

STAFF MEMO

Norwegian banks' foreign currency funding of NOK assets

NO 2 | 2014

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MARKET OPERATIONS
AND ANALYSIS



NORGES BANK

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ISSN 1504-2596 (online only)

ISBN 978-82-7553-792-6 (online only) Normal

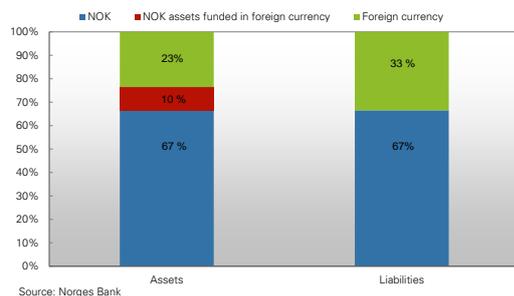
Norwegian banks' foreign currency funding of NOK assets

Jermund L. Molland¹

Norwegian banking groups fund NOK assets by borrowing in foreign currency. Banking groups use currency swap markets to convert foreign exchange to NOK and manage their liquidity in various currencies over time. This strategy makes the currency swap market a key component of the financial system.

Norwegian banks and mortgage companies (hereinafter referred to as *banking groups*) held NOK 1 875 billion in outstanding foreign currency funding at end-2013. This accounted for one third of banking groups' total funding (see Chart 1).

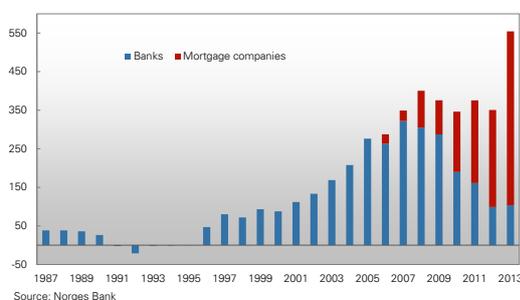
Chart 1 Assets and liabilities of Norwegian banks and mortgage companies by currency. End-2013



Banking groups that obtain funding in a foreign currency may do so for two reasons: They can fund assets in the same currency or they can exchange that currency to fund assets in another currency. For Norwegian banking groups, these will primarily be NOK assets.

Norwegian banking groups' foreign currency funding is largely used to fund assets in currencies other than NOK. At end-2013, approximately 10 percent of banking groups' NOK assets had been funded by borrowing in another currency (see Chart 1). This accounted for approximately NOK 550 billion in assets (see Chart 2).

Chart 2 NOK assets funded in foreign currency. Norwegian banks and mortgage companies. In billions of NOK. 1987 – 2013



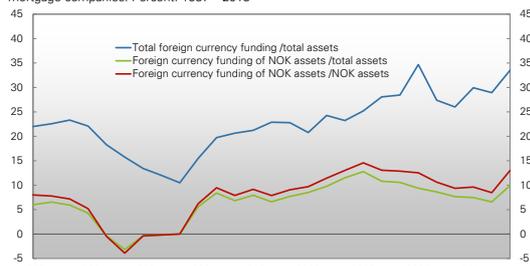
Foreign currency funding of NOK assets grew substantially in volume from the end of the 1990s up until 2008, stabilising somewhat in the following years (see Chart 2). One reason is the swap arrangement, which was established during the financial crisis. The swap arrangement gave banking groups access to long-term NOK funding and reduced the need to obtain funding in foreign currency.² Lower credit growth following the financial crisis also reduced banking groups' funding needs. Nevertheless, data for 2013 suggest that in the past year, banks again increased their borrowing in foreign currency to fund NOK assets (see Chart 2). This may be related to the phasing-out of the swap arrangement, which is to some extent being replaced as a source of funding by foreign currency funding.

In the years between 2008 and 2013, foreign currency funding of NOK assets declined as a proportion of Norwegian banking groups' total assets (see Chart 3). In addition to the factors discussed above, the main reason for the decline was that banks increased their short-term funding and their liquid foreign exchange investments. This has raised total assets in the banking sector and thus reduced the relative volume of foreign currency funding of NOK assets. Foreign currency funding of NOK assets as a proportion of total assets rose again over the past year.

¹ I am grateful to Per Atle Aronsen, Sigbjørn Atle Berg, Olav Bø, Ketil Rakkestad and Norman Spencer for helpful comments and feedback.

² Under the swap arrangement with the government, banks exchanged covered bonds for Treasury bills. This increased the issuance of covered bonds in NOK. In addition, swap arrangement transactions were entered twice on bank balance sheets. This inflates bank balance sheets, amplifying the effect on the proportion of foreign currency relative to NOK.

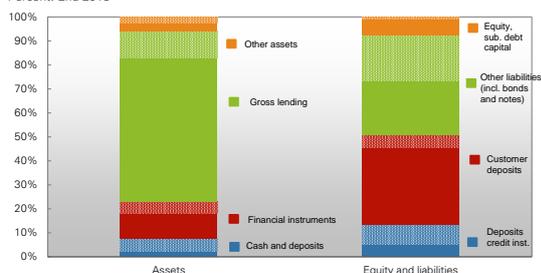
Chart 3 Foreign currency funding as a proportion of asset funding. Norwegian banks and mortgage companies. Percent. 1987 – 2013



Source: Norges Bank

Various forms of wholesale funding are Norwegian banking groups' most important sources of foreign currency funding. These are primarily bonds, short-term paper and deposits from credit institutions. Only a small fraction of foreign currency funding is in the form of traditional customer deposits (see Chart 4).

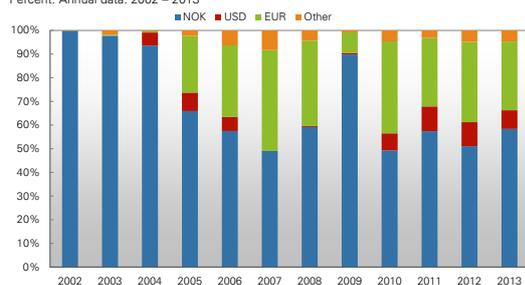
Chart 4 Balance sheet items, Norwegian banks and mortgage companies, by currency. Percent. End-2013



Source: Norges Bank

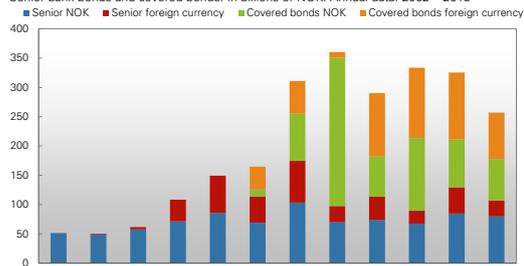
Most long-term wholesale funding in foreign currency is in EUR and USD (see Chart 5). Previously, Norwegian banking groups' long-term wholesale funding primarily comprised bank bonds, but since 2007, banking groups have also been able to issue covered bonds through subsidiary covered bond mortgage companies. This has provided new funding sources and access to new markets. In recent years, covered bond issuance has accounted for an ever increasing share of banking groups' bond funding (see Chart 6).

Chart 5 Bond issuance by currency. Norwegian banks and mortgage companies. Percent. Annual data. 2002 – 2013



Sources: Bloomberg, Stamdata and Norges Bank

Chart 6 Bond issuance by currency. Norwegian banks and mortgage companies. Senior bank bonds and covered bonds. In billions of NOK. Annual data. 2002 – 2013



Sources: Bloomberg, Stamdata and Norges Bank

Banks' short-term wholesale funding in foreign currency is largely matched by liquid foreign exchange investments. The remainder of this article will focus primarily on foreign currency funding through senior bank bonds and covered bonds that are swapped to fund NOK assets. I will examine how banking groups convert foreign exchange to NOK, the risks associated with the various strategies and the vulnerabilities in the financial system that might arise from the use of currency swaps. In conclusion, I discuss why banking groups have behaved in this manner and what may be done to possibly modify these strategies or reduce attendant vulnerabilities.

1. Conversion to NOK

Funding NOK assets by borrowing in foreign currency exposes banking groups to foreign exchange risk. Banking groups need to exchange foreign currency for NOK, while at the same time making certain that the foreign currency is returned before the loan matures. Foreign exchange derivatives, especially various forms of currency swap, have characteristics that are particularly suited to this purpose. Under a currency swap, a banking group exchanges the foreign currency it has borrowed for NOK while at the same time ensuring that it will receive the same currency to redeem the loan at maturity.³

³ In this article, *currency swap* is used as an umbrella term for *foreign exchange swaps* and *cross-currency basis swaps*. See the appendix for a further discussion of currency swaps and other kinds of interest rate and foreign exchange derivatives and their characteristics.

1.1 Banking groups' conversion of foreign currency funding into NOK

In slightly simplified terms, banking groups have two choices when exchanging foreign currency for NOK, while ensuring that the same currency is returned when the foreign currency bond matures:

- Enter into a currency swap with the same maturity as the foreign currency funding. This will normally be a cross-currency basis swap for long-dated funding, or a foreign exchange swap, if the funding is short-dated.
- Enter into a currency swap with a shorter maturity than the foreign currency funding. This will normally be a foreign exchange swap.

In assessing its options, a bank will consider its balance sheet as a whole, including assets and liabilities in various currencies. A large bank will have a large number of transactions each day that affect the bank's liquidity in various currencies. The conversions that the bank needs to perform will therefore change over time. For example, customers who wish to deposit NOK in the bank will, all else being equal, reduce the bank's need to exchange foreign currency for NOK. The bank takes this into consideration when choosing maturities and instruments for foreign exchange hedging. Thus, shorter maturities on foreign exchange and hedging transactions will increase flexibility for the bank, although they may also, as discussed further in Section 1.2, give rise to increased risk.

Covered bond mortgage companies have a different strategy from banks for exchanging foreign currency for NOK. Unlike banks, mortgage companies⁴ cannot accept customer deposits. Mortgage companies' liquidity fluctuations are therefore less pronounced than those of banks. The Financial Institutions Act with appurtenant regulations also sets strict

⁴ In this article, the term *mortgage company* refers to a *covered bond mortgage company*, unless otherwise specified.

limitations on mortgage companies' assumption of liquidity and foreign exchange risk.⁵ Mortgage companies that issue covered bonds in foreign currency to fund residential mortgage lending in NOK therefore need to have in place interest rate and foreign exchange hedges with the same maturity as the bonds. For this purpose, they normally use cross-currency basis swaps with the same maturities as the bonds they issue. They thereby obtain NOK in exchange for foreign currency raised by the bond issue, while ensuring that they can pay interest expenses over the term of the bond and have hedged the value at maturity of the bond in foreign currency.

Banks' and mortgage companies' strategy also appears in data reported to the triennial BIS central bank survey and Norges Bank's money market survey.⁶ Foreign exchange swaps and outright forwards account for the largest portion of the turnover in foreign exchange derivatives involving NOK, while cross-currency basis swaps only account for a small portion of the turnover (see Chart 7). Foreign exchange swaps, which banks use extensively, have short maturities (see Chart 8). Turnover data for these instruments have therefore been considerably higher than for cross-currency basis swaps, which normally have longer maturities. Nevertheless, turnover in cross-currency basis swaps has risen sharply after Norwegian banking groups were authorised to issue covered bonds in 2007 (see Chart 7).

⁵ Chapter IV of Act No. 40 of 10 June 1988 relating to financing activity and financial institutions (Financial Institutions Act) and Regulation No. 550 of 25 May 2007 relating to mortgage companies that issue bonds with preferential rights to a cover pool comprising public sector loans or loans secured by dwellings or other real property.

⁶ Every three years since 1989, Norges Bank has conducted a survey in collaboration with the Bank for International Settlements (BIS) (see Norges Bank (2013)). From 2013, Norges Bank has also conducted an annual survey of the Norwegian money market (see Saakvitne (2013))

Chart 7 Turnover volume for selected instruments in the Norwegian foreign exchange market in April by transaction type. In billions of USD. 2001 – 2013

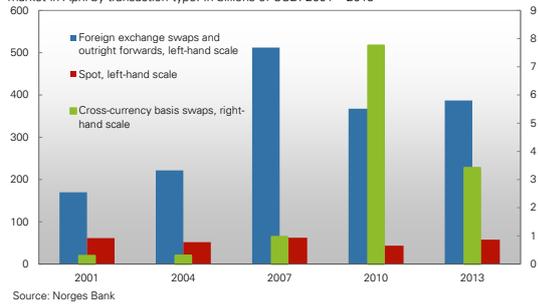
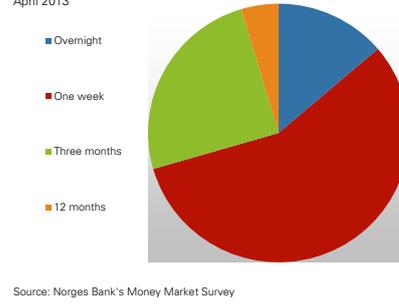
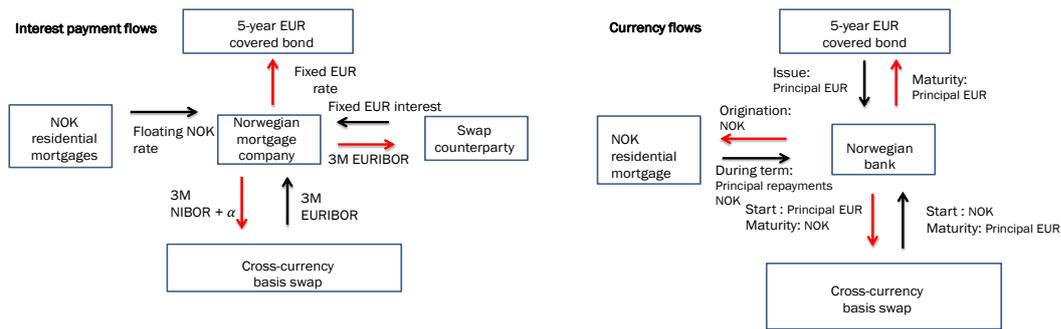


Chart 8 Maturities of Norwegian banks' foreign exchange. Foreign currency to NOK. April 2013



Box 1 shows examples of banks' and mortgage companies' strategies.

Box 1 Examples of strategies for funding lending in NOK by borrowing in foreign currency

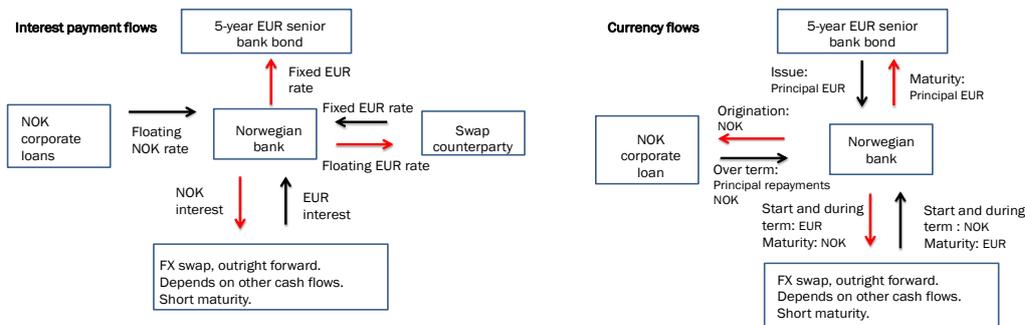


Example: covered bond

A mortgage company issues a covered bond in EUR with a fixed rate and maturity of five years. The bond is intended to fund adjustable rate mortgages in NOK. To hedge the interest rate and foreign exchange risk associated with foreign currency funding of its mortgages, the mortgage company normally employs the following strategy:

- Interest rate swap in EUR, under which it receives a fixed EUR rate and pays a floating EUR rate for five years.
- Cross-currency basis swap, under which it exchanges EUR for NOK at the current spot rate with an agreement to re-exchange the principal in five years at the same rate. Under the cross-currency basis swap, it receives a floating EUR rate and pays a floating NOK rate.

Over the term of the contract, the mortgage company will receive a floating NOK interest rate on its mortgages and exchange this under the cross-currency basis swap for a floating EUR interest rate, which, in turn, via the interest rate swap in EUR, will cover the interest payments over the term of the bond. When its NOK mortgages mature, the mortgage company will re-exchange NOK for EUR under the cross-currency basis swap and redeem the maturing covered bond in EUR. By employing such a strategy, the mortgage company has fully hedged its interest rate and exchange rate risk over the term of the bond, but may be exposed to liquidity risk associated with refunding the covered bond after five years.



Example: bank bond

A Norwegian bank issues a bond in EUR with a fixed rate and maturity of five years. The bond is intended to fund various adjustable rate loans in NOK. To hedge interest rate and foreign exchange risk associated with foreign currency funding, the bank *can* employ the following strategy:

- Interest rate swap in EUR, under which it receives a fixed EUR rate and pays a floating EUR rate for five years.
- Outright forwards or short-dated foreign exchange swaps, normally overnight to three months. The choice of instrument and maturity will depend on the bank's other cash flows in various currencies.

Since the need to exchange for NOK can vary over time, the use of instruments will also vary in parallel. But by viewing other cash flows in context with the use of these instruments, the bank can ensure that it is able at all times to cover the interest payments on the bond and redeem the principal at maturity. Nevertheless, the bank will be more exposed to changes in market conditions using this strategy compared with the use of a cross-currency basis swap as in the example above. The bank may also be exposed to liquidity risk associated with refunding the bond after five years.

1.2 Risks for banking groups associated with conversion of foreign currency funding into NOK

Maturity transformation

Banks' key role is to enable market participants to choose consumption and saving paths that diverge from their current income. Lenders and borrowers often have differing needs regarding the amounts they want to borrow or save and how long they want to commit themselves. Borrowers may have a substantial immediate need for capital, while the income intended for repayment is often spread over several years. However, someone who saves, e.g. by making a bank deposit or purchasing a security issued by the bank, may prefer to commit his capital to shorter maturities than the lender prefers to lend at. By transforming short-term savings into long-term lending, the banking system has a key role in maturity transformation in an economy.

Refunding and foreign exchange risks

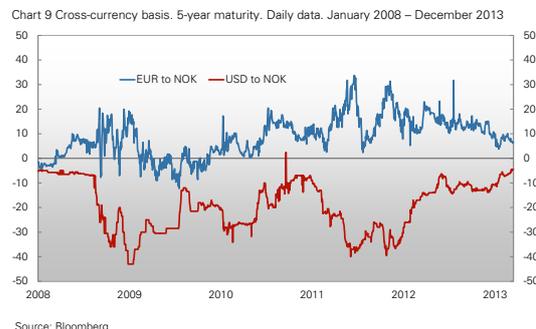
Banking groups' maturity transformation entails *refunding risk (liquidity risk)*. Since funding normally has shorter maturity than loans, banking groups need to roll over funding before their loans mature. Banks can limit this risk by adjusting the maturity profile of their funding to achieve a better maturity match between funding and loans.

In addition, funding assets in one currency by borrowing in another gives rise to *foreign exchange risk*. As discussed above, this risk can be mitigated through the use of currency swaps. If banks exchange foreign currency for NOK at shorter maturities than the maturity of the NOK-funded asset, banks will nevertheless have to enter into a series of currency swaps before the asset matures. In periods of substantial market turbulence, participants may in the worst case perceive counterparty risk as so high that they will not renew or enter into new currency swaps. In such a situation, banks will have a *refunding need (liquidity need)* in NOK.

Premium risk (basis risk)

Norwegian banking groups normally have access to currency swap markets, even in times of substantial market turbulence. However, there is a risk that in such a situation the price banking groups must pay to enter into currency swaps will rise.

The cost of entering into a currency swap is ordinarily expressed as the difference between two market interest rates, i.e. a premium. The premiums banking groups pay to enter into cross-currency basis swaps between foreign currency and NOK have fluctuated substantially in periods (see Chart 9). The volatility of these premiums is periodically considerably higher than the volatility of risk premiums on bond funding. Therefore, to obtain the lowest possible funding costs in NOK, it may be just as important for the banking group to adjust the timing of bond issues in foreign currency in relation to the premium on the cross-currency basis swap as in relation to the risk premium on bond issues.



The shorter the maturity on banking groups' currency swaps, the more vulnerable they are to having to enter into new contracts in periods when the cost of doing so is high. On the other hand, high premiums will to some extent contribute to a preference for shorter-dated currency swaps, in order to avoid a commitment to a high premium over time. This in turn may induce banking groups to assume greater *refunding and liquidity risk*.

Liquidity risk

Besides the risk of not being able to enter into new currency swaps or of a higher price to enter into these contracts, banking groups may

be exposed to *liquidity risk* related to exchange rate movements. For a Norwegian banking group that receives NOK in exchange for foreign currency under a currency swap, an appreciation of the krone exchange rate, all else being equal, may mean that the group will receive less NOK when entering into a new contract or settling the foreign currency leg under an existing contract. The banking group will not incur losses from such exchange rate fluctuations, but may have a need for liquidity in NOK.

This kind of liquidity risk may also arise if a bond is hedged by a cross-currency basis swap with the same maturity as the bond. Owing to movements in exchange rates, interest rates and premiums, the market value of a cross-currency basis swap has positive value for one party and correspondingly negative value for the other party. Mark-to-market margin payments to the counterparty over the term of the contract and settlement of the foreign currency leg before maturity are common market practices for reducing the counterparty risk associated with a currency swap (see section on counterparty risk in Box 3). Nevertheless, mortgage companies cannot assume this kind of liquidity risk and therefore utilise *unilateral margin agreements* without settlement of the foreign currency leg over the term of their cross-currency basis swaps. In such cases, the mortgage company receives margin payments from the counterparty when the swap has positive value for the mortgage company, but does not post margin to the counterparty in the opposite case. Thus, the mortgage company is not exposed to liquidity risk associated with cross-currency basis swaps.

Counterparty risk

In addition to the risk factors already mentioned, banking groups entering into currency swaps will be exposed to *counterparty risk*, i.e. the risk that a counterparty will not fulfil its contractual obligations. Counterparty risk can be roughly divided into two types: counterparty risk associated with changes in market conditions and settlement risk. From the inception date

until settlement at maturity, a party to a trade will face a risk that the counterparty will fail to fulfil its contractual obligations. Currency swaps normally have a net present value of zero at inception but, owing to movements in interest rates and foreign exchange rates, the value of the contracts will change, and one party will then have a claim against the other. Changes in market conditions can make replacing the trade in the market costly. Since the risk of both substantial market volatility and counterparty uncertainty increases over time, counterparty risk is greater the longer the time between the inception date and settlement at maturity.

Settlement risk is the risk of losing the principal at settlement or that liquidity problems will hinder repayment or reduce the value of the trade. In principle, foreign exchange settlement takes place in two independent payment systems, and there is a risk of having to deliver foreign currency that has been sold before receiving confirmation of receipt of foreign currency purchased. This unhedged exposure may last for up to several days and represents a material counterparty risk for the banking group. Liquidity problems can also prevent one party from performing his portion of the settlement at the agreed date. Many banking groups have very high foreign exchange settlement exposures, and a failure can have serious consequences, not only for the individual participant, but for the financial system as a whole.

Box 2 illustrates a simplified example of how a bank may be *partially* exposed to various kinds of risk, depending on its chosen foreign exchange strategy.

Box 3 discusses how the financial infrastructure can mitigate counterparty risk associated with banking groups' currency swaps.

Box 2 Risk factors associated with various strategies

Below is a simplified example of how a bank may be partially exposed to various types of risk depending on its foreign exchange hedging strategy. The bank intends to fund an asset (i.e. a loan) worth NOK 800 000 for five years by borrowing in EUR. The current spot rate is NOK 8/EUR 1 and the bank funds the asset by issuing a five-year bond worth EUR 100 000. The bank needs to exchange this amount for NOK today to make its loan. To avoid foreign exchange risk, the bank also needs to ensure that the NOK amount it receives from its NOK asset is sufficient to redeem the EUR bond with maturity in five years' time. I disregard the bank's other cash flows, if any.¹

No foreign exchange hedge

If the bank purchases NOK at the spot rate today, it will receive NOK 800 000 to fund the NOK loan. Over the term of the loan, the bank will be exposed to *refunding* and *liquidity risk*. If the krone exchange rate depreciates to NOK 9/EUR 1 before the loan matures, the bank will receive NOK 800 000 when its asset matures, but it will cost the bank NOK 900 000 to purchase EUR at the spot rate to redeem the bond. Conversely, if the krone exchange rate appreciates to NOK 7/EUR 1 before the loan matures, the bank will still receive NOK 800 000 from the asset, but it will only cost the bank NOK 700 000 to purchase EUR at the spot rate to redeem the bond. With this strategy, the bank has an open foreign exchange position and is vulnerable to changes in market conditions.

Short-dated foreign exchange swap

The bank purchases NOK at the current spot rate and at the same time enters into an agreement to buy back EUR at the forward rate at some specified future date, e.g. in three months. If the three-month forward rate is also NOK 8/EUR, the bank will pay NOK 800 000 receive EUR 100 000 after three months. If at this time, the spot rate deviates from the forward rate agreed at inception, the bank may have an increased need for liquidity when renewing the swap. A depreciation of the krone to NOK 9/EUR 1 will mean the bank will receive NOK 900 000 under a new foreign exchange swap after three months, while an appreciation of the krone to NOK 7/EUR 1 will mean the bank will only receive NOK 700 000 under the new swap. In the latter case, the bank will have to obtain an additional NOK 100 000 to fund the NOK asset for the subsequent period, for example by borrowing in NOK. If the spot and forward rates remain unchanged at NOK 7/EUR 1 until maturity, the bank will after five years receive EUR 100 000 and pay NOK 700 000 when the swap terminates, and will have to pay EUR 100 000 and NOK 100 000 to redeem maturing bonds. In addition, the bank will have an income of NOK 800 000 from selling the asset. Thus, the bank does not incur any direct losses associated with exchange rate movements, but is exposed to *liquidity risk* because it may have to borrow more if an exchange rate changes.² The bank may also be exposed to *refunding* and *premium risk* associated with changes in market conditions when renewing foreign exchange swaps every three months.

Long-dated cross-currency basis swap

By entering into a cross-currency basis swap from EUR to NOK with the same maturity as the bond, the bank will receive NOK 800 000 today and pay EUR 100 000. At the same time, the parties agree to re-exchange the currencies in five years at today's spot rate. After five years, the bank will then receive EUR 100 000 under the swap and pay the NOK 800 000 it receives from the asset. With this strategy, the bank has fully hedged its exchange rate exposure, since the ability to repay the amount owed is unaffected by exchange rate movements.

If the exchange rate moves over the term of the contract, one party will hold a position with a positive market value, while the other party will hold a position with a correspondingly negative market value. If, for example, the exchange rate moves to NOK 7/EUR 1, the Norwegian bank's swap will have a negative market value. Under the swap, the Norwegian bank lent NOK 100 000 and received NOK 800 000. If the bank cannot fulfil its settlement obligations, the counterparty will only receive NOK 700 000 when the bank replaces the trade in the market. In addition, the price of entering into a new cross-currency basis swap may have changed. As in the case of other derivatives, it is therefore normal for banks to post margins over the term of the swap for such counterparty exposures. In this case, with full cash margining the bank would have to pay the present value of NOK 100 000 at maturity in margins to the counterparty for exchange rate movements, adjusted for any margins that take account of changes in the price (premium) of entering into a new swap. Banks can raise these funds by borrowing in NOK. If the exchange rate is still NOK 7/EUR 1 at maturity, the bank will receive NOK 800 000 from its NOK asset, while it will receive EUR 100 000 under the swap, which it will use to redeem the maturing bond. At the same time, the bank pays NOK 800 000 to the counterparty under the swap (less the amount already transferred in the form of margin payments).

Since exchange rates can change considerably and counterparty exposures in a long-dated cross-currency basis swap can be substantial, banks ordinarily settle the foreign currency legs of basis swaps over the term of the contract. Exchange rate movements will give rise to *liquidity needs* in about the same way as rolling over short-term foreign exchange swaps or margin calls on basis swaps. Nevertheless, in contrast to foreign exchange swaps, a bank using a long-dated basis swap will not be exposed to *refunding* and *premium risk* associated with contract rollover.

1) For the sake of simplicity, a zero interest rate and constant cross-currency interest rate differential are implicitly assumed.

2) Liquidity risk may be limited by interest rate changes that counteract exchange rate movements in the two currencies. It can be shown that the risk in the example will not arise if interest rate parity holds and the krone loan bears the overnight rate.

For more about the krone exchange rate and factors that explain movements in it, see e.g. Flatner, Tornes and Østnor (2010).

Box 3 Financial infrastructure mechanisms for risk reduction

Banking groups' internal risk management and the financial infrastructure ensure that counterparty risk associated with currency swaps is adequately addressed. Banking groups can reduce counterparty risk through their choice of counterparties. In addition, counterparty risk associated with changes in market conditions also depend in part on hedging transaction maturities. The longer the maturities are, the greater the likelihood that market prices will move, that the value of the contract will change and that the counterparty will fail to fulfil its contractual obligations. Currency swaps with shorter maturity will, all else being equal, have lower counterparty risk associated with changes in market conditions. Banking groups can therefore mitigate this risk by entering into currency swaps with short maturities. Even so, some entities, such as mortgage companies, do not have this option.

Besides intra-group adjustments, counterparty risk can be mitigated through the financial infrastructure. The most common way to regulate counterparty risk associated with changes in market conditions is through a credit support annex (CSA) (see e.g. Bakke, Berner and Molland (2011)). CSAs are one of the components of an ISDA Master Agreement, which is a framework of contracts that govern bilateral derivatives trades. CSAs regulate counterparty risk in a derivatives contract from inception date to settlement at maturity. This involves posting margins to the counterparty. Market participants set exposure limits to one another and exchange margins on the basis of their net exposures to one another in derivatives contracts under the CSA agreement. Margins are normally in the form of cash or highly liquid securities.

For long-dated derivatives, such as cross-currency basis swaps, there is a greater risk that market price movements can lead to changes in value over the term of the contract. It is therefore common for banks to settle the foreign currency leg of a cross-currency basis swap over the term of the contract, e.g. every three months. Thus, market participants' counterparty exposures do not build up to the same degree, nor do they have the same need for posting margins.

At the Pittsburgh Summit in 2009, G20 leaders decided on measures to reduce risk and improve transparency in the OTC derivatives market. In response, the EU adopted the European Market Infrastructure Regulation (EMIR), which requires relevant OTC derivatives contracts to be cleared through a central counterparty. Whether or not a derivatives contract is relevant is largely determined by how liquid or standardised the derivative contract is. A larger share of the derivatives contracts utilised by Norwegian banking groups ahead will also likely be cleared through central counterparties.

Counterparty risk associated with settlement of foreign exchange trades has been considerably reduced by the CLS settlement system (see Bakke, Berner and Molland (2011)). By using CLS, participants avoid having to deliver foreign currency sold without receiving foreign currency purchased, since each leg of a transaction is matched on a *payment versus payment* (PvP) basis. CLS settles trades in 17 currencies, including NOK, and covers spot contracts, currency swaps (foreign exchange swaps but not cross-currency basis swaps) outright forwards, foreign exchange options, non-deliverable forwards and credit derivatives. Estimates compiled by CLS indicate that around 60 percent of global foreign exchange trades are settled in the CLS system. NOK was included in CLS in 2003.

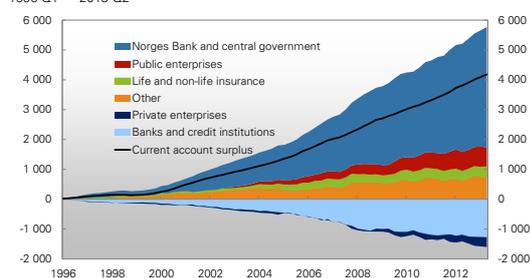
2. Rationale and vulnerabilities

In this section, I will take a closer look at Norwegian banking groups' rationale for borrowing in foreign currency to fund NOK assets and the vulnerabilities that may be associated with this strategy.

2.1 Rationale for this strategy

In recent years, substantial revenues from the petroleum sector have given Norway large current account surpluses (see Chart 10). At the same time, capital outflows from Norway have exceeded the current account surplus. When capital outflows have exceeded the current account surplus, other sectors must have accounted for a capital inflow equal to the difference. Capital outflows have primarily come from insurance companies, pension funds and public enterprises, while banks and mortgage companies have accounted for a large share of capital inflows (see Chart 10).⁷

Chart 10 Net capital outflows from sectors in Norway. Cumulative. In millions of NOK. 1996 Q1 – 2013 Q2



Source: Statistics Norway

Current account surplus

Petroleum revenues not absorbed into the Norwegian economy by financing the structural non-oil budget deficit are transferred to the Government Pension Fund Global (GPF) and invested in foreign currency assets. These assets represent a transfer of wealth from

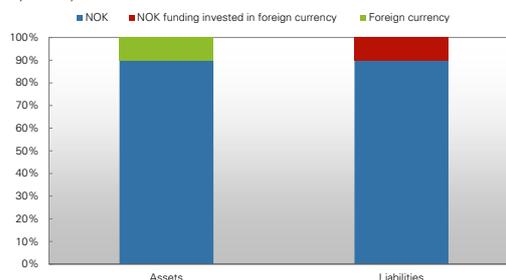
⁷ Capital inflows and outflows vis-à-vis other countries in the financial sector accounts is a net concept and is defined on the basis of the transaction parties' domicile and not on the currency exchanged. Therefore, capital inflows from Norwegian banking groups do not correspond with their foreign currency funding of NOK assets. This is because portions of foreign counterparties' funding is in NOK, Norwegian banking groups extend foreign currency loans to Norwegian customers and the sample of banks and mortgage companies in Chart 10 is more extensive than the one shown in e.g. Chart 2.

natural resources to financial assets in foreign currency and do not give rise to a need for Norwegian banking groups to raise funding in foreign currency. Investing petroleum revenues directly in the Norwegian economy could, however, have reduced banking groups' foreign currency funding, since more saving decisions would have taken place in NOK. There are nevertheless other reasons why this has not been done.

Capital outflows in excess of the current account surplus

Domestic agents who seek to diversify their saving decisions and take advantage of business opportunities abroad contribute to capital outflows. For example, domestic households save in the form of bank deposits, securities and mutual funds in Norway, but to a limited extent directly in other countries. Insurance companies, pension funds and other mutual funds are key managers of household savings in the form of securities. These entities seek to diversify their investments by counterparty, sector, instrument and currency to minimise risk and maximise the return on their investments. Therefore, investing solely in claims on Norwegian counterparties or in NOK will not be an optimal strategy. At end-2012, Norwegian insurance companies and pension funds had NOK 300 billion in claims on foreign counterparties (see Chart 10). At the same time, all insurance company and pension fund funding was in NOK (see Chart 11).

Chart 11 Assets and liabilities of Norwegian insurance companies and pension funds by currency. End-2012



Sources: Norges Bank, Statistics Norway

When domestic agents invest capital abroad, their counterparties will receive NOK or foreign currency. If we assume that domestic agents hold NOK, the NOK will end up in the hands of the foreign counterparty, if the investment is in NOK, or in the hands of the foreign

counterparty to a currency swap, if the investment is in foreign currency. If the agents take no further action, the NOK value of the capital outflow will end up in an account at a Norwegian bank overnight, since only Norwegian banks have deposit accounts with Norges Bank. In this situation, the banking system will account for a capital inflow equal to the capital outflow from other sectors.

If the banking system comprised only a single agent, the NOK would be deposited in this agent's account. This single agent would then not have any need to issue bonds or otherwise attract saving decisions from foreign entities as a consequence of the capital outflow. Nor would the agent need to borrow in foreign currency to fund NOK loans as a consequence of capital outflows from other sectors.

On the other hand, in a system comprising several agents, such a strategy may entail a substantial *refunding risk*. The NOK deposits have, in principle, maturity of one day, and the recipients of these funds may vary. Banks or other private enterprises in need of more stable funding will seek to attract longer-term saving decisions. One way they can do this is by issuing bonds in NOK or foreign currency. The choice of currency will partly depend on the cost to the domestic agent of issuing a bond in foreign currency and then exchanging it for NOK, relative to the cost of issuing a bond directly in NOK. The cost associated with these alternatives depends in part on the compensation investors demand for holding a NOK bond compared to one in foreign currency.

In Norway, most credit is provided by the banking sector. Banks' knowledge of liquidity and foreign exchange risk management also makes them better suited to obtaining funding in foreign currency. Consequently, banking groups attract most foreign saving decisions and account for most of the foreign capital inflows. Most of the foreign investors that it would be natural for Norwegian banks to attract will be institutional investors, banks and similar, rather than households and enterprises. These investors invest primarily in financial instruments. Thus domestic capital

outflows will be paralleled by increased wholesale funding by Norwegian banking groups. But, all else being equal, this wholesale funding could just as well be in NOK as in foreign currency.

Nor need it be the case that banking groups or other domestic entities must be responsible for capital inflows because of domestic agents' capital outflows. The opposite can also be the case. Funding in various currencies and markets provides valuable diversification of banking groups' funding sources. Diversification can reduce refunding risk and banking groups' funding costs. It may therefore be in banking groups' interest to attract foreign capital. This capital inflow must then be matched by capital outflows from other sectors.

One of the most substantial welfare gains of open financial markets is that market participants largely meet other participants with opposite needs. Overall, it will be the risk-adjusted rate of return associated with the various strategies that determines how much capital domestic agents choose to invest abroad and the volume of capital inflows banking groups will account for. If agents do not correctly price the risks associated with their strategies from an economic perspective, banking groups may account for excessive capital inflows and have too much foreign currency funding relative to economically optimal levels.

Credit growth

Banking groups' access to wholesale funding affects lending growth. A considerable share of lending is funded by deposits by households and businesses, but deposits are limited by household financial investment and businesses' build-up of liquid assets (see e.g. Shin and Shin (2011)). In periods of high credit growth, the supply of deposits is not sufficient to fund the increase in lending. In periods when banking groups' lending growth exceeds deposit growth, banking groups therefore raise a larger share of funding directly in financial markets. Credit growth may be both supply- and demand-driven. Attractive investment opportunities in profitable projects and access to cheaper financing may stimulate additional

lending by banking groups, while demand for loans also grows. This contributes in isolation to higher credit growth and an increase in the reserve multiplier in the banking system (see the Federal Reserve Bank of Chicago (1992)). Domestic agents will then seek to diversify their investments to an even greater extent and will then usually reduce the share of bank deposits. They can diversify by e.g. investing in financial instruments in NOK or foreign currency. Similarly, banking groups will also increasingly seek to diversify their funding sources. Therefore, in periods of high credit growth, banking groups' wholesale funding will normally increase. Since domestic opportunities for diversification are limited for Norwegian savers and Norwegian banking groups, „a larger proportion of banking groups' wholesale funding will normally also be obtained from foreign savers and in foreign currency in periods of high credit growth.

As argued above, the government's current account surplus cannot in itself explain why Norwegian banking groups raise funding in foreign currency. Nevertheless, the economic activity generated by the petroleum sector, both directly and through ripple effects to other industries, may contribute to higher investment and credit growth, which may in turn result in increased foreign currency funding of NOK assets by banking groups.

2.2 Vulnerabilities associated with banking groups' strategies

As shown in Section 1, banking groups can reduce the institution-specific risk associated with funding NOK assets by borrowing in foreign currency. Nevertheless, there may be structural vulnerabilities associated with this strategy.

Counterparties

Foreign banks are the most important counterparties to Norwegian banking groups' currency swaps. In April 2013, approximately 70 percent of the counterparties to Norwegian foreign exchange trades were foreign entities (see Chart 12). At the same date, 90 percent of all counterparties were financial entities.

Chart 12 Foreign exchange market turnover in April 2013 by counterparty



Source: Norges Bank

In the Norwegian banking system, there are few entities with the capacity and risk management framework to be a counterparty to currency swaps. Among domestic entities, it is primarily market departments of major Norwegian and Nordic banks that are active in these markets. One way to reduce the risk associated with being a counterparty to e.g. a cross-currency basis swap will be to enter into a matching currency swap in the opposite direction with another counterparty outside the Norwegian banking system. Risk can thus be relayed further on behalf of other Norwegian entities.

Currency swaps within the Norwegian banking system redistribute risk among entities and reduce their need to enter into currency swaps with entities outside the system. The NOK 550 billion that Norwegian banking groups funded net at end-2013 by borrowing in foreign currency (see Chart 2) represented the banking system's net need to enter into currency swaps with entities outside the system.

Regardless of whether they are Norwegian or foreign, counterparties to currency swaps must borrow NOK to be a participant in such a swap. Foreign entities may have natural access to NOK, but need to exchange it for another currency and thus become counterparties for Norwegian banking groups. This may be because they are initially counterparties to entities seeking to exchange NOK for another currency. Foreign entities can also participate in currency swap markets as a purely speculative strategy. They then borrow NOK, usually short-term, which they swap for another currency under a swap contract. Subsequently, they reverse the currency swap

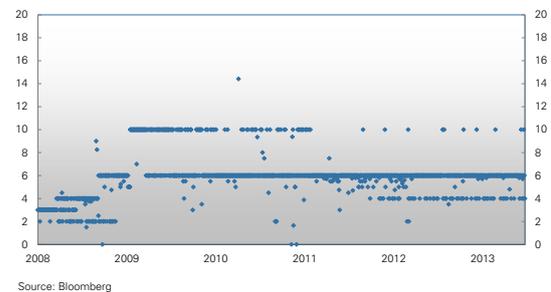
and repay the NOK loan with the objective of earning a positive return on the trade.

The availability and price of currency swaps for Norwegian banking groups partly depends on who the counterparties to currency swaps are and how they have funded the NOK they are lending. When an entity's borrowings in NOK have a shorter maturity than that of the currency swap under which they are obliged to pay out NOK, the entity will be exposed to *refunding risk*. Turbulence and higher premiums in the Norwegian money market may make it costlier and more difficult to borrow in NOK. Foreign entities will likely be particularly vulnerable in this situation. Unlike Norwegian banks, they do not have access to central bank lending facilities in NOK and they often have less of a commercial need to participate in markets for currency swaps involving NOK. The risk is therefore greater that they will withdraw from the market in periods of turbulence.

The availability and price of cross-currency basis swaps for Norwegian banking groups, especially mortgage companies, are particularly exposed to risk in this situation. The cross-currency basis swap market is ordinarily less liquid than the foreign exchange swap and outright forwards markets. There are several reasons for this. Cross-currency basis swaps normally have longer maturities than foreign exchange swaps. Counterparties must therefore raise more long-dated NOK funding or convert short-dated NOK funding. In addition, there are credit rating standards for the counterparties that mortgage companies can enter into cross-currency basis swaps with. This limits the number of available counterparties. Counterparties also increasingly price in risk factors associated with being a counterparty to a cross-currency basis swap with a mortgage company, such as the fact that mortgage companies do not post margin over the term of a cross-currency basis swap (under *unilateral margin agreements*). This affects the availability and the cost of entering into cross-currency basis swaps for mortgage companies. The volume of mortgage company foreign currency bond issues is often substantial, and they need to be able to swap

for NOK quickly. This periodically results in a considerable volume of one-way transactions and low market liquidity (see Chart 13).

Chart 13 Bid-ask spreads on 5-year cross-currency basis swaps. From USD to NOK. Basis points. Daily data. January 2008 – December 2013



Implications for maturity transformation in NOK
Foreign exchange swaps and outright forwards normally have short maturities and counterparties to these contracts will, in isolation, contribute little to maturity transformation in NOK, even though they have borrowed NOK at short maturity. If banks utilise these instruments to fund long-term NOK lending, they will themselves account for most maturity transformation in NOK. Under cross-currency basis swaps with the same maturity as the foreign currency funding, the swap counterparty will account for more of the maturity transformation in NOK. If the counterparty has funded with short-dated borrowing, in the most extreme case overnight, the swap counterparty will account for all of the maturity transformation. However, if the counterparty has funded the NOK it will pay under a currency swap with long-dated borrowing, the maturity transformation in NOK will take place with the counterparty to that counterparty.

Overall, foreign currency funding of Norwegian residential mortgages, primarily by means of covered bond issuance, likely accounts for a relatively more substantial share of the maturity transformation in NOK by counterparties outside the Norwegian banking system than foreign currency funding of other kinds of lending. Nevertheless, to the extent Norwegian entities are counterparties to long-dated cross-currency basis swaps, the manner in which they mitigate risk will determine where maturity transformation will take place. If banks reduce portions of this risk by using short-

dated currency swaps, a larger proportion of the maturity transformation and associated risk will take place in the Norwegian banking system.

Concentration risk in the Norwegian banking system

There are only a few Norwegian banks with the capacity and risk management framework to be a counterparty to currency swaps. These banks are usually the same banks that are active in international markets and that are correspondent banks⁸ for foreign banks that are active in NOK. Thus, currency swaps may help to increase these banks' market power, increasing the concentration risk associated with them.

Intra-group currency swaps

Mortgage companies that issue foreign currency bonds can mitigate interest rate and foreign exchange risk by entering into intra-group cross-currency basis swaps with the parent bank. This allows the bank to net the mortgage company's position against the bank's other positions to reduce the group's total risk exposure to external entities. If risks associated with the mortgage company's foreign currency funding are not mitigated through the use of cross-currency basis swaps, the banking group may still be exposed to liquidity risk associated with issuing covered bonds in foreign currency, despite that fact that the mortgage company is fully hedged and meets statutory requirements.

2.3 How can the system be made more resilient?

In view of banking groups' funding strategies, currency swap markets are a key component of the financial system. Financial stability will therefore depend on these markets' resilience and accessibility even in periods of market turbulence. It is likely that reducing risk associated with banking groups' use of currency swaps can make the financial system

more resilient. While banking groups largely mitigate these risks already, there may still be refunding and liquidity risk associated with the maturity mismatch between the NOK they obtain under swap contracts and the NOK-funded assets. The financial system can also be made more resilient by enhancing the resilience of currency swap markets or by reducing the scope of foreign exchange funding of NOK assets.

2.3.1 Currency swap markets

Counterparties to currency swaps

Market participants with a need to exchange currencies in the opposite direction are natural direct counterparties to banking groups' currency swaps. Life insurance companies and pension funds are examples of market participants that invest domestic savings in long-dated foreign currency assets. They primarily use short-dated currency swaps as foreign exchange hedges for their investments. A move to longer-dated currency swaps may mean that life insurance companies and pension funds will assume a greater share of maturity transformation in NOK. This may improve the availability of long-dated currency swaps for Norwegian banking groups.

Nevertheless, there are other reasons why long-dated foreign exchange hedges might not necessarily be more attractive to life insurance companies and pension funds. Currency swaps with short maturities allow for greater flexibility in adjusting investments compared with long-dated cross-currency basis swaps, for example.

As is the case for life insurance companies and pension funds, other market participants with a need to exchange NOK for foreign currency will be natural providers of NOK under long-dated currency swaps. Foreign entities that issue NOK bonds, but that wish to swap for another currency, will be banking groups' natural counterparties to long-dated currency swaps.

Limiting the use of intra-group counterparties to cross-currency basis swaps by mortgage companies may reduce the liquidity risk and

⁸ I define correspondent bank as a bank that settles trades and invests liquidity in NOK on behalf of market participants that do not have access to a krone account with the central bank.

concentration risk in a particular banking group.

Well functioning NOK markets and a well capitalised banking system

Vulnerabilities in the currency swap markets also depend on the counterparties to currency swaps. As mentioned in Section 2.2, foreign banks are important counterparties. They may be more vulnerable than Norwegian entities to shortages of NOK funding. If access to or the price of NOK is deemed to be an uncertainty factor among foreign entities, this may spread to currency swap markets. This, in turn, can affect the supply of and terms for Norwegian banking groups' currency swaps. Confidence in Norwegian interbank rates and a well functioning NOK market are therefore fundamental to a resilient currency swap market. Access to the central bank lending facilities in NOK by foreign banks that are active counterparties to currency swaps may also conceivably help to bolster the resilience of currency swap markets. This, in turn, may reduce the concentration risk in the largest domestic banking groups.

Foreign entities' assessments of the risk of having Norwegian banks as counterparties will be an important factor for the terms they offer Norwegian banks under currency swaps. This may affect the number of counterparties available to Norwegian banking groups as counterparties to currency swaps as well as swap maturities and terms. A well regulated and well capitalised banking system will be a positive contribution in such an assessment.

Resilient financial infrastructure

Today, banking groups can reduce the counterparty risk associated with currency swaps via the financial infrastructure. Use of bilateral margin agreements and settlement through CLS can substantially reduce the counterparty risk linked to these transactions (see Box 3). Nevertheless, there are several areas where the financial infrastructure can probably contribute further to reducing this risk.

Increasing the share of foreign exchange trades settled through CLS, by including more

currencies and instruments and by increasing the number of system participants, may further reduce the settlement risk associated with these trades. The largest Norwegian market participants are currently members of CLS, either directly as settlement members or with third-party access provided by a settlement member. CLS also offers settlement with finality in the most important currencies for Norwegian banking groups. Norwegian banking groups may be able to further mitigate the risk associated with foreign exchange trades if CLS offers settlement of more types of instrument than it does currently.

Today, Norwegian banking groups primarily use bilateral margin agreements, called credit support annexes (CSAs), to mitigate counterparty risk in foreign exchange derivative contracts. Even so, the G20 decision of 2009 and the incorporation of the European Market Infrastructure Regulation (EMIR) into the EEA Agreement will likely result in a requirement for liquid and standardised derivatives to be settled through central counterparties. It is still somewhat uncertain when all the formalities will be in place and whether the rules will apply to all types of derivatives and all market participants. Nevertheless, by using CSAs, banks reduce the counterparty risk associated with derivatives contracts today, and it is not clear that central counterparties will make a further contribution in this regard.

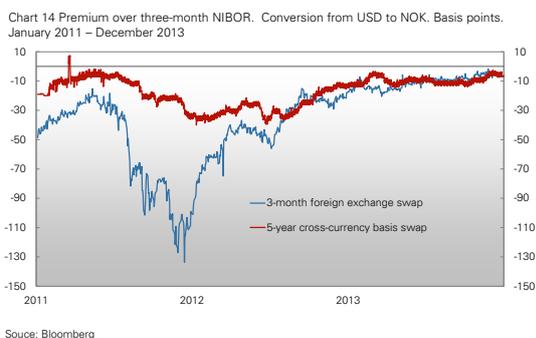
2.3.2 Reduced foreign currency funding of NOK assets

Vulnerabilities associated with banking groups' funding strategies may also be limited by reducing the extent of foreign currency funding of NOK assets.

Maturity of currency swaps and liquidity regulation

As discussed in Section 1, a number of factors influence banks' choice of maturities for currency swaps. Costs can also be one such factor. For periods there may be a considerable differential in funding costs in NOK between using a short-dated foreign exchange swap to hedge a long-dated foreign

currency liability and using a long-dated cross-currency basis swap (see Chart 14). This may induce banks to choose a shorter maturity for their foreign exchange hedges that they would otherwise. All else equal, they will thereby assume a higher liquidity risk in NOK. One reason for this may be that Norwegian banks assess the risk associated with maturity transformation in NOK as lower compared with foreign entities. Access to liquidity facilities in NOK may influence such an assessment. A different assessment of this risk might have led banks to choose to obtain more long-term funding in NOK or choose longer maturities for their currency swaps. This would have made them less vulnerable to turbulence in the currency swap markets.



The quantitative liquidity standards introduced under Basel III/CRD IV are intended to regulate the liquidity risk that banks can assume. Under the liquidity coverage ratio (LCR), banks are required to hold liquid assets sufficient to meet their liquidity needs for a 30-day liquidity stress scenario. Under the definition of the LCR, the currency of liquid assets is required to match the currency of the institution's liquidity needs. Costs related to holding such a liquidity buffer may thus make it more attractive to increase the maturities of currency swaps and make it relatively more advantageous for banks to raise more long-term NOK funding.⁹

⁹ In theory, the cost associated with holding a liquidity buffer stems from the fact that assets approved for inclusion in the liquidity buffer have a lower credit and liquidity risk than the bank. The bank's funding cost, all else being equal, will then be higher than the return on the assets in the buffer, and the bank has a "cost of carry" associated with holding the liquidity buffer.

For currencies with limited availability of liquid assets relative to liquidity needs in the banking system, three alternative liquidity approaches (ALAs) have been outlined in the amended presentation of the LCR (see Basel Committee on Banking Supervision (2013)). NOK may be approved as a currency that is eligible for an ALA. Nevertheless, the scope and costs associated with such alternative approaches should be viewed in the context of banks' ability to reduce liquidity needs in other ways, such as e.g. increasing the maturity of currency swaps.

A more liquid NOK bond market

A larger and more liquid Norwegian bond market may reduce the liquidity premium investors require for investing in NOK bonds. Thus, measures to improve the liquidity of the Norwegian bond market may contribute to a lower liquidity premium on Norwegian bonds, with banks thereby finding it more attractive to issue NOK bonds.

Recently, bond issuance by Norwegian non-financial enterprises has increased substantially. Some of this increase is because enterprises that previously borrowed from banks have preferred, for various reasons, to issue bonds. This reduces the need for banking groups to issue bonds to fund corporate loans, while broadening the set of Norwegian bond issuers. In the Norwegian market, fewer investors may thus be bound by exposure limits to individual market participants, and a larger share of total bond issuance could be in NOK. This could, all else being equal, contribute positively to the liquidity of the Norwegian bond market.

3. Summary

Norwegian banking groups choose to fund lending in NOK by borrowing in foreign currency. This strategy makes currency swap markets a key element of the financial system. Financial stability will therefore depend on banks mitigating risks associated with *currency mismatches* and on the resilience of currency swap markets to market turbulence. To the extent Norwegian banks use short-dated

currency swaps to hedge long-dated lending, this means that banks are assuming greater liquidity risk in NOK than warranted by the maturity of their funding. If banks price this risk too low from an economically optimal standpoint, it is possible that they will raise more foreign currency funding than is economically optimal. The final formulation of the LCR and the role of the central bank as lender of last resort may influence bank's choice of currency hedging strategies. Measures that can induce banking groups to raise more of their funding in NOK could also reduce the vulnerabilities associated with banking groups' use of currency swaps.

Appendix

Outright forwards

An outright forward is a contract to purchase or sell a stated amount of currency at an agreed rate on a certain future date. The forward rate is determined on the basis of the spot rate on the inception date and the interest rate spread between the currencies. With this kind of contract, the size of the exposure will not be affected by fluctuations in the exchange rate, since this remains fixed over the term of the contract. Thus, outright forwards can be used by market participants seeking to avoid foreign exchange risk associated with liabilities or claims in foreign currency that fall due at a stated future date, but they can also be used by market participants whose view differs from the market view of future exchange rate developments and who wish to take a position on this basis.

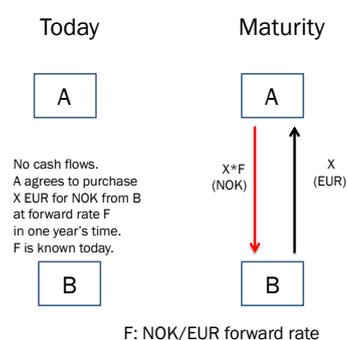
Example:

The chart below illustrates how an outright forward functions. Party A will need to make a payment in EUR in one year's time. To ensure that he has EUR on the due date, the participant can purchase EUR for NOK under an outright forward contract with settlement in one year's time. The forward rate will reflect the expected interest rate spread between the

two currencies over the contract term and can be expressed by the formula:

$$F_{0,t} = S_0 * e^{(interest\ NOK - interest\ EUR)t}$$

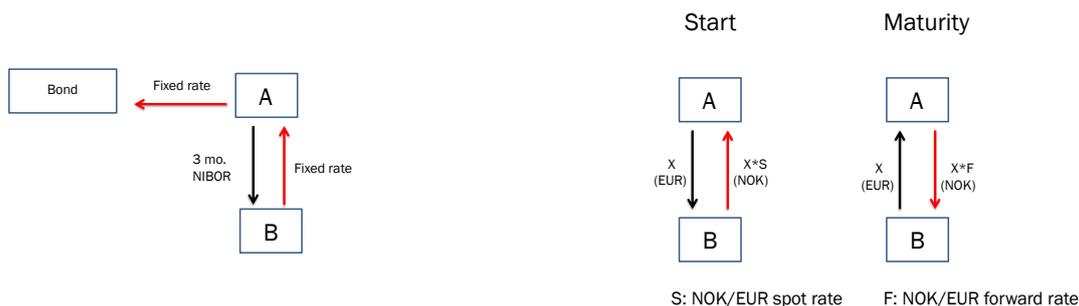
where F stands for the forward rate, S stands for the spot rate. 0 is the inception date, while t is the termination date. For example, if the EUR/NOK spot rate is 7.50, the one-year NOK interest rate is 1.5 percent and the one-year EUR interest rate is 1 percent, the 1-year forward rate today will be NOK 7.54/EUR 1.00.



Interest rate swap

An interest rate swap is an agreement between two parties to exchange periodic interest payments with different characteristics. In the most common form, a floating interest rate is swapped for a fixed rate, or the reverse.

A bank that issues a bond with a fixed rate, but that wishes to pay a floating rate, can enter into an interest rate swap (see Chart below). Under the contract, the bank will receive a fixed rate and pay a floating rate. The fixed rate on the bond corresponds to the fixed rate received under the swap. The bank ends up paying a floating rate equivalent to what it would have paid if it had issued the bond at a floating rate.



Currency swaps

Foreign exchange swaps

A foreign exchange swap is an agreement to exchange an amount in one currency for an amount in another currency and at the same time enter into a binding agreement with the right and obligation to re-exchange the amounts on an agreed future date. The amounts delivered by the parties are based on the current spot rate, and the notional principal remains fixed until the currencies are re-exchanged at the agreed closing rate. The agreed closing rate is often the current forward rate for the maturity date.

By entering into this kind of contract with the same maturity as a loan, a party will avoid gains and losses associated with exchange rate movements between the loan origination or bond issue date and the maturity date. Foreign exchange swaps are suited to parties intending to make an investment or borrow in a foreign currency and who do not wish to incur exchange rate risk.

The chart below shows how a foreign exchange swap functions. Party A has borrowed an amount in EUR, but needs to swap this for NOK by entering into a currency swap. On the inception date, party A lends EUR X to party B and receives the equivalent amount in NOK ($X \cdot S$), where S is the NOK/EUR spot rate. At maturity, party B will return EUR X euro to party A, while party A returns NOK $X \cdot F$ to party B, where F is the exchange rate agreed by the parties at inception (as a rule, the forward rate for the maturity date is at inception).

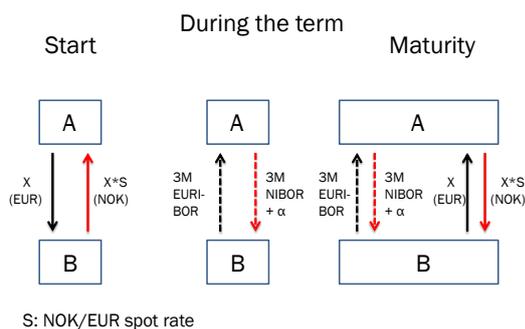
Cross-currency basis swaps (combination interest rate and currency swaps)

A cross-currency basis swap is a combination interest rate and currency swap under which the parties lend each other an agreed amount in two different currencies and, in addition, exchange interest payments over the term of the contract. The exchange rate is normally the spot rate at inception, both at the inception of the swap and at maturity. The interest rate on the NOK loan is normally set equal to three-month NIBOR with a premium, while the rate on the foreign currency loan is set equal to the corresponding money market rate for that currency (three-month LIBOR for USD or three-month EURIBOR for EUR).

By entering into a combination interest rate and currency swap with the same maturity as a loan or bond, the parties will avoid gains and losses associated with exchange rate movements between the loan origination or bond issue date (the date the investment is made) and the maturity date. These contracts are suited to parties intending to make an investment or borrow in a foreign currency and who do not wish to incur exchange rate or interest rate risk.

The chart below shows how a cross-currency basis swap functions. Party A has borrowed an amount in EUR, but needs to swap this for NOK by entering into a currency swap. On the inception date, party A lends EUR X to party B and receives the equivalent amount in NOK ($X \cdot S$), where S is the NOK/EUR spot rate at the inception date. Over the term of the contract, the parties will exchange interest payments. Party A will receive payments at a

EUR interest rate (normally three-month EURIBOR) and pay a NOK interest rate (normally three-month NIBOR) plus a premium α to party B. α is the price of the swap, which was agreed between the parties at the start of the contract. Thus, what the Norwegian bank pays net is NOK interest as if it had borrowed in NOK. At maturity, party B will return EUR X to party A, while party A returns NOK $X \cdot S$ to party B.



The price of the swap, or the premium, α , can be decomposed into various subcomponents. As discussed by inter alia Tuckman and Porfirio (2003) and Flavell (2009), the premium can be decomposed as follows:

1. *The difference in risk premiums on the money market rates exchanged under the swap*

The difference between the three-month money market rate and the expected policy rate for the next three months is an expression of the money market risk premium for a three-month maturity.

Under a cross-currency basis swap between e.g. EUR and USD the difference in risk premiums in the two money market rates will be compensated for. This is because banks have to pay the risk premium they themselves qualify for. If the risk premium in the EUR money market rate is higher than the risk premium in the corresponding USD money market rate, the premium under the cross-currency basis swap will compensate for this. One possible interpretation is that the bank that holds USD which it lends while receiving

EUR under the cross-currency basis swap, on the basis of the risk premiums in the money market rates in the two currencies, will pay less to borrow EUR compared with what is reflected in the risk premium in the EUR money market rate. Alternatively: the bank seeks extra compensation for lending USD to a counterparty with, all else being equal, a higher counterparty risk than US banks and the risk reflected in the risk premium in the US money market rate.

2. *Distortions in the short-term foreign exchange market*

Such distortions can be expressed by the OIS (overnight index swap) basis. The OIS basis expresses the deviation of the OIS rate from covered interest parity. As long as covered interest parity holds, the OIS basis is zero, but if the forward rate does not compensate for the difference in OIS rate between two currencies, the OIS basis will deviate from zero. For example, a shortage of USD in the market will result in a higher implicit cost for USD for banks that wish to use another currency to obtain USD. The implicit USD rate (the swap rate via another currency) will then be higher than the USD OIS rate, and the OIS basis between USD and the currency in question will not be zero. Under a cross-currency basis swap between USD and EUR, this will translate all else being equal, into a premium on the USD rate that European banks will have to pay to obtain USD. This difference will be reflected in the premium in the cross-currency basis swap.

3. *Imbalance between the supply of and demand for cross-currency basis swaps*

Supply and demand effects related to cross-currency basis swaps can also influence the premium in the short term. This applies in particular to markets between currencies where liquidity is thin and there is periodically a substantial need to exchange currencies in one direction. An example of this may be a Norwegian

mortgage company that has obtained a considerable volume of funding in foreign currency that it needs to exchange for NOK.

Margin calculation for derivatives

The margins that parties post to each other to reduce counterparty risk associated with derivative contracts normally takes the form of cash or other highly liquid financial instruments. According to Fitch (2013), the size of the margins can be expressed by the following formula:

$$\text{Max } [0; MV+(LA*VC*X*P)]$$

- MV = Market value of the derivative contract.
- LA = Liquidity adjustment, which takes into account the liquidity of the derivative concerned. A low liquidity derivative will typically have a higher margin requirement, since its replacement cost will be higher, all else being equal, than a more liquid derivative.
- VC = Volatility cushion, which takes into account any changes in market

value before the next margin payment. The higher the volatility of the market value, the greater the risk of a substantial change in the market price before the next margin payment and the higher the margin requirements will be.

- X = Factor that reflects counterparty risk associated with the relevant counterparty. This may be based, for example, on the counterparty's credit rating. The higher this factor is, the greater the risk that the counterparty will fail to fulfil its contractual obligations.
- P = Notional principal or value of the underlying on which the derivative contract is written.

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