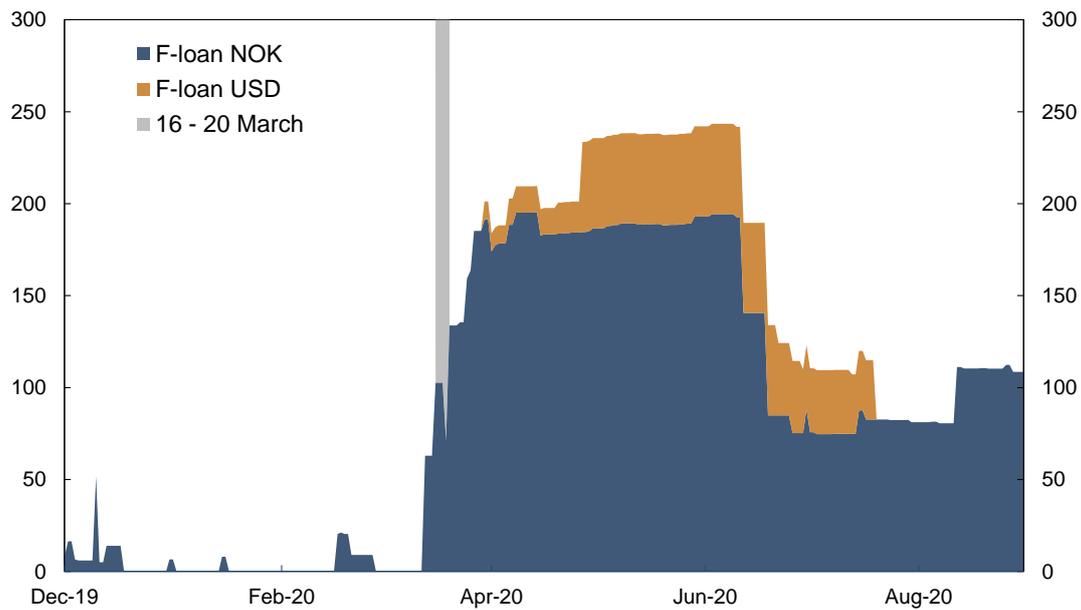
(a) EURNOK and USDNOK



(b) Bid-ask spread for EURNOK

Note: Figure 7a shows the EURNOK and USDNOK exchange rates between January 2020 and June 2020. Figure 7b shows the 14-days moving average bid-ask spread in EURNOK for volumes between EUR 1-5 million, between January 2020 and June 2020. 1000 pips equals 0.10 krone. Displayed on the right axis is market pricing of 3-month implied volatility in EURNOK expressed in annualized percentage points. Sources: Bloomberg and Norges Bank.

Figure 8: Loans to banks. Billions of NOK



Note: This figure shows the F-loans to banks outstanding between December 2019 and September 2020. Source: Norges Bank.

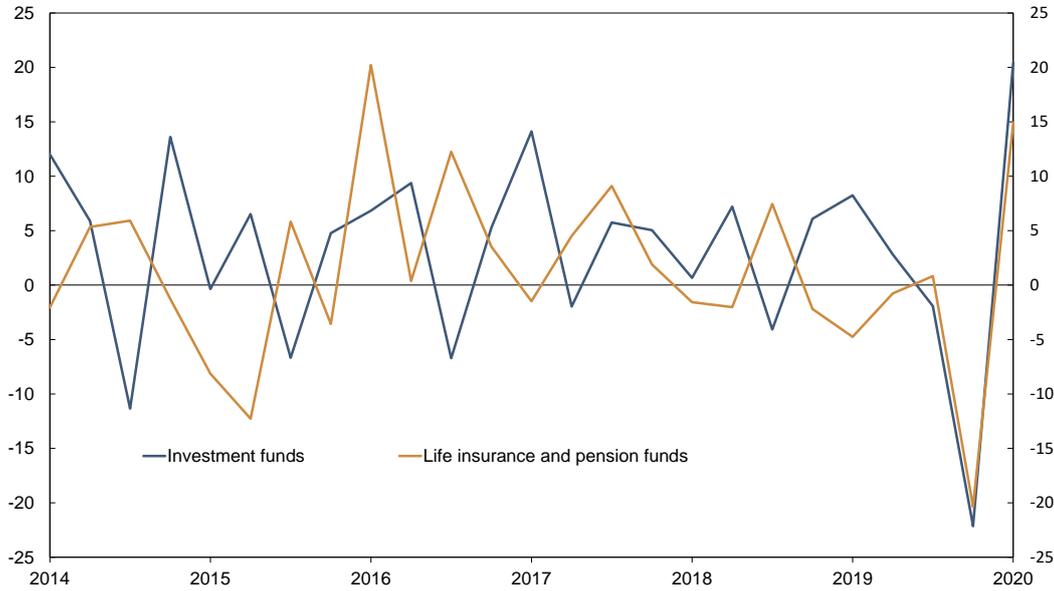
to the same margining needs. Retail investors are small in comparison to the institutional investors in Norwegian funds.

At the same time as NBFIs needed to sell bonds, high money market premia meant that it was costly for banks to fund bond purchases - even though bond prices were steadily falling. After Norges Bank supplied F-loans, and the risk premia in the money market fell, banks became important buyers in the bond market. Banks started primarily to buy covered bonds issued by their subsidiary covered bond mortgage companies (CBMCs) in mid-March when the central bank provided more funding and later also eased collateral requirements, see Figure 11. Balance sheet data confirm that banks increased their holdings of fixed income securities in NOK in the first quarter of 2020, see Figure B.4 on page 33.

The stress in the Norwegian bond market was not unique. Even in liquid markets like the market for US corporate bonds, risk premia escalated, see e.g. Kargar, Lester, Lindsay, Liu, Weill, and Zuniga (2020). The authors suggest that the main source of illiquidity in the US corporate bond market was the reluctance of dealers to absorb inventory on their balance sheets and the outflow from funds. Some have argued that the regulatory changes after the financial crisis in 2008-2009 may have reduced banks' incentives to deploy balance sheet capacity and act as market makers. Similar mechanisms may to some extent have been relevant in Norway, making it harder for asset managers to find buyers of bonds when they needed to post margins. The bond market in the US calmed down when the Fed intervened directly.

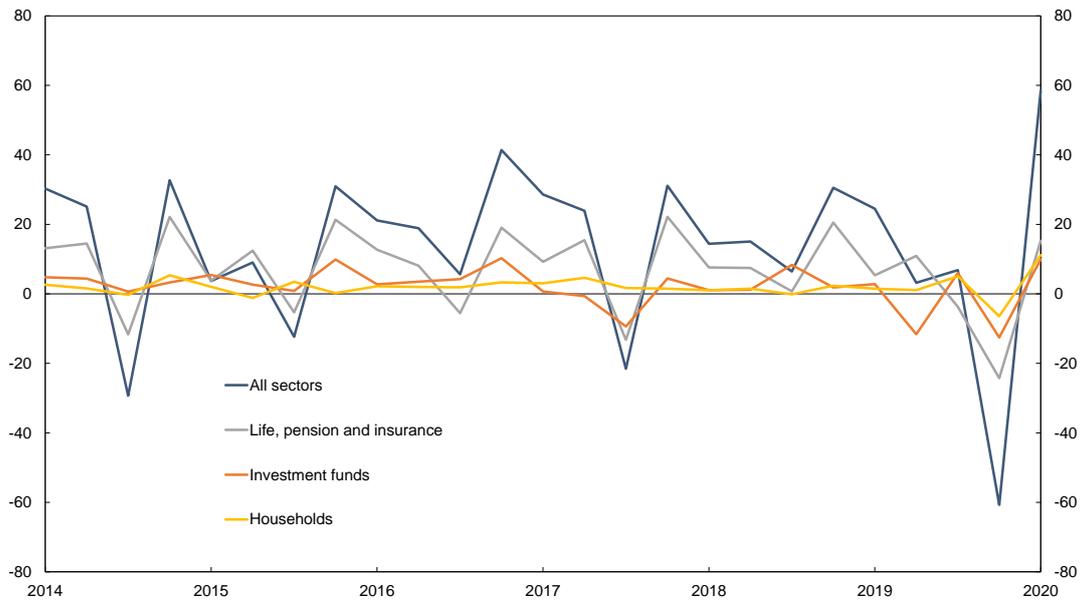
Similarly, the stress in the Norwegian money market and in the swap market receded

Figure 9: NBFIs' net purchases of bonds



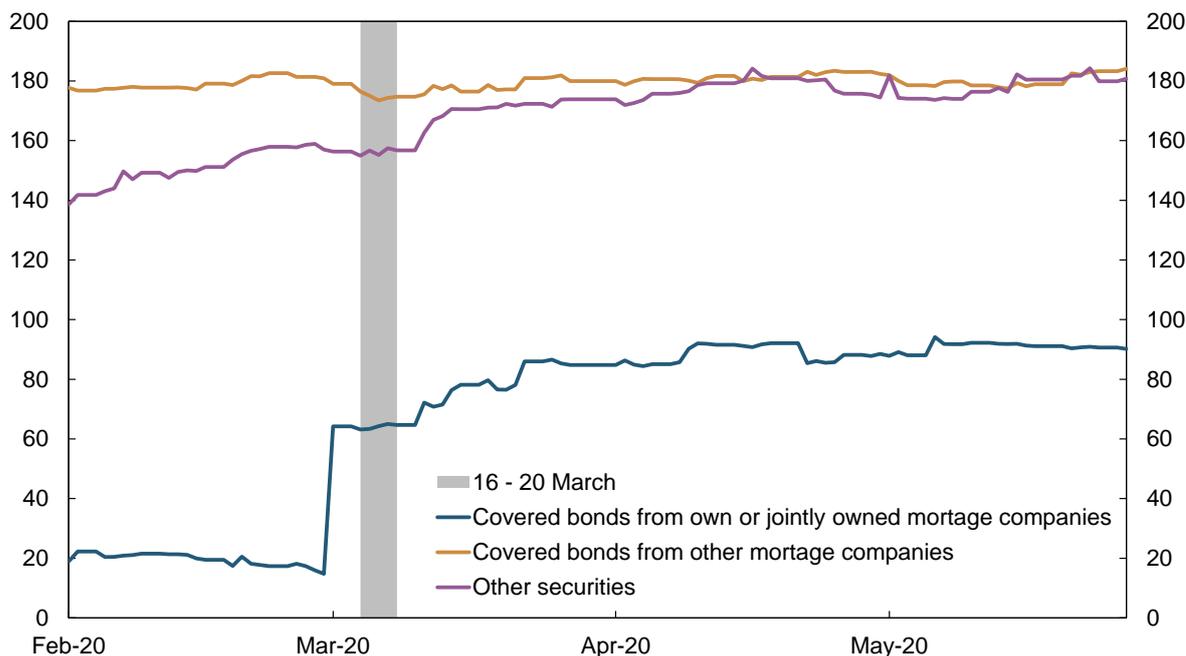
Note: This figure shows that NBFIs were net sellers of bonds in Q1 2020. Billions of NOK. Q2 2014 - Q2 2020. Source: Statistics Norway.

Figure 10: Inflows to funds



Note: Institutional investors sold fund units in Q1 2020. Billions of NOK. Q2 2014- Q2 2020. Source: Statistics Norway.

Figure 11: Banks' securities holdings.



Note: Sample of Norwegian banks that report on a consolidated basis under CRD IV. February 13th 2020 - June 8th 2020. Billions of NOK. Sources: VPS and Norges Bank.

when Norges Bank provided liquidity. As global equity markets had reached their lows towards the end of March, NOK sales driven by investors' rebalancing needs also faded. Along with the foreign exchange interventions, this contributed to a more balanced and stable foreign exchange market. Liquidity in the FX swap market improved, which subsequently improved conditions for rolling over swap agreements.

The strong liquidity demand to meet margin requirements also abated when the Norwegian krone stabilized, reducing the selling pressure in the bond market. As banks funding costs in the money market started to normalize and demand for bonds picked up, this contributed to the reduction in bond market risk premia. Several Norwegian asset managers have since expanded their access to repo facilities with their Nordic counterparties, and have CSA agreements that allow margin exchanges in the form of securities (e.g. bonds, with a certain haircut, depending on whether they are government securities or supranationals). Such facilities may reduce the need for liquidation of assets to meet margin requirements.

5 INTERNATIONAL EXPERIENCE

The global nature of the recent crisis means that its effects spread across countries and markets. Authorities around the world responded quickly and forcefully to the crisis. Most central banks have reduced policy rates close to zero or below, and restarted or expanded their asset purchase programs. They have also provided liquidity in the form of longer maturity loans to banks, and in some cases to non-financials, as well as relaxed

collateral requirements for such loans. In this section we highlight some topics that have been common to groups of countries. Towards the end we provide a brief comparison of developments under the Covid event to market developments during the fall of 2008.

A common factor during the financial market turmoil of March 2020 has been that, due to new international regulations since the global financial crisis (GFC), banks are sounder and better capitalized, but (particularly) liquidity risks have shifted to non-banks.¹¹

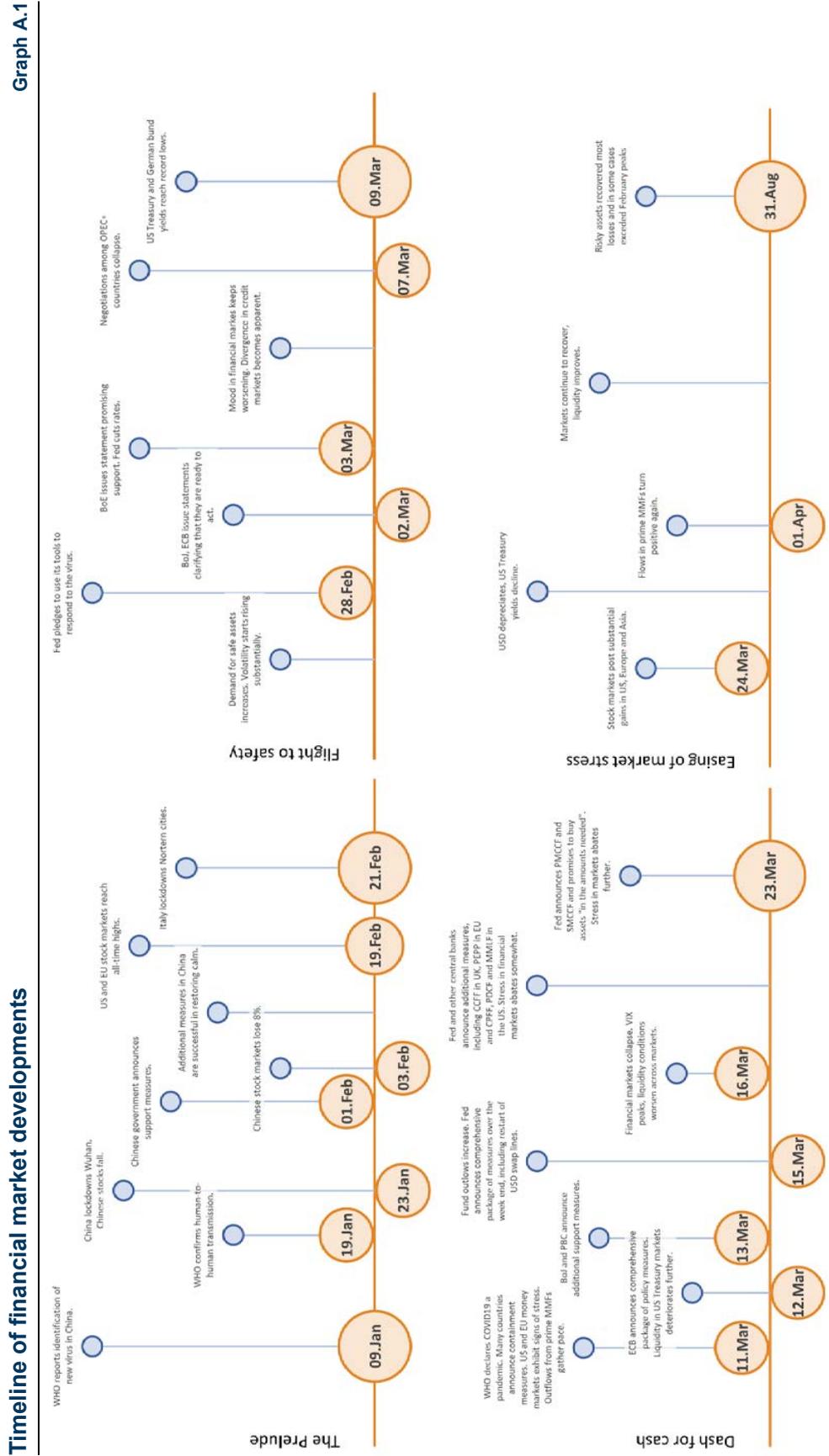
Whereas small open economies experienced depreciating currencies, safe haven currencies appreciated. Hence, while Denmark's Nationalbank intervened in the foreign exchange market by purchasing DKK as well as hiking its policy rate to stem the currency depreciation, the Swiss National Bank intervened by selling a significant amount of CHF to protect its currency from strong appreciating pressure. Financial markets of major economies, such as the US and UK, were heavily hit by a liquidity drain (see for example the Interim Financial Stability Report (IFSR) by the Bank of England Financial Policy Committee (2020), and the report from the Financial Stability Board (2020)). The term “dash for cash” was coined to describe the sell-off of safe assets that would usually be attractive in turbulent times, but that now were hit because leveraged investors faced increased margin calls. The deterioration of liquidity in the market for US government bonds was of historic dimensions.¹² Figure 12 shows a timeline from the FSB report.

The European Systemic Risk Board (ESRB) emphasizes the importance of margining (as well as central clearing) for limiting counterparty risk, but acknowledges the potential liquidity problems that may arise from these practices (European Systemic Risk Board, 2020). The report, that mostly focuses on CCP regulation, suggests that margins (both initial and variation) have risen since February 2020 and warns that pro-cyclicality of (initial) margins should be avoided.

¹¹See, for example, reports by the ESRB (European Systemic Risk Board, 2020), FSB (Financial Stability Board, 2020), and Bank of England (Bank of England Financial Policy Committee, 2020).

¹²To get an idea of the magnitude of the increase in margin calls, the IFSR states; “At the peak in March, daily variation margin calls – which mirror moves in underlying markets – by UK central counterparties (CCPs) were five times higher than the average in January-February, at around GBP 30 billion.”

Figure 12: Timeline FSB report



Note: This figure shows a timeline of financial market developments between January and August 2020, originally published in the FSB report. Source: Financial Stability Board (2020)

SMALL OPEN ECONOMIES

Various small open economies experienced very similar challenges to Norway, related to rebalancing of hedging ratios, significant increases in margin calls, and disrupted liquidity conditions in the foreign exchange, - derivatives, -and money markets. What differs across countries is the depth and severity of each issue.

The Reserve Bank of Australia (RBA) experienced the market dysfunction in the market for Australian dollars, with deteriorated liquidity and bid-ask spreads widening to its highest level for years. RBA has been monitoring the hedging practices of Australian asset managers for years, and highlights the correlation of Australian dollars with global equity markets. In March 2020 they observed that sharply declining global equity indices led to immediate rebalancing of hedging ratios, causing the Australian dollar to depreciate. Moreover, RBA communicated in its Statement on Monetary Policy in May 2020 that “volatility and large volumes of transactions occurred at a time when intermediaries were constrained in their ability to warehouse risk”.¹³

In Sweden, Riksbanken in their Financial stability report addressed the deteriorated liquidity in the FX swap market in March 2020 due to limited access to USD funding supply, see (see Sveriges Riksbank (2020)). They highlighted that a non-functioning swap market where contracts cannot be rolled over would create vulnerabilities in the financial system. In the extreme case of Swedish asset managers being unable to roll over and re-enter FX swaps with their bank counterparties, they would need to close their existing swap positions by transacting in the spot market, thus selling large amounts of Swedish kroner while also leaving the foreign investments unhedged. Despite poor market conditions in March 2020, asset managers managed to roll over their swap contracts, albeit for shorter maturities and through multiple transactions. Riksbanken suggests that the main source of these vulnerabilities may be the maturity mismatch between swap agreements and asset positions amongst market participants.

The Danish krone, which is pegged to the euro, also experienced strong depreciating pressure in March 2020. This was not triggered by speculation about the peg, but rather due to the rebalancing of hedging portfolios by domestic institutional investors in order to maintain stable hedge ratios (see Risbjerg and Grønlund, 2020). The Danish central bank intervened by selling foreign exchange reserves worth DKK 65 billion. In Denmark, margin calls also contributed to the depreciating pressure. In order to raise cash to meet margin calls to be paid in foreign currency, institutional investors sold domestic assets exchanging the proceeds in the foreign exchange market, thereby adding to the selling pressure on the Danish krone.¹⁴

¹³<https://www.rba.gov.au/publications/smp/2020/may/box-b-recent-developments-in-foreign-exchange-markets.html>

¹⁴It is not clear to what extent this latter mechanism also contributed to the weakening of the Norwegian krone in Norway's case. In Norway, margin requirements are often exchanged in NOK, or if exchanged in foreign currency it is often met by selling assets in the relevant currency, which avoids a currency transaction to meet margin calls.

BIS AND FSB POLICY RECOMMENDATIONS

In particular for the smaller economies, the financial market turmoil in March was amplified by the dependency on USD funding liquidity. In a report on USD funding from 2020 (Bank for International Settlements, 2020b), the BIS makes three policy recommendations:

- Improve visibility, in particular by data collection of non-bank financial institutions' (NBFIs') activities.
- Reduce vulnerabilities, in particular related to currency mismatch. Although banks are more resilient now, new regulations can also cause them to reduce intermediation activities during crises, thus shifting vulnerabilities to NBFIs. In turn, regulators could provide guidance to NBFIs on how their liquidity risk management should include a currency dimension, encourage them to match the maturity of their hedges with the maturity of their asset holdings, and assess the substitutability of funding sources.
- Improve safety nets, in particular by central banks holding sufficient foreign currency reserves, where USD swap lines should only be seen as an important liquidity backstop in times of crises (and hence not a long term solution). The report emphasizes that safety nets need to be in place for those who need them, provided that there is a robust regulatory and supervisory framework.

The FSB endorses these policy recommendations, and emphasizes that it is crucial for future work to analyze and understand the systemic risks associated with NBFIs, both in the context of understanding the consequences of the Covid-19 shock, as well as in order to assess and improve the resilience of the financial sector to future shocks. Moreover, more work needs to be done on assessing policies to address these systemic risks in NBFIs (see Financial Stability Board, 2020).

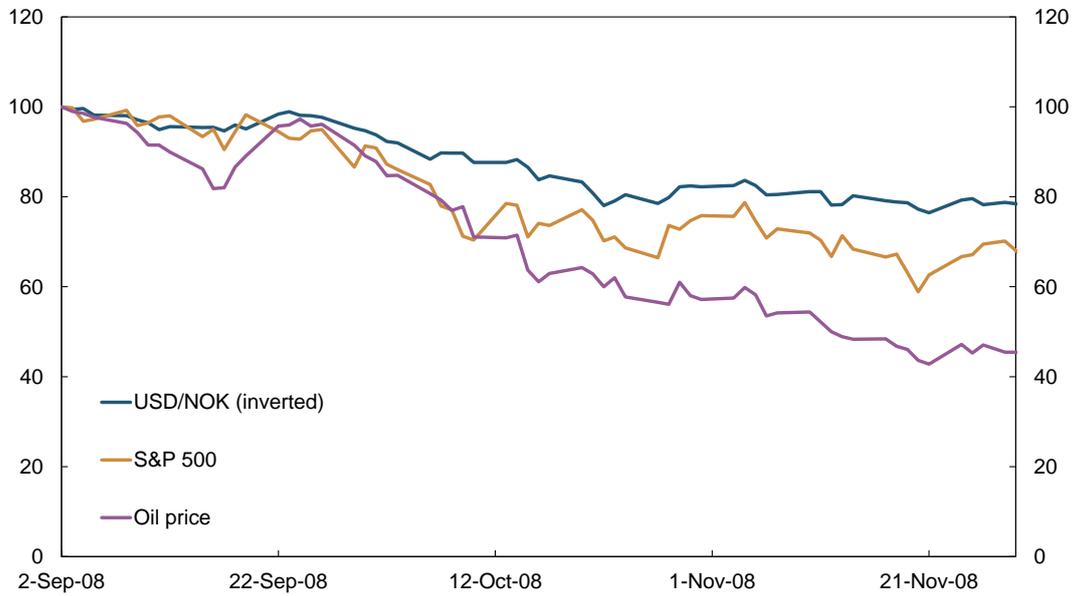
Early-on, concern was raised by market participants that stricter regulations of the trading book would lead to reduced liquidity in bond markets.¹⁵ Banks need to hold the same level of capital for their risk in their trading book as for credit risk in the banking book. All Norwegian banks use the standard approach to measure market risk. Focus on liquidity regulations and stricter capital rules have probably made banks less willing to buy and hold ("warehouse") bonds compared to the situation before the financial crisis. Implementation of FRTB-rules from 2023 with increased capital charges for market risk may make banks even less willing to deploy balance sheet capacity and act as market makers.

IS THIS TIME DIFFERENT? MARCH 2020 VERSUS OCTOBER 2008

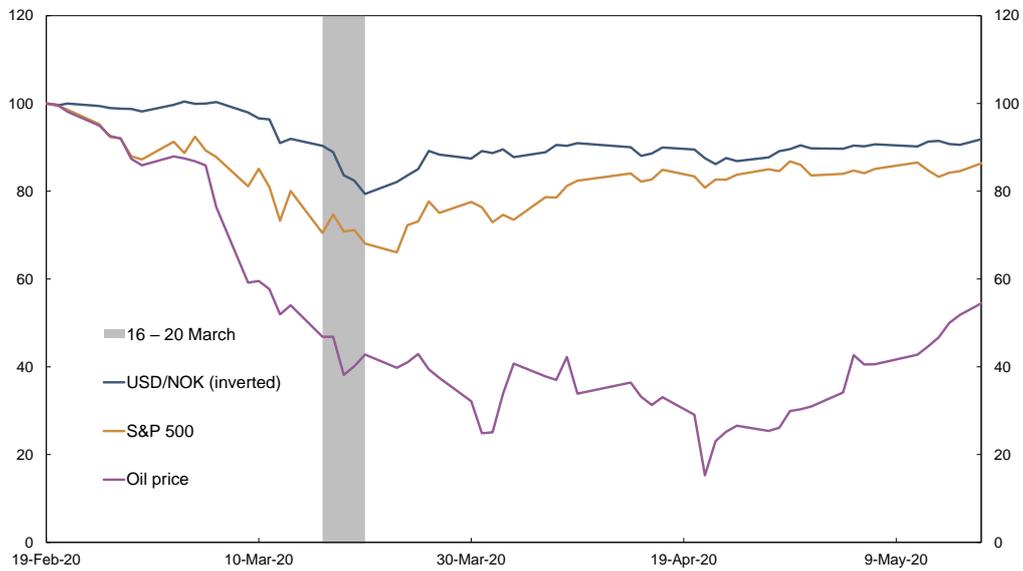
Although it was NBFIs, rather than banks, that experienced the most severe difficulties this time, one can argue that some of the same mechanisms were at play as under the global financial crisis. One particular feature of the March 2020 turmoil was the sharp

¹⁵See, e.g., "Fixed income market liquidity", CGFS Papers No 55, Committee on the Global Financial System, January 2016 and "Market-making and proprietary trading: industry trends, drivers and policy implications", CGFS Papers No 52, Committee on the Global Financial System, November 2014.

Figure 13: Norwegian krone depreciation 2008 versus 2020



(a) 2008



(b) 2020

Note: These figures show the S&P500, the Brent oil price, and the USDNOK exchange rates for 2008 and 2020. All series are indexed for ease of comparison. In the first figure, September 1st 2008 = 100, in the second figure, February 19th 2020 = 100.

depreciation of the Norwegian krone. The fall in US equity prices has been cited as a main contributor to the depreciation. Another important driver of the Norwegian krone is the oil price. In order to visualize how these three variables (co)moved in 2008 and 2020, Figure 13 plots the Brent oil price, the S&P500 stock price index, as well as the krone exchange rate against the US dollar. Figure 13b plots these variables from the 19th of February 2020 and 85 days going forward. Figure 13a shows the corresponding picture for two months from the 1st of October 2008 onwards. All series are indexed for ease of comparison. A striking feature is the much stronger fall in the oil price in March 2020. The relative importance of the different mechanisms behind the stress in the market for NOK in March 2020 is a topic for future research, but it seems likely that the drop in the oil price played an important role.

6 CONCLUDING REMARKS

This staff memo is a documentation of the events in the Norwegian financial markets in March 2020. In particular, it highlights the effects of FX hedging ratios and margin requirements on the NOK and on the Norwegian bond market. Authorities have traditionally been most concerned about the financial stability effects of international financial market turbulence affecting the banks' funding side. The turbulence that was witnessed in March 2020 made clear that non-bank financial institutions are also vulnerable through their foreign asset positions. Whereas their currency hedging practices reduce their exposure to exchange rate risk, they increase their exposure to risks associated with derivative markets, such as counterparty-, rollover-, and liquidity risk. Moreover, rebalancing of hedging portfolios and the payment of daily variation margins have had substantial effects on the markets for Norwegian kroner and bonds.

The turbulent episode of March 2020 have reminded us that there are vulnerabilities in the financial system that may need to be further uncovered. Improved surveillance of non-banks and hedging instruments is an international trend. Certain regulations, such as EMIR, has improved access to data, which Norges Bank will use to improve surveillance and for research purposes. Experiences from the “dash for cash” event have made market participants more aware of liquidity risk associated with daily margining. There is reason to believe that market standards and bilateral terms of collateral exchange in derivative contracts are being reviewed and designed to be more flexible and robust during turbulent times, something also Norges Bank has recommended, see Norges Bank (2020a).

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APPENDIX

A FX HEDGING: EFFECTS ON THE EXCHANGE RATE, CASH FLOWS AND MARKET VALUES OF FOREIGN INVESTMENTS

A.1 HEDGING FX RISK WITH SWAP AGREEMENTS

In order to hedge exchange rate risk, an asset manager often enters a foreign exchange (FX) swap agreement, consisting of two simultaneous transactions: a spot transaction where the asset manager sells kroner and buys currency for an amount corresponding to the foreign investment, combined with a forward transaction with settlement at a future contract date, where the asset manager sells foreign currency and buys back Norwegian kroner, see Figure A.1. Given the continued ownership of the underlying foreign asset, the foreign exchange hedging is extended by entering a new FX swap at maturity of the initial FX swap.

Figure A.1 illustrates currency-flows associated with a swap agreement. The swap agreement is useful when the investor does not have initial access to foreign currency, but wants to invest in foreign assets (e.g. foreign equities), and at the same time prefers to protect her investment against foreign exchange risk. The investor then first needs to acquire the relevant currency for the planned investment by exchanging Norwegian kroner for foreign currency in a spot transaction for the full amount of the foreign investment. Given an uncertain duration of the foreign investment, a typical hedging tenor for a FX swap could be three months. The exchange rate that will apply at future agreed time $T+1$ (in three months) is then agreed upon at time T (today). The agreed exchange rate on the forward term is set at the current spot exchange rate plus/minus a surcharge to offset the expected interest rate differential in the period.

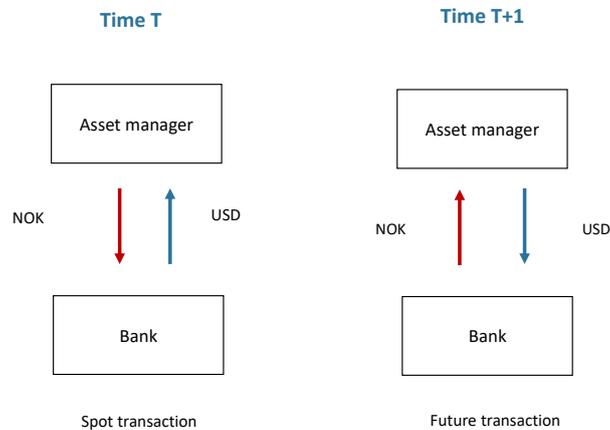
Since the future exchange rate is agreed upon when entering the swap contract, the FX risk of the underlying foreign investment is eliminated throughout the lifetime of the derivative contract (see section A.4 on page 27). The hedging period can be extended by rolling over (repeating) the swap contract. Given the regulatory requirements for derivative contracts between financial counterparties, the hedging will, in addition, have liquidity effects (see section A.3 on page 26). Such liquidity effects depend on the required collateral (margining) defined through bilateral agreements. Hedging may also have exchange rate effects, as described in the next subsection.

A.2 THE EXCHANGE RATE EFFECT OF HEDGING

Since there is no net capital flows involved in the hedged foreign asset investment above, the investment will not have direct effect on the spot exchange rate. The equal and opposite initial and final exchanges of the FX swap neutralize each other.

The situation would be different if, for example, a Norwegian market participant received

Figure A.1: A swap agreement between an Asset Manager and a Bank.



1

income in USD, and wanted to invest this in foreign equities, and at the same time wanted to hedge the investment. In this case, hedging *would* have an effect on the exchange rate: There would be no purchase of foreign currency at time T (because the investor already had USD from export income), but there would be a sale of USD at time T+1. There would hence be a net sale of foreign currency, and an appreciation pressure on the Norwegian krone. The NOK appreciation effect of the hedged investment is in this case similar to what we would see with an immediate exchange of export income into Norwegian kroner for consumption domestically. If instead the investment financed by export income is kept abroad and invested in USD, unhedged, and is not brought home for consumption in NOK, there will be no NOK purchase, and no effect on the NOK exchange rate of the export income.

The effect of increased export income on the NOK exchange rate is similar to the effect of foreign capital gains on the exchange rate: For example, we may assume that the value of equities invested abroad, measured in USD, increases. The investor may then choose to hedge the increased value of the equities, that is, rebalance the hedge to take into account a higher foreign investment value. In order to do so, the investor will need to enter a contract to sell USD at time T+1. But alternatively, the investor might choose to sell some equities and bring the capital gain home (and sell the USD received and buy NOK at time T) and spend it on Norwegian goods immediately. In either case, the increased value of the equities will trigger net purchases of NOK and contribute to an appreciation of the NOK exchange rate. If the value increase is not hedged (via rebalancing), and not repatriated for consumption either, there will be no effect on the exchange rate.

A.3 EFFECTS OF MARGIN REQUIREMENTS ON CASH FLOWS

We want to illustrate the effect of margin requirements on liquidity risk. Margining affects the timing of liquidity flows, but not the size. With daily margining, the liquidity flows across agents with similar positions become more synchronized, and for a large and abrupt move in the local currency leading to sizeable margin payments, the collective liquidity need can be sizeable.

We consider an example where an investor has deployable liquidity in NOK, and she uses FX swap contracts to roll over a hedged investment in the global equity markets (for example in USD). For simplicity, we assume that there is no equity gain or loss during the lifetime of the investment. In Figure A.2, we illustrate the cash flow effect of a currency depreciation. For simplicity, we assume no interest rate differential, and that the spot exchange rate and agreed forward rate are both equal to USD 1 = NOK 10. We assume that the situation is the same when the contract is rolled over the first time. But during the second contract period, we assume that the NOK exchange rate (unexpectedly) depreciates, so that USD 1 = NOK 12.

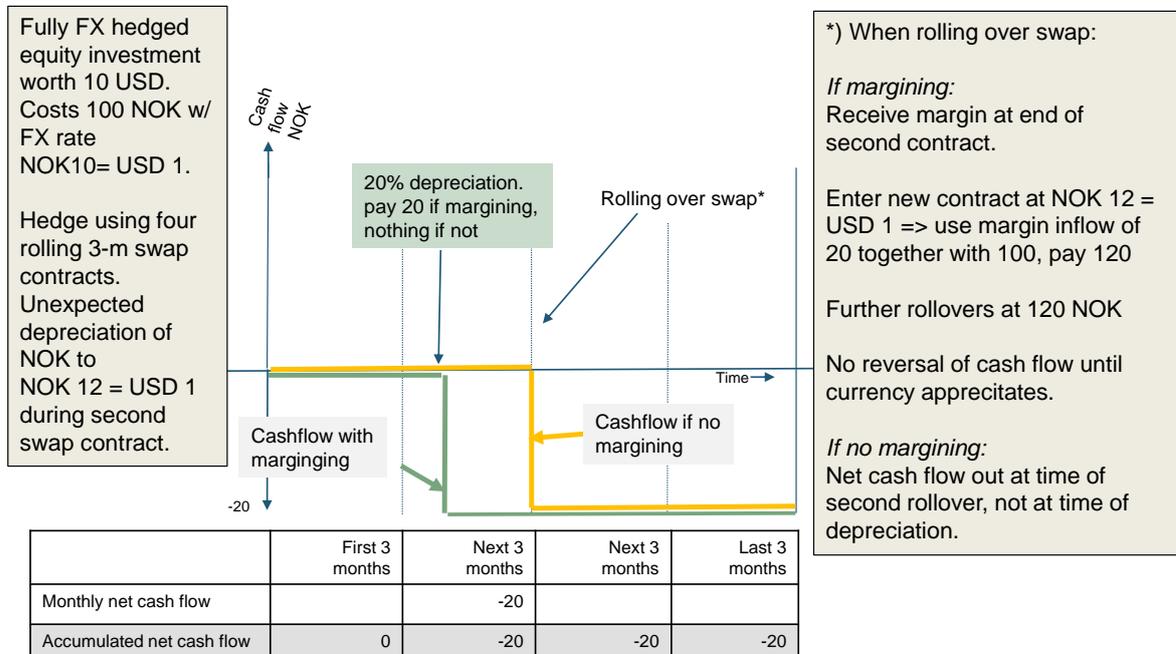
First, consider a simplistic situation with no margin requirement related to derivative contracts between the counterparties, see yellow line in Figure A.2. With the (unexpected) depreciation, the asset manager has a marketable loss on the swap agreement, but she does not need to post margin. However, at the first rollover of the swap agreement after the NOK depreciation, the asset manager must first deliver USD at the rate USD 1 = NOK 10 to fulfill the initial contract. She is to receive NOK 100 against delivering USD 10, as per the agreed terms of the initial swap. We assume that the asset manager wants to roll over the swap, continuing to hedge the FX risk of the underlying investment, and immediately enters a new swap contract at the prevailing exchange rate. She receives USD 10 from the spot leg of the new swap agreement, and immediately fulfills the maturing USD-leg of the initial swap agreement. In return she receives NOK 100 from from the initial swap agreement, but needs to pay an additional NOK 20 in line with the prevailing exchange rate. But in addition to the 100 NOK from the initial swap agreement, the asset manager needs to pay NOK 20 extra for the 10 dollars, because the current exchange rate applies. The net cash flow from this operation *at the time of rollover* is minus 20 NOK, and the liquidity effect arises when rolling the FX swap, see graph.

In line with regulatory requirements and current market practice, where the asset manager is subject to daily margin calls, we can see that the timing of the cash flow effect is different. Now, immediately when the exchange rate depreciates, the asset manager needs to make NOK 20 available as collateral for the counterparty. At the time of rollover when the initial FX swap matures, the asset manager receives back that NOK 20 from the counterparty, and thus already has the extra cash needed to enter a new swap agreement at the new exchange rate level. There is no net cash flow at the time of rollover, assuming the margin is repaid at maturity date.

If the exchange rate stays the same after the 20 percent depreciation, the net cash-flow will remain unchanged until the investment is terminated (margining or no margining). If and when the underlying investment is terminated, the market value exchange rate gain

on the underlying investment will neutralize the outflow of 20. Alternatively, if the investment is not terminated, the cash flow will be reversed only when and if the exchange rate appreciates.

Figure A.2: Cash flows related to rolling over four swap contracts: stylized example

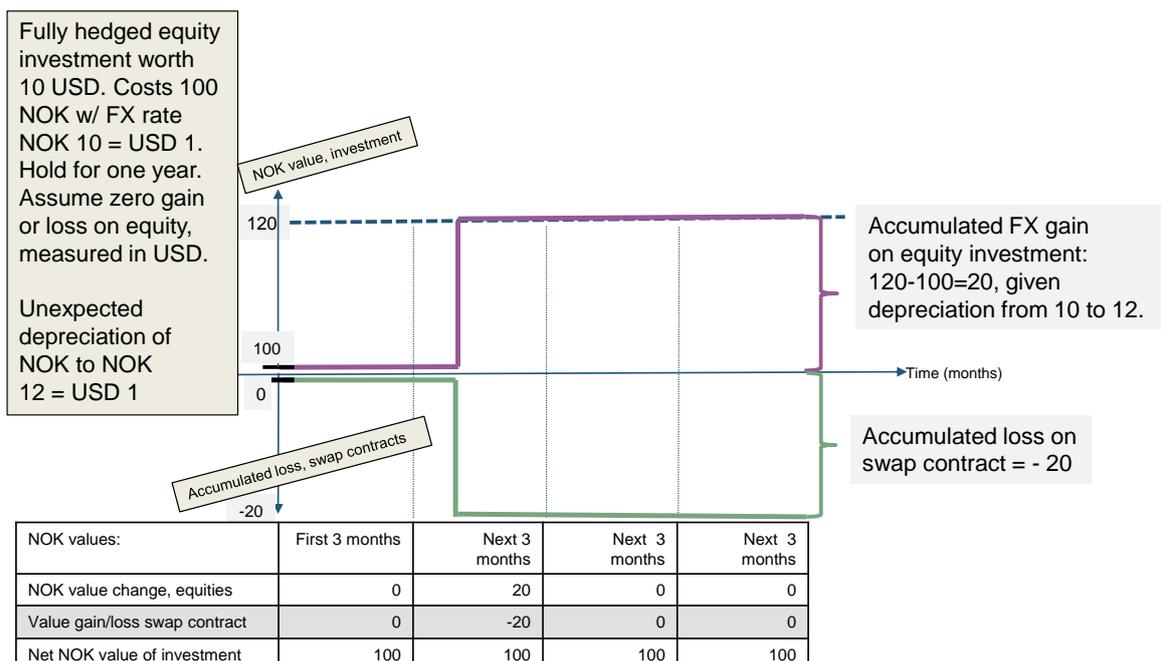


Note: This figure shows an example with cash flows related to rolling over four 3-month swap contracts. The NOK exchange rate depreciates by 20 percent after the start of the second contract.

A.4 HEDGING PROTECTS THE MARKET VALUE OF FOREIGN INVESTMENT MEASURED IN LOCAL CURRENCY

In Figure A.3, the effect of FX-hedging on the market value of the same equity investment is illustrated. The effect of fully hedging the foreign investment is that one neutralises any unfavourable foreign exchange risk, but also foregoes the upside potential. The net market value of the investment, including the hedge and as measured in NOK, is constant through time regardless of movements in the exchange rate.

Figure A.3: Value developments of a stylized hedged foreign equity investment.



Note: This figure shows an example where a one-year investment is hedged by rolling over four 3-month swap contracts. The NOK exchange rate depreciates by 20 percent after the start of the second contract.

B BANKS' NET FX DEBT POSITION

The stock of debt securities in foreign currency issued by banks and covered bond mortgage companies (CBMCs) is about NOK 1 200 billion, see Figure B.1. The CBMCs' share is about 60 percent. The FX debt surplus, i.e., total FX debt less total assets denominated in FX, is between NOK 800 billion and 900 billion, see Figure B.2.¹⁶ Most of the CBMCs' assets are in NOK, making the CBMCs' share of the foreign debt surplus about 90 percent in June 2020 and about 80 percent in December 2019 and March 2020. In the first quarter of 2020 the value of FX securities increased by about 10 percent and the value of the FX funding surplus by about 14 percent.

CBMCs are owned by one or several banks. The name of the company indicates its ownership, see Table B.1. CBMCs are by law obliged to hedge their currency and funding rate risk.¹⁷ They do this by using financial derivatives. The largest CBMC, DNB

¹⁶Note that there is a discrepancy between the numbers based on banking statistics and the sectoral accounts in Statistics Norway, see Figure 1. Numbers in the sectoral accounts are net amounts and defined based on the home countries of the parties and not on the currency denomination of the holdings. The net holdings of Norwegian banks do therefore not correspond to banks' FX financing of NOK assets. Parts of the foreign funding are in NOK and Norwegian banks lend FX to Norwegian customers. Numbers in this section cover Norwegian banks including branches abroad and foreign bank branches operating in Norway, as well as Norwegian covered bond mortgage companies.

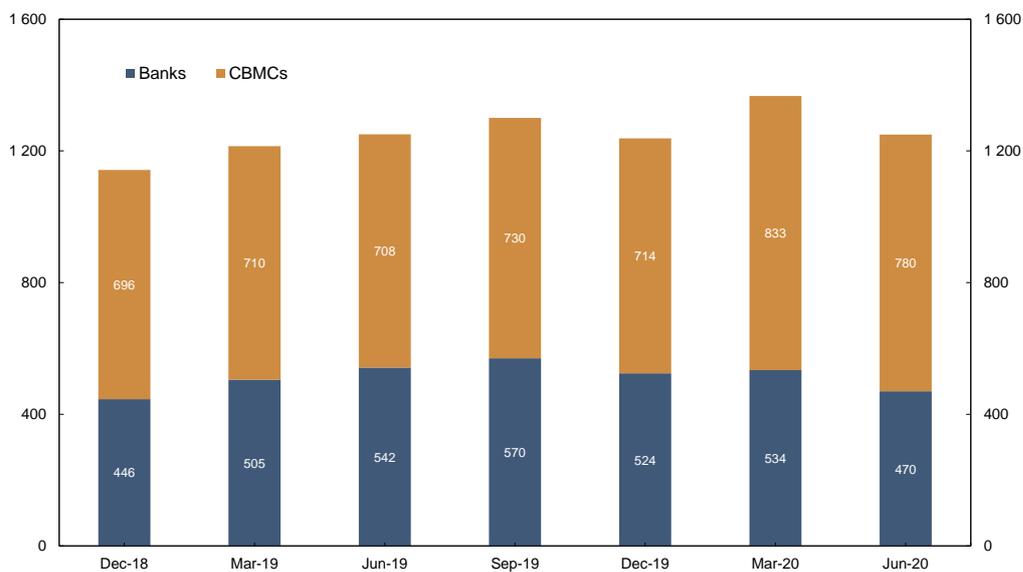
¹⁷See Sections 11-1 and 11-3 of the Financial Institutions Regulation and Section 11-8 of the Financial Institutions Act.

Boligkreditt AS, enters into swap contracts with its parent bank, DNB Bank ASA. Some CBMCs enter into swap contracts with external counterparties. CBMCs transform their fixed or floating rate FX borrowing to floating rate NOK borrowing. A common method is to use cross-currency interest rate swaps (often referred to as basis swaps). When the NOK weakened in March, the value of FX denominated derivatives increased on the asset side of CBMCs' balance sheet, see Figure B.3. This contributed to offset the increase in the value of FX debt on the liability side of the balance sheet.

The balance sheet data in Figure B.1, B.2 and B.3 are based on individual company accounts and are not consolidated. This means that for banks acting as a derivatives counterparty to their fully owned CBMCs, the banks' balance sheet reflects the loss in market value on their swap agreements with their subsidiary CBMCs in March. However, these parent banks hedge their FX and interest rate risk from their CBMC subsidiaries together with risks arising from their own activities. Figure B.3 therefore shows balanced developments in the market value of derivatives on the asset and liability sides of the balance sheet of banks, both for NOK and FX derivatives.

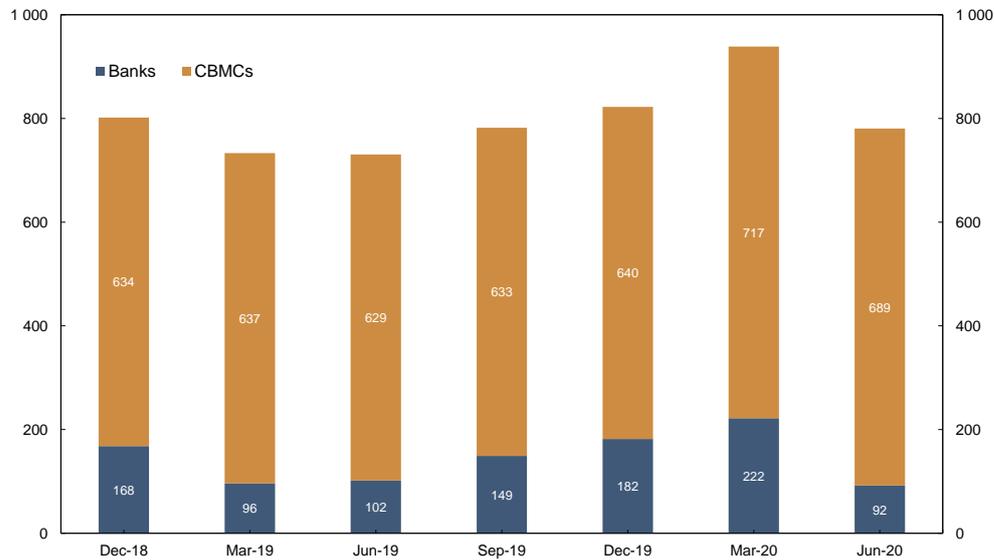
Banks' total net supply of FX derivatives will approximately correspond to banks' and CBMCs' FX debt surplus, i.e., about NOK 800 billion - 900 billion. We can, however, not determine the volume of different FX derivatives based on the data from the banking statistics. Cross-currency interest rate swaps are often used to hedge foreign funding. Such contracts do not necessarily include a swap of the notional amount between the parties. If not, the CBMC can enter into two contracts - a currency swap for the notional amount and a cross-currency interest rate swap for the interest payments. Irrespective of this, banks that are counterparties to CBMCs can offset their derivative exposure by offering different types of contracts to third parties, like investment funds. As an example, a bank entering into a long term swap with a CBMC and receiving USD, can swap USD for NOK on short term contracts to investment funds.

Figure B.1: Foreign currency debt securities issued by banks and covered bond mortgage companies



Note: Norwegian banking statistics (ORBOF) and quarterly balance sheet data. Numbers in NOK billion. Source: Norges Bank.

Figure B.2: Banks' and covered bond mortgage companies' foreign currency debt surplus



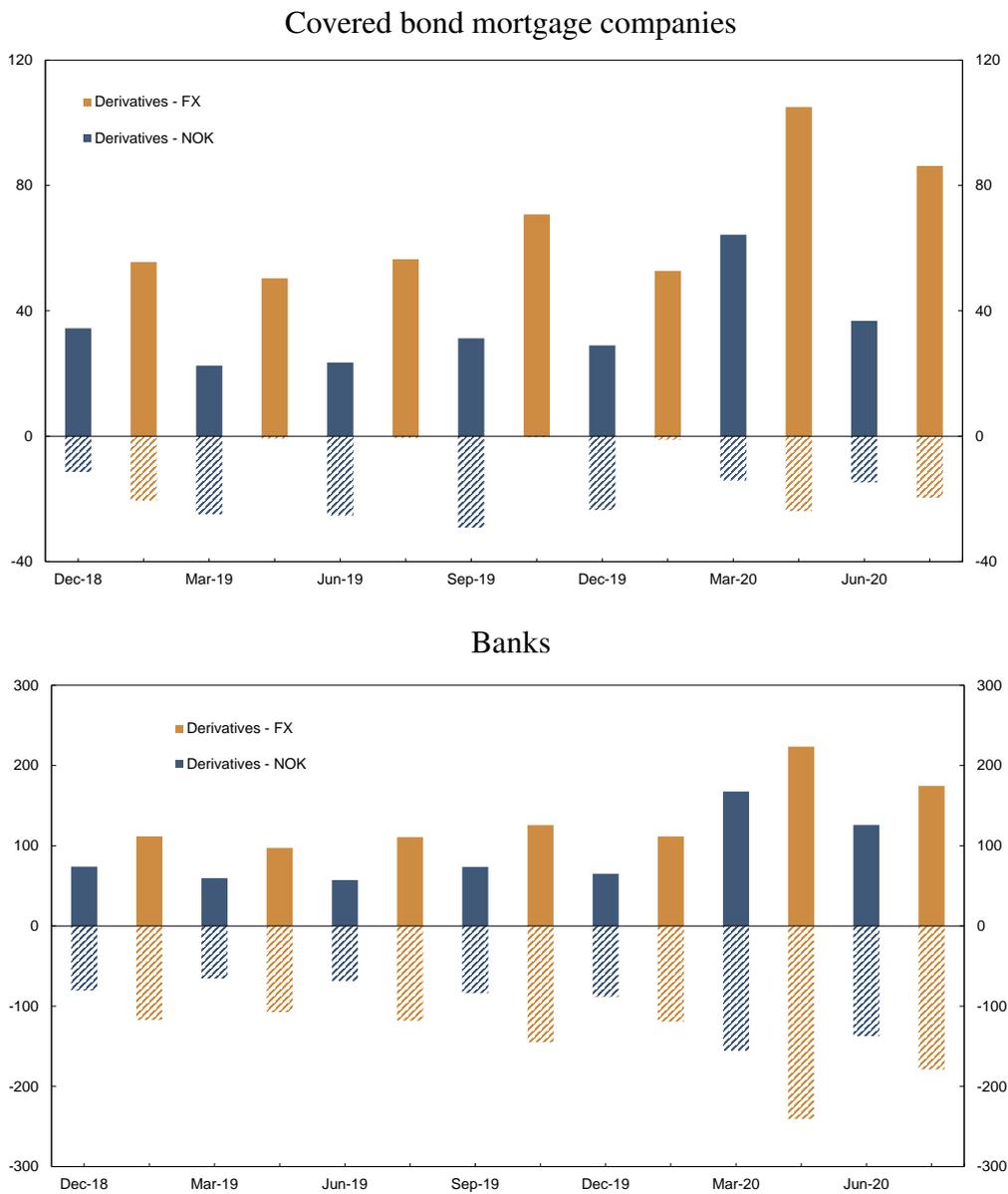
Note: Figure B.2 describes total foreign currency debt less total assets denominated in foreign currency. From Norwegian banking statistics (ORBOF) and quarterly balance sheet data. Numbers in NOK billion. Source: Norges Bank.

Table B.1: Covered bond mortgage companies' total assets, year-end 2019.

Covered bond mortgage company	NOK bn
DNB Boligkreditt AS	694
Sparebank 1 Boligkreditt AS	246
Eika Boligkreditt AS	106
Sparebanken Vest Boligkreditt AS	92
SR-Boligkreditt AS	78
Sparebanken Sør Boligkreditt AS	44
Sbanken Boligkreditt AS	36
Møre Boligkreditt AS	28
Storebrand Boligkreditt AS	21
OBOS Boligkreditt AS	20
Bustadkreditt Sogn og Fjordane AS	20
KLP Kommunekreditt AS	19
Sparebanken Øst Boligkreditt AS	16
Sparebank 1 Næringskreditt AS	11
Verd Boligkreditt AS	10
SSB Boligkreditt AS	9
Fana Sparebank Boligkreditt	9
Helgeland Boligkreditt AS	8
KLP Boligkreditt AS	8
Eiendoms-kreditt	6
Landkreditt Boligkreditt AS	4
Toten Sparebank Boligkreditt AS	3
SUM	1 487

Norwegian banking statistics (ORBOF). Source: Norges Bank.

Figure B.3: Derivatives contracts at fair value on the asset (+) and liability (-) side of the balance sheet

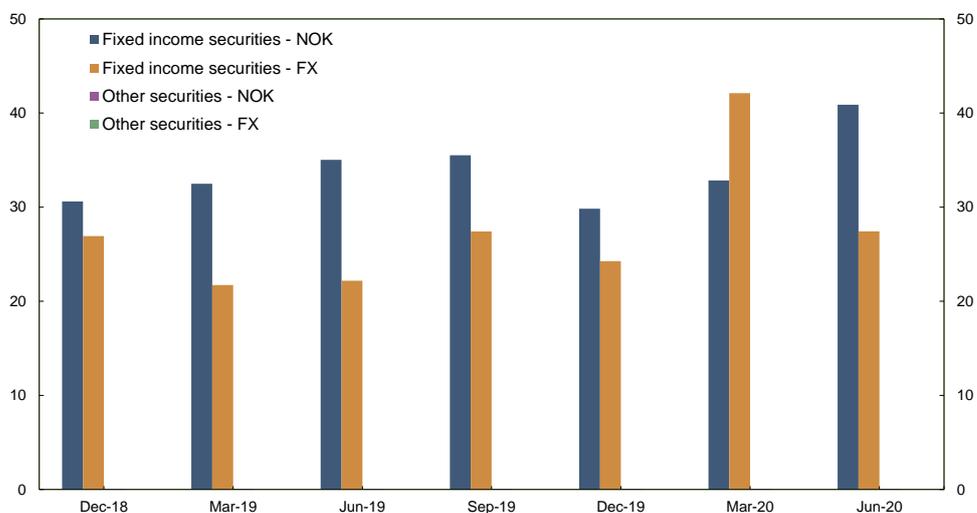


Note: Norwegian banking statistics (ORBOF) and quarterly balance sheet data. Numbers in NOK billion. Source: Norges Bank.

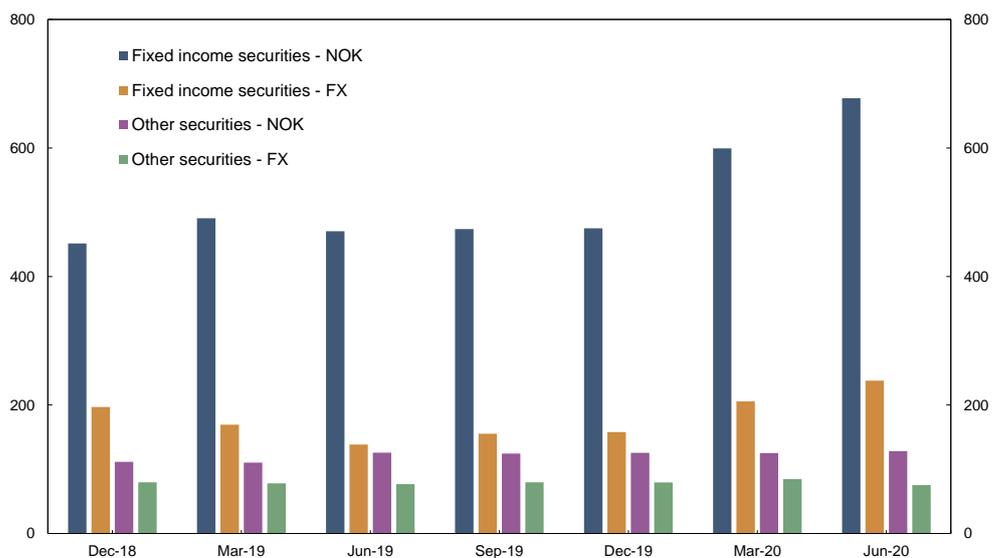
In March NBFIs and other investors facing market value losses on their FX swaps wanted to sell liquid and highly rated NOK fixed income securities to raise cash to meet margin calls. The natural buyers of such securities were banks, who were seeing market value gains on the swap contracts. Balance sheet data show that banks did increase their holding of fixed income securities denominated in NOK in the first quarter of 2020, see B.4. Banks started primarily to buy covered bonds issued by their subsidiaries in mid-March, see Figure 11.

Figure B.4: Securities holdings

Covered bond mortgage companies



Banks



Note: The category other securities includes derivatives. Norwegian banking statistics (ORBOF) and quarterly balance sheet data. Numbers in NOK billion. Source: Norges Bank.