# The Norwegian financial bond market

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## Abstract

In this paper, we examine the Norwegian financial bond market, i.e. the market for bonds issued by Norwegian banks. We describe the market by characterizing the market participants in the different securities on both the supply side and the demand side. The main contribution of the paper is analyzing the price formation processes, and modeling spread compositions of senior and subordinated bank bonds. We examine relations between explanatory variables and bond spreads at various quantiles of the distribution of the dependent variable, using quantile regression. Being able to fully explain the entire distribution of credit spreads, we find that relations between the dependent and explanatory variables are stronger at the tails of the distributions of the dependent variables, than closer to the median.

*Key words*: Financial bonds, credit spread composition, financial risk factors, quantile regression models.

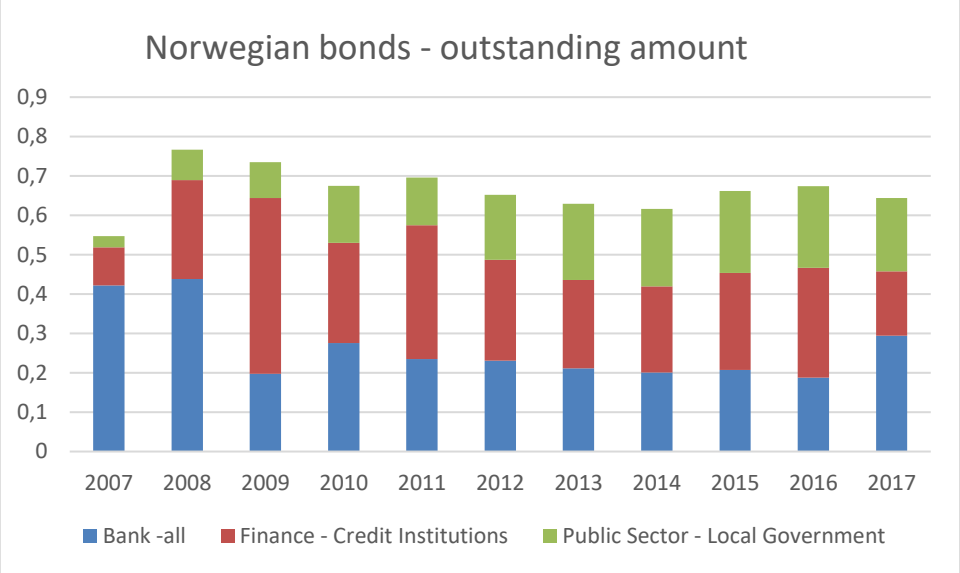
# The Norwegian financial bond market.

## 1. Introduction.

In this paper we explain and model the generic drivers of credit spreads of financial bonds in the Norwegian fixed income market. This is important information for investors, traders, analysts and researchers alike.

The Norwegian financial bond market has its own genuine traits both on the supply- and demand side. On the demand side (from the perspective of the investors), it is dominated by a few major institutional players, and on the supply side the market consists of approximately 125 different issuers. As illustrated by figure 1, the domestic banks and covered bond companies owned by the banks (Finance and Bank) are by far the most important issuers in the Norwegian bond market. The banks are of highly varying size in terms of assets denominated in Norwegian currency and belong to different risk categories, issues we will discuss later in this paper.

Figure 1. Outstanding amount in the Norwegian bond market exclusive sovereigns, share of total main issuers. Source: Stamdata.




It is reasonable to expect that this particular market structure must have an impact on the price mechanism itself, and on the magnitude and possibly on the behavior of credit spreads. The rest of the paper is organized as follows: In section 1.1 we look at some related work on modeling credit spreads. Section 2 outlines the most important legal statutes that regulates Norwegian financial institutions. Section 3 characterizes the players on the supply and demand side of the Norwegian financial bond market. Section 4 discusses banks the need to fund their balance sheets abroad. Section 5 explains the price formation processes in this market. Section 6 discusses compositions and particularly drivers of spread compositions of Norwegian senior and subordinated financial bonds. Section 7 describes our regression model approach, and reports results from running quantile regressions on time series data for senior and subordinated financial bonds spreads. Section 8 concludes.

## A brief look at the literature

Few authors have examined spreads on senior and subordinated bank bonds in the Norwegian market. Valseth (2017) analyses liquidity in the Norwegian government bond market, considering different aspects and drivers of this variable. Historically liquidity in this market has been poor, mainly because of low supply. The Norwegian government does not rely heavily on debt funding due to its enormous oil-related financial wealth. Still Valseth finds that supply and liquidity in the Norwegian government bond market has improved in the 2000s, although it dropped during the financial crises. Bremnes et. al (2001) examine relationships among short term and long term interest rates in the United States, Germany and Norway, using a cointegration methodology. They find that US interest rates have a large influence on both Norwegian and German interest rates, illustrating the close linkage between US and global fixed income markets. According to the authors, the reverse effect was modest. These studies give valuable insight and guidance, however they do not explicitly address the modeling of credit spreads in the Norwegian bank bond market.

Internationally, credit spreads, their components and underlying drivers, have however been extensively examined in the literature from a variety of angles using linear regression models, often testing or referring to an underlying financial theory like Merton's (1974) theory of asset pricing. Theory often suggests the following generic drivers for credit spreads: Interest rates, equity prices and equity volatility (see Alexander (2008) for examples). We shall report results from using these and other proxies for underlying generic drivers of financial bond spreads in the Norwegian market in section 7 of this paper. Jarrow et al. (1997) estimate a Markov model for the term structure of credit risk spreads. We do not consider the term structure as such, but look at 5 years duration senior and subordinated financial bonds. Murphy and Murphy (2010) examine the determinants of European credit default swap (CDS) spreads and corporate bond spreads. Employing principle component analysis they find that a single factor, either implied aggregated volatility (VIX) or forecasted (GARCH) idiosyncratic volatility, accounts for more than 80 percent of the variation in spread changes.

Van Landschoot (2004) studies determinants of the euro term structure of credit spreads. She identifies (among other variables) equity volatility, yield curve slope and market return on the bonds as explanatory variables for bond spread changes. Her study is in line with our research, although she does not consider the distribution of the dependent variable, only its mean.

Weigel og Gemmill (2005) use bond prices to study how the credit worthiness of Argentina, Brazil, Mexico and Venezuela is influenced by global, regional and country specific factors. Although not the authors' intention, this is an interesting perspective from which to study what influences bond prices and spreads. They estimate each country's distance to default monthly, and find that a small set of variables are able to explain 80 percent of the variance of the distance to default variable. The largest part of the variance (about 45 percent), is explained by regional factors, which relate to joint stock market returns and volatility. Global conditions, related mainly to US stock market returns, explain another 25 percent of the variance in the distance to default variable, whereas country specific factors only account for about 8 percent of the variance. Analogously, in our models we use US equity volatility, i.e. the Vix, as an explanatory variable for Norwegian bond spread variance.

Huang and Huang (2012) show that credit risk accounts for only a small fraction of yield spreads for investment-grade bonds of all maturities, but accounts for a much larger fraction of

yield spreads for high-yield bonds. In the context of our analysis, this would mean that credit risk is more important to spreads on subordinated bonds than to senior banking bond spreads. This could partly explain why a typical cash flow variable like the slope of the yield curve, according to our findings, is a driver of spread volatility of subordinated bonds but does not seem to matter for senior banking bond spreads. We discuss this issue further in section 7.

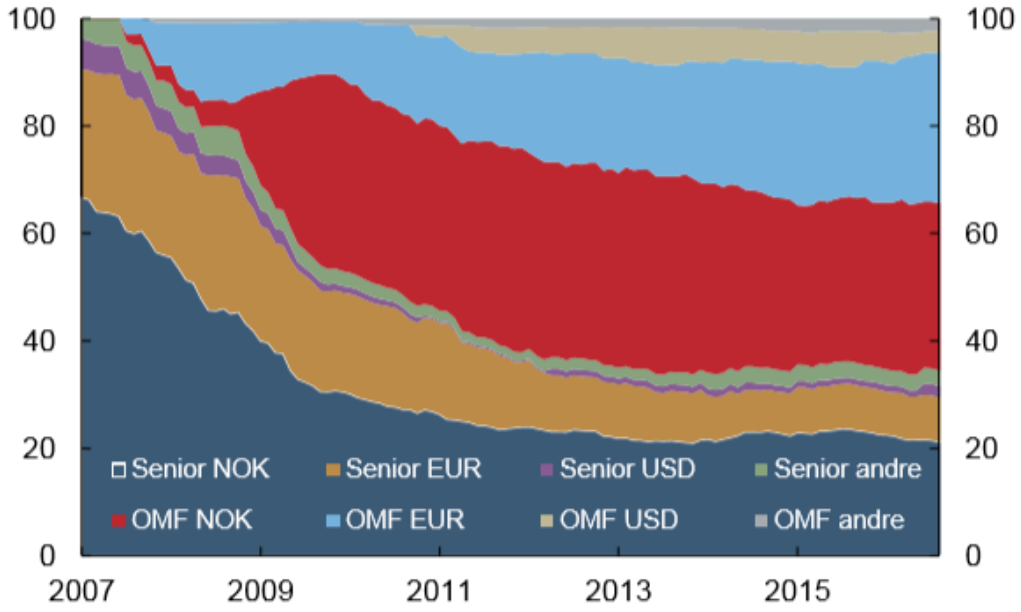
In the next section we identify and characterize the players, discuss the most important statutory regulations, and describe the workings of the market as it is experienced by the market participants. We explain how the legal statutes are key determinants of the banks' balance sheet composition. We will then in section 7 examine monthly time series data for senior and subordinated Norwegian financial bond spreads between 2003 and 2016, in order to find out if the data supports the alleged workings of the market, i.e. the price processes and risk factor compositions perceived by the market participants.

## 2. Institutional changes

The decade between 2000 and 2010, saw two important institutional changes in the Norwegian financial bond market. Prior to the financial crisis (2008 - 2009), Norwegian banks were heavy buyers of senior bank bonds, i.e. they were the major buyers of other banks top rated bonds. If there is a default, holders of senior bonds will have priority access to the remaining assets, which means the senior bonds are the safest among the assets in the capital structure; they have seniority. In 2008 and 2009 Norwegian bank legislation was changed, and banks could no longer deposit other bank's senior bonds as collateral when obtaining funds at the Norwegian central bank (Norges Bank).

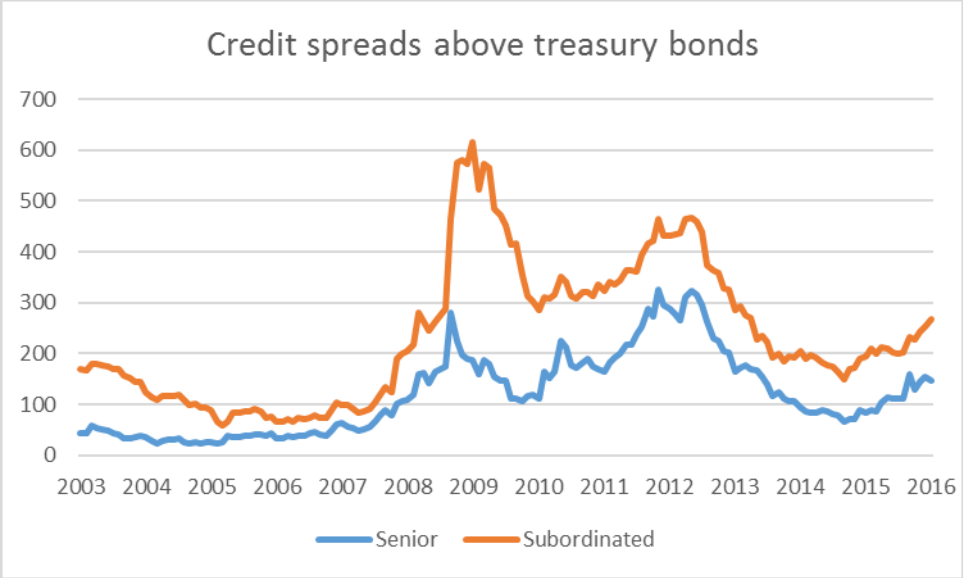
The rationale for this more restrictive legislation was to accommodate the central bank's need to diversify its balance sheet risk. When a Norwegian bank is permitted to use bonds issued by another Norwegian bank as collateral, for instance to facilitate the money market operations of the central bank, it might equally well have issued these bonds itself. Why? Because banking risk, from the perspective of the central bank, is synonymous with banking *sector* risk, i.e. *system* risk. Prior to the legislative change Norwegian banks owned approximately 20 percent of outstanding domestic senior financial bonds. During the last few months leading up to the change, a substantial portion of existing senior bonds were converted to «hold to maturity» bonds[1], to avoid an instant fire sale and severe mark to market losses because of deteriorating liquidity resulting from the legislative change.

Figure 2.1. Outstanding bond financing of Norwegian banks: Senior and covered bonds, share of total bonds. Note: Subordinated bonds are considered share of the banks'equity capital. Source: Norges Bank, Financial Stability Report, 2016.




In the immediate aftermath of the legislative change, as figure 2.1 illustrates, the banks' demand for senior financial bonds clearly decreased. Consequently the banks, who used to be both issuers and huge investors, lost impact on the market price of these securities, while other more distant investor groups gained impact on the price. When the banks were considering buying other, more or less similar, banks' securities, they were in a relatively comfortable position to perform accurate credit assessments, keeping the risk premium on bank bonds at a reasonably low level. After the change to the legislation, the financial bond market largely consists of investors who by definition are more distant from the banks than the banks themselves. These players require compensation for their information disadvantage compared to the banks, and for their increased *perceived* risk. Accordingly, the level and volatility of spreads on senior bonds have increased following the legislative change (figure 2.2).

Figure 2.2. Credit spreads on senior and subordinated bank bonds




This line of events created the need for alternative funding instruments for the Norwegian banks. As it turns out the new instrument that has risen to prominence is covered bonds, which had already become popular internationally.

When Norwegian and international money market liquidity plummeted during the global financial crises in June 2008, the central banks quickly implemented various emergency policy measures for fixed income markets around the world to alleviate the credit crunch. The Norwegian central bank established an exchange facility, by which the central bank would accept newly issued covered bonds in exchange for treasury securities or government bonds. The banks would either keep these highly marketable low risk securities on their balance sheet, or sell them for cash in the market. Covered bonds are considered low risk because they are backed by underlying pools of high quality residential or commercial mortgages.

The reason why the central bank would create this particular emergency facility was that, from their point of view, the Norwegian money market was suffering from contagion from the US and European money markets. The lack of liquidity did not reflect an underlying weakness in the Norwegian mainland economy. Looking back there is no doubt that the facility did help restore liquidity in the Norwegian money market.

Covered bonds are now a key funding instrument for Norwegian banks, whose debt mix typically consists of covered bonds, deposits and still some senior debt.

### 2.1. Liquidity coverage ratio

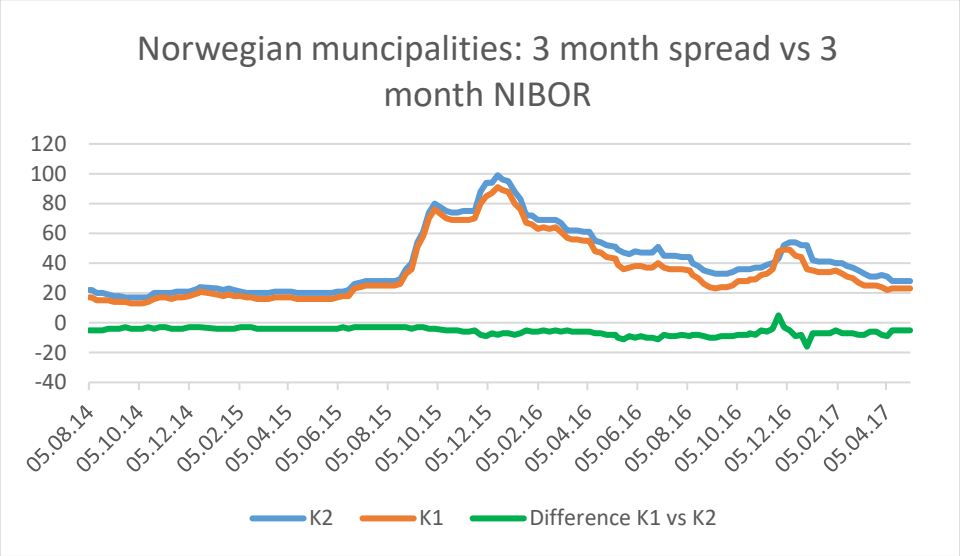
We now explain another important determinant of the banks' balance sheet composition, namely the required liquidity coverage ratio (LCR).

The LCR as it applies to Norwegian banks implies that the banks at any time should keep a liquidity buffer, the size of which must always equal net cash outflow over a period of 30 days denoted the "stress period". This translates into keeping a portfolio of liquid assets accounting for 100 percent of net cash outflow during the stress period. The LCR is gradually coming into effect; the portfolio of liquid asset should cover 70 percent of net outflow by 31. December 2015, 80 percent by 31. December 2016, and 100 percent by 31. December 2017.

Institutions thought to be of systemic importance, i.e. too big to fail, must however comply with the LCR requirement by 31. December 2015. In Norway only three banks are classified as crucial to the stability of the banking system: DNB, Nordea and KBN Kommunalbanken. These banks face an even more demanding LCR requirement in terms of the quality of assets that are accepted in the portfolio of liquid assets: The LCR-assets must be *highly* liquid. In the Norwegian fixed income market highly liquid assets are: Treasuries, state guaranteed assets and *covered bonds* with outstanding nominal volume in excess of 4 billion NOK. Part of the portfolio (not exceeding 40 percent), may also be invested in other types of securities like covered bonds with outstanding volume between 2-4 billion NOK, and municipal bonds.

When analyzing the market participants in the next section, we do not include KBN Kommunalbanken because its operations do not affect the bond market explicitly. Should however KBN suspend buying bonds from the municipalities for a prolonged period of time (for instance due to stricter capital requirements), municipal credit spreads will increase as will most other bond spreads. The figure below shows this effect on municipal spreads, which increased sharply during the spring of 2015 in response to KBN becoming less active in the bond market, and did in fact stay elevated until early 2016 when KBN reentered the market.

Figure 2.3. Municipal bond spreads




We now discuss the market participants in the various instruments in the Norwegian financial bond market, starting with the demand side.

## 3. Market participants

We characterize the players on the demand and supply side in terms of who trades in the different financial instruments, leaving deposits aside.

### 3.1. The demand side

*Senior financial bonds*: Life insurers, pension funds, casualty insurers, asset managers, family offices and banks. However as we noted above, banks tend to hold far less of other banks' senior bonds than prior to the financial crises. The reduced demand for senior financial bonds amongst banks is also partly due to the required liquidity coverage ratio (LCR), which we explained earlier.

*Covered bonds*: Banks, life insurers, pension funds, casualty insurers, asset managers and hedge funds.

Of course different types of players dominate the demand side in the various instruments at different times. In the autumn of 2015 banks were the major investors in covered bonds. The reason was that the Financial Supervisory Authority of Norway (FSA) put forward a proposal regarding the new LCR requirements that called for 100 percent compliance with the standard by the end of 2015. The proposal was later modified to 70 percent, but banks with more assets than 20 billion NOK had already adapted to the proposed rules and bought a huge amount of covered bonds. Later a few Danish hedge funds became very active in this market. In particular two Danish hedge funds were the major players in the Norwegian covered bond market in 2016 and 2017. Typically these institutions will borrow money in the repurchase market (the repo market) at the repo interest rate in order to buy covered bonds, while at the same time depositing these bonds as collateral in the repo market. The repo rate is significantly lower than the yield on covered bonds, and the hedge funds will harvest the spread between the yield on the covered bonds and the repo rate, these trades being of course key to their business models.

*Subordinated bonds:* life insurers, pension funds, casualty insurers, asset managers and hedge funds.

### 3.2. The supply side

Generically the supply side consists of four different categories of institutions:

*The NIBOR banks*

*Other commercial banks*

*The largest loans- and savings banks*

*Smaller loans- and savings banks*

The sell side (supply side) of the Norwegian financial bond market is relatively small and transparent, consisting of 125 banks in total. This number includes 106 loans- and savings banks of considerably varying balance sheet size, and it further includes 19 commercial banks.

The largest banks are the NIBOR banks. Some of these are of systemic importance. The Norwegian interbank offer rate (NIBOR) is established by a small number of so called panel banks. This theoretical reference interest rate (theoretical meaning that you cannot trade at it), is calculated as a simple arithmetic mean of the actual interest rates published by each panel bank for different maturities, leaving out the highest and lowest rates. NIBOR rates are quoted with maturity 1 week, 1 month, 3 months and 6 months. Currently the panel banks, or NIBOR banks, are: DNB Bank ASA, Danske Bank, Handelsbanken, Nordea Bank Norge ASA, SEB AB and Swedbank.

These banks vary considerably in terms of balance sheet size, i.e. the size of their loan books and asset portfolios denominated in NOK. DNB is by far the largest bank in the Norwegian market, being almost four times larger than the second largest bank, which is Nordea Bank. Among the loans- and savings banks, there are many small players with relatively modest sized loan books. These banks rely mainly on deposit financing.

The last few years have also seen the creation of banks like Bank Norwegian, specializing in extending unsecured consumer credit to Norwegian households. These banks are new kinds of players in the domestic financial market, and they rely heavily on deposits to finance their business models, but they are also issuing some bonds. Typically, the consumer credit banks are offering top of the chart deposit rates, and are often charging provocatively high interest rates on consumer loans. The heavy growth of unsecured consumer credit to Norwegian households over the last 10 years, is by many considered a risk with the potential to threaten financial stability in the Norwegian economy (de Lange and Reite, 2017).

Figure 3.1. The banks by balance sheet size

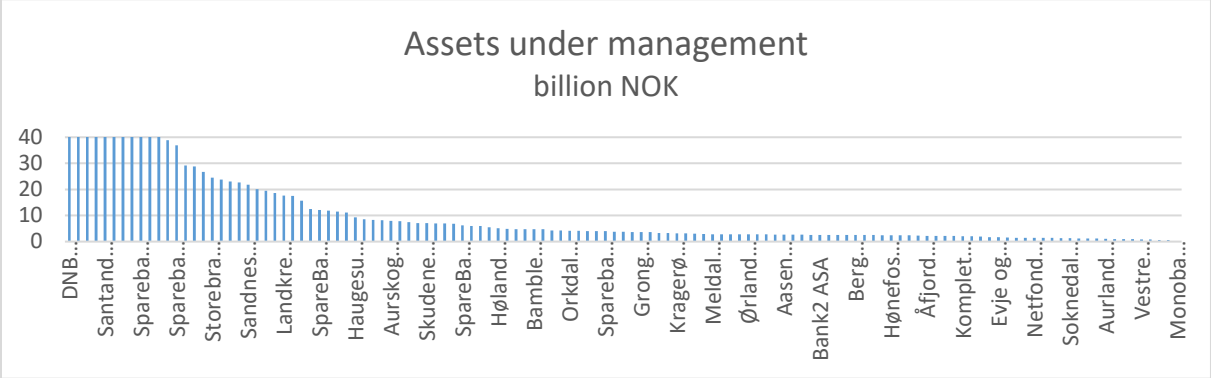
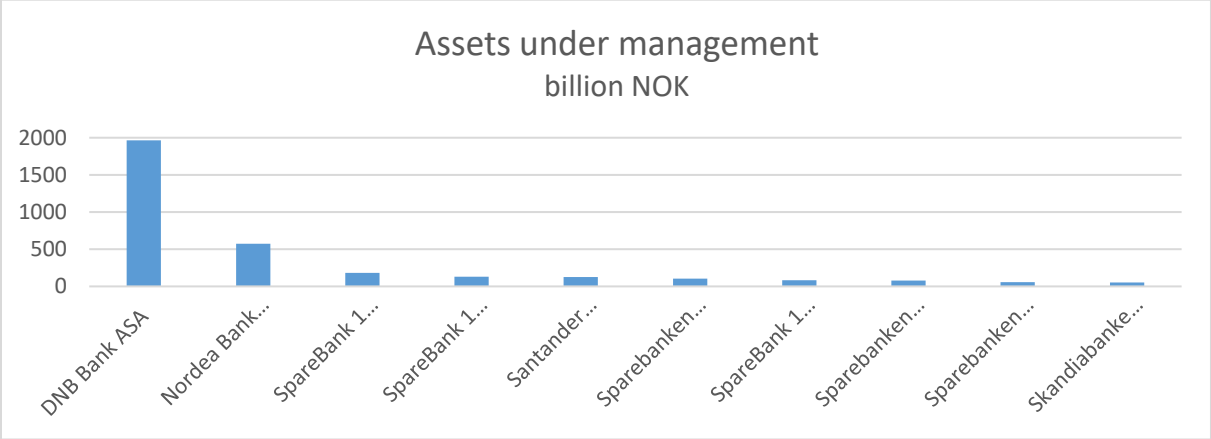



Figure 3.2. The 10 largest Norwegian banks




As of January 2nd 2017, Nordea Norway is a subsidiary of Nordea Sweden.

We mentioned in section 2 above that covered bonds are now an important source of funding for Norwegian banks. Not all companies may issue covered bonds, however. Only companies classified as credit institutions are permitted to issue such bonds, and these companies are typically owned by the largest banks and are in effect *vehicles* for managing portfolios of high quality mortgages. In Norway there are twenty five such companies; twenty two of them own residential mortgages, and the remaining three manage commercial mortgages. Mortgages are of course considered low risk assets, and consequently the credit institutions, i.e. the banks, may source cheap funding by issuing covered bonds. This mechanism has of course reduced the quality of the banks' remaining assets, implying a higher risk premium on the core banks' assets.

## 4. International funding of Norwegian bank balance sheets.

Prior to the financial crisis, Norwegian banks relied primarily on domestic funding. Because global financial investors did not know the Norwegian banking sector particularly well, risk premiums on senior and subordinated bonds issued abroad would be prohibitively high. This situation meant that the banks were heavily dependent upon a "handful" of large domestic institutional investors. Obviously the banks had long preferred to fund a fraction of their balance sheets abroad, i.e. diversify, and when they started issuing covered bonds after the crises, this opened up a whole new global funding market for them. Covered bonds had already a strong reputation internationally, and these securities would be purchased by foreign investors even if issued by relatively small Norwegian banks. This also meant that gradually the international investment community became familiar with the Norwegian banking sector, and the largest banks can now issue senior bonds abroad.

### 4.1. Strategy utilized when Norwegian banks obtain funding in foreign currency

When issuing bonds abroad denominated in foreign currency, Norwegian banks will typically prefer exposure to a *floating* domestic interest rate, and to achieve this they will need to construct a "hedge portfolio" including a basis (currency) swap contract. The strategy works as follows: Assume that initially a domestic bank has issued a fixed interest rate bond denominated in EUR. The bank must now short sell (write) a fixed interest rate swap contract (with corresponding nominal amount to the bond) denominated in EUR. To offset the short swap position, it needs to buy a floating interest rate swap contract also denominated in EUR. Depending on the maturity of the swaps relative to the bond, these trades will typically leave the bank exposed to a floating three or six month Euribor interest rate plus a risk premium (RP). Finally in order to convert its exposure from EUR to NOK, the bank must enter into a EUR/NOK basis swap. It will then pay 3 (or 6) month floating NIBOR plus a risk premium in the basis swap, plus a risk premium on the nominal amount of the bond it originally issued in EUR. To summarize:

(+) Issue a *fixed* interest rate bond in EUR

(-) short a fixed interest rate swap contract in EUR

(+) long a *floating* interest rate swap contract in EUR

= exposure to 3 or 6 months Euribor plus a (fixed) RP

(+) long EUR/NOK basis swap

= exposure to 3 or 6 months NIBOR plus a fixed RP plus an *additional* risk premium in the basis swap

The tendency after the financial crises for Norwegian banks to fund a larger share of their balance sheets abroad, and prominently in the EMU, has meant increased significance of the EUR/NOK basis swap, and also the GBP/NOK and US/NOK basis swap. Effectively the basis swap represents the cost of converting a foreign loan into domestic currency. The basis swap includes a risk premium in *addition* to the risk premium of the bond originally issued in foreign currency, to compensate foreign investors (the swap counterparts) for the differential between Norwegian and foreign interest rates.

Typically, monetary policy affect the magnitude of the basis swap spread. For instance, in response to the global financial crises and the subsequent debt crisis in the peripheral Eurozone countries, the European central bank launched massive quantitative easing policy (QEP) measures, providing abundant liquidity and zero interest rates in the Eurozone. The abundant euro liquidity induced American financial institutions to obtain cheap funding in euro, which subsequently was converted into relatively scares US dollar liquidity through the basis swap, causing the premium in the EUR/USD basis swap to soar. In other words: US financial institutions had to compensate their swap (investment bank) counterparts for giving up higher yielding dollars in exchange for zero interest bearing euros.

The widening in cross currency basis swaps can essentially be considered a tax on hedging costs, distorting global capital flows. A potential Fed tightening making US dollar liquidity more scares, which is now considered slightly less likely given the result of the US November 2016 presidential election, will make FX hedging even more expensive counter-intuitively forcing investors to increase, rather than reduce, FX, credit or duration risk.

## 5. Price formation

The financial infrastructure facilitating the price processes in the Norwegian financial bond market, is administered by an agency called Nordic Bond Pricing. The system is neat, but as we will see below, it has its challenges.

Norwegian banks are classified in eight risk categories, based on size and official and unofficial ratings. The smallest banks are those with balance sheets below five billion NOK. These banks belong to category eight, which receives the highest risk premium.

Price *estimates* one week ahead are adjusted weekly and submitted to Nordic Bond Pricing from eight specific investment banks. The weekly price estimates received by Nordic Bond Pricing are *volume weighted* averages based on actual trades in financial bonds, belonging to one of the eight risk categories observed by each investment bank during the week preceding the forecasting period. Obviously, the price estimates also contain some subjective assessments on the part of the investment banks. Future, one week ahead, bond prices submitted to Nordic Bank Pricing thus reflect the views of investors who traded over the last week, combined with the market views (expectations) of the investment banks submitting the prices. Note that the one week forward price estimates coming out of Nordic Bond Pricing may not actually be traded, but will serve as crucial input to investors' investment processes, and as such will influence realized bond prices.

Bond markets are price driven in the sense that brokers (securities dealers) "get on the phone" to find bidders, or investors bid directly on existing securities holdings. When securities dealers construct their one week forward price estimates to be submitted to Nordic Bond Pricing, they will need to review some manageable amount of information. Typically important input to the process will be:

- Prices on newly issued bonds
- Newly realized prices in the (secondary) market
- The investment banks' own knowledge about investors' portfolios, risk preferences, risk tolerance and their need for specific securities
- The investment banks' view of market sentiment, i.e. the overall attitude of investors toward a particular security or larger financial market

- The investment banks will further try to exclude what they believe are internal trades in investors' portfolios. We explain the reason for this below.

Assume that an asset manager changes his view on the yield curve, and needs to reallocate an amount of money between several of his *internally managed* funds, for instance a money market fund and a financial bond fund to adjust portfolio duration. To satisfy auditors such internal trades are "priced on the curve", i.e. the fund manager will use the (theoretical) spreads quoted by Nordic Bond Pricing when disclosing the trades. These transactions as such provide less accurate price signals than "real" transactions between different market participants, and are excluded from the investment banks' price formation processes.

Nordic Bond Pricing, on their part, will evaluate the integrity of all submitted prices. A further challenge to the system is that some banks jump back and forth between categories, especially the most risky ones.

Another aspect of the market dynamics in the financial bond market is a particular investor behavior. Typically institutional investors buy five year duration senior bonds, and keep them for three years harvesting the spread, before they sell them to a broker and buy newly issued 5 year duration bonds all over again. The broker will either warehouse the risk for a year or so, or sell them on to money market funds. Finally senior bonds maturing within a year, are often bought back by the issuing bank.

In this analysis we treat prices and spreads analogously. The price processes described above will naturally drive spreads accordingly, although in the opposite direction. We now turn to the important topic at the center of this paper, which is that of modeling spread compositions in the Norwegian financial bond market.

## 6. Spread compositions

According to financial theory, bond spreads are composed of different risk factors. The most important ones are market risk, default risk, duration or interest rate risk and liquidity risk. When spreads change, the movement is attributable to changes in one or several of the underlying risk factors. Based on our combined 30 years of experience with the Norwegian financial bond market, our hypothesis of plausible *generic drivers* of bond spreads in this market is:

1. Market liquidity
2. The slope of the yield curve
3. Equity volatility, or equity market conditions
4. Residential property market conditions
5. Inflation or inflation expectations
6. Employment conditions

As it turns out, market liquidity is the most difficult variable to model partly because there are so many possible candidates. We consider the risk premium on covered bonds a valid proxy for market liquidity. This is because covered bonds in practice have minuscule credit default risk, and should in theory at least not receive any risk premium. If such a premium can be identified, the underlying driver will typically be a liquidity crunch causing spreads to soar. However, from a modeling perspective covered bonds represent a huge challenge because they are almost perfectly correlated with other financial bonds such as senior and subordinated bank bonds,

which are the main focus of this analysis. Therefore, we cannot regress them on bank bonds. Liquidity wise, these bonds probably have the same underlying drivers as senior and subordinated bank bonds. We therefore need to find an alternative proxy for market liquidity in our structural model. We have tested three different variables.

Our first and equally intuitive liquidity proxy, is the evolution of capital allocated to fixed income fund managers investing in the Norwegian fixed income markets. This "measure" is however not a perfect indicator of "pure" market liquidity, because an increase in funds under management by fixed income fund managers could equally well reflect a reallocation of funds between asset classes motivated by risk assessments. Nevertheless, when fixed income fund managers receive capital they will deploy the funds in the fixed income markets, which leads to stronger liquidity in these instruments. We therefor regard the change in net inflow of capital to fixed income fund managers a possible proxy for liquidity in the fixed income markets.

A second, straightforward and almost obvious alternative liquidity measure is credit extended to non-financial businesses. An increase in this variable should reflect an increase in underlying business activity and transactions volume. Eventually this will lead to an increase in bank deposits boosting overall liquidity in the economy. A fair share of this liquidity will typically leak into financial markets.

Finally we consider the excess reserves of the banking system deployed at the central bank an obvious liquidity proxy. When excess reserves are piling up in the central bank, the banks are unable to find attractive investment opportunities in the real economy or the financial markets, meaning that liquidity dries up.

The slope of the yield curve is of course directly observable, and could be expressed as the difference between three months NIBOR and 10 or 15 years treasury yields.

Unfortunately there are no broadly traded volatility indices measuring volatility in the Norwegian equity market. Because of the strong correlation between Norwegian and US stock indices, we use the Vix index measuring implied option market volatility on the S&P 500 index in the US, as a proxy for volatility in the Norwegian equity market.

The nominal value of the housing market is important in its capacity as *collateral* supporting the banks' mortgage portfolios. Any national residential property index might represent the price dynamics of the housing market. Even more significantly, the underlying risk to the housing market, and to the ability of customers to service their loans, is the labor market. Thus, we expect both employment conditions and the value of the housing market to have an impact on credit spreads.

Inflation expectations can be captured by numerous macroeconomic variables. Normally, we prefer to quantify inflation expectations as the difference between the yield on nominal 10-15 years government bonds and corresponding inflation adjusted bonds. Inflation indexed bonds are traded bilaterally in the Norwegian fixed income market, but none of these securities are exchange traded, and their information value is probably poor. Luckily, inflation indexed bonds are traded in many European markets, and since these instruments are part of Norwegian institutional investors' bond portfolios, they can serve as proxies for inflation expectations among fixed income investors in the Norwegian market.

If we can estimate a structural model for Norwegian financial bonds spreads, incorporating all or several of the above factors as plausible explanatory variables, we will be on the right track in terms of investigating whether our data supports the risk factors perceived by the market participants.

Explanatory variables in a structural model for Norwegian financial bonds spreads thus might be:

- *Credit extended to non-financial businesses*. As bank lending in general increases, liquidity becomes more abundant and credit spreads should narrow. Therefore, the coefficient on this *liquidity variable* should be *negative.*
- *The change in net inflow of funds to fixed income fund managers*. If net inflow of funds to fixed income fund managers operating in the Norwegian fixed income market increases, liquidity in these markets will improve inducing a downward pressure on credit spreads. Therefore, the coefficient on this *liquidity variable* should be *negative.*
- *Excess reserves of the banking system.* When excess reserves are falling the banks find investment opportunities in the real economy or the financial markets causing liquidity to soar and spreads to narrow. Therefore, the coefficient on this *liquidity variable* should be *negative.*
- *The slope of the yield curve*. A steep, positively sloped yield curve offers banks an attractive (almost) risk free opportunity to "ride the yield curve", meaning that they may obtain cheap short term funding in the central bank and invest the funds in higher yielding long duration government bonds, enabling the banking sector to build equity capital. Also higher interest rates in general should decrease the default probability (and the credit spread), because this increases the risk neutral drift in the firm value process. We would therefore expect the coefficient on the yield curve *slope variable* to be *negative.*
- *Equity volatility*. An increase in equity volatility increases the likelihood of the bank's value hitting the default threshold (insolvency), and thus increases the credit spread. Obviously, the coefficient on the *volatility proxy*, i.e. the Vix, should be *positive*.
- *Unemployment*. Employment conditions are key to borrowers' ability to service their debt liabilities. Furthermore, residential property is an extremely important part of the commercial banks' loan books. Consequently, the value of the housing market impacts the quality and value of the banking sector's residential collateral. However, the real risk to the property market is unemployment. Therefore, the coefficient on the *unemployment variable* in our structural model should be *positive*.
- *Inflation expectations*. Typically, a fixed income investor is looking for a fixed cash flow. An increase in inflation reduces the real value of the nominal cash flow from a fixed income security. Consequently, the credit spread has to increase in order to compensate potential investors in fixed income securities under increasing inflation expectations. We therefore expect the coefficient on the *inflation variable* to be *positive*.

## 7. Results

We have tested these variables as explanatory variables in structural models where senior and subordinated bank bonds respectively feature as the explained variables. We have run both linear OLS regressions and more interestingly *quantile regressions* (Koenker 2005), which in

our view, as we will explain shortly, often better capture important real world relations between economic variables.

OLS estimation capture the average value of the explained variable, given the average values of all the explanatory variables. The fitted regression line, as such, is of course no more than an extrapolation of the behavior of the relationship between the explained variable and the explanatory variables at the mean to the remainder of the data. Often this relationship changes across the distribution of the dependent variable. In our opinion, what often really matters is how the relationship looks like in the tails of the distribution of the explained variable.

This is exactly what quantile regression will allow us to examine. Quantile regressions, developed by Koenker and Basset (1978), is a non-parametric technique for estimating models for the quantile functions. Instead of minimizing the distance from the mean in an OLS fashion, effectively running the regression line through the mean of the distribution of the dependent and explanatory variables, quantile regression will run the regression line through the required quantile of the distribution of the dependent variable.

To estimate the $\tau$-th quantile of the distribution of the dependent variable *y* in the case of *k* explanatory variables, $x_i : i = 1, \ldots, k$, we write the minimization problem for a set of quantile regression parameters $\hat{\beta}_\tau$, each element of which is a *k* x 1 vector:

$$\hat{\beta}_\tau = \arg\min_\beta \left( \sum_{i:y_i > \beta x_i} \tau \,|\, y_i - \beta x_i \,| + \sum_{i:y_i < \beta x} (1-\tau) \,|\, y_i - \beta x_i \,| \right) \qquad (7.1)$$

If we let $\tau = 0.5$ we get the median of the distribution and if $\tau = 0.1$ we get the quantile below which the 10 percent lowest observations are distributed.

Panels A and B of table 7.1 below show quantile process estimates from regressing *changes* in 5 years duration senior financial spreads (above treasuries), on four explanatory macroeconomic variables and one financial variable. These variables are five of the seven variables we discussed above; credit extended to non-financial businesses, the slope of the yield curve, unemployment, inflation expectations and equity volatility, which is the financial variable. To keep the processes stationary, all variables are expressed in terms of their first differences. Also, there is no autocorrelation in the residuals.

The results are intuitively appealing. Equity volatility (the Vix) only matters when spread movements are above their average value. The coefficient on this variable is statistically significant at the four highest quantiles, and the sign is positive as expected. This makes economically sense: When spread changes on senior bonds are already large, i.e. when *credit* spread volatility is high, increased equity volatility is highly unwelcome and increases credit spreads further. On the other hand, when spread movements are low an increase in volatility does not seem to affect fixed income investors much, and the coefficients on the volatility variable are not statistically significant at quantiles below 0.6.

The same pattern can be identified for the inflation variable (Norwegian CPI inflation). At the 0.8 and 0.9 quantile of the distribution for the dependent variable, the slope coefficients are highly statistically significant and positive as they should be. When spread volatility is high,

changes in inflation obviously matter a lot. As can be seen from the high value of the coefficient at these quantiles, this variable is extremely important to fixed income investors.

Surprisingly the unemployment and yield curve variables, although correctly signed, are not statistically significant at any quantile. The liquidity variable is neither statistically significant nor correctly signed, irrespective of which of the three proxies discussed above for this variable we employ. In principle, or generically, these variables should matter. We might have the wrong proxies, or their impact might be contained in the inflation and volatility variable.

Table 7.1 Panel A
Quantile Process Estimates
Specification:
SENIOR C EQUITY_VOL LIQUIDITY INFLATION YIELD_CURVE_SLOPE UNEMPLOYMENT

| | Quantile | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|---|
| **C** | 0.100 | -0.128682 | 0.040338 | -3.190104 | 0.0017 |
| | 0.200 | -0.084454 | 0.034416 | -2.453945 | 0.0153 |
| | 0.300 | -0.057061 | 0.024040 | -2.373567 | 0.0189 |
| | 0.400 | -0.020076 | 0.024624 | -0.815309 | 0.4162 |
| | 0.500 | -0.001736 | 0.025550 | -0.067935 | 0.9459 |
| | 0.600 | 0.012986 | 0.024173 | 0.537226 | 0.5919 |
| | 0.700 | 0.057930 | 0.033511 | 1.728682 | 0.0859 |
| | 0.800 | 0.110053 | 0.034256 | 3.212627 | 0.0016 |
| | 0.900 | 0.148474 | 0.037484 | 3.960950 | 0.0001 |
| **EQUITY_VOL** | 0.100 | -0.005969 | 0.144887 | -0.041196 | 0.9672 |
| | 0.200 | 0.053380 | 0.038859 | 1.373695 | 0.1716 |
| | 0.300 | 0.046677 | 0.043842 | 1.064647 | 0.2888 |
| | 0.400 | 0.028906 | 0.049022 | 0.589647 | 0.5563 |
| | 0.500 | 0.116399 | 0.091093 | 1.277795 | 0.2033 |
| | 0.600 | 0.170212 | 0.082720 | 2.057695 | 0.0414 |
| | 0.700 | 0.204985 | 0.090340 | 2.269043 | 0.0247 |
| | 0.800 | 0.189622 | 0.085186 | 2.225967 | 0.0275 |
| | 0.900 | 0.213617 | 0.075247 | 2.838877 | 0.0052 |
| **LIQUIDITY** | 0.100 | -0.005530 | 0.038543 | -0.143487 | 0.8861 |
| | 0.200 | 0.014155 | 0.014657 | 0.965762 | 0.3357 |
| | 0.300 | 0.013520 | 0.012637 | 1.069868 | 0.2864 |
| | 0.400 | 0.008343 | 0.013481 | 0.618870 | 0.5369 |
| | 0.500 | 0.011448 | 0.013360 | 0.856855 | 0.3929 |
| | 0.600 | 0.011372 | 0.013241 | 0.858832 | 0.3918 |
| | 0.700 | 0.011234 | 0.018598 | 0.604062 | 0.5467 |
| | 0.800 | 0.009175 | 0.019641 | 0.467107 | 0.6411 |
| | 0.900 | 0.039999 | 0.032414 | 1.234006 | 0.2191 |

Table 7.1 Panel B
Quantile Process Estimates
Specification:
SENIOR C EQUITY_VOL LIQUIDITY INFLATION YIELD_CURVE_SLOPE UNEMPLOYMENT

| | Quantile | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|---|
| **INFLATION** | 0.100 | 2.813175 | 9.197668 | 0.305857 | 0.7601 |
| | 0.200 | 3.124705 | 3.993018 | 0.782542 | 0.4351 |
| | 0.300 | 6.977445 | 3.508648 | 1.988642 | 0.0486 |
| | 0.400 | 6.494159 | 3.811277 | 1.703933 | 0.0905 |
| | 0.500 | 5.996418 | 3.891736 | 1.540808 | 0.1255 |
| | 0.600 | 6.856368 | 3.980479 | 1.722498 | 0.0871 |
| | 0.700 | 11.10320 | 5.883570 | 1.887153 | 0.0611 |
| | 0.800 | 17.00068 | 5.832464 | 2.914837 | 0.0041 |
| | 0.900 | 20.72607 | 5.971347 | 3.470920 | 0.0007 |
| **YIELD_CURVE_SLOPE** | 0.100 | -0.017552 | 0.033797 | -0.519350 | 0.6043 |
| | 0.200 | -0.003897 | 0.030679 | -0.127025 | 0.8991 |
| | 0.300 | -0.007763 | 0.020845 | -0.372427 | 0.7101 |
| | 0.400 | -0.019287 | 0.020671 | -0.933046 | 0.3523 |
| | 0.500 | -0.009424 | 0.019665 | -0.479202 | 0.6325 |
| | 0.600 | -0.006773 | 0.018094 | -0.374326 | 0.7087 |
| | 0.700 | -0.018799 | 0.024584 | -0.764707 | 0.4457 |
| | 0.800 | -0.040307 | 0.025824 | -1.560837 | 0.1207 |
| | 0.900 | -0.034033 | 0.028889 | -1.178066 | 0.2406 |
| **UNEMPLOYMENT** | 0.100 | 0.236356 | 0.695330 | 0.339918 | 0.7344 |
| | 0.200 | 0.146238 | 0.367202 | 0.398248 | 0.6910 |
| | 0.300 | 0.029145 | 0.388734 | 0.074975 | 0.9403 |
| | 0.400 | 0.230806 | 0.395210 | 0.584010 | 0.5601 |
| | 0.500 | 0.212918 | 0.400874 | 0.531135 | 0.5961 |
| | 0.600 | 0.303145 | 0.396625 | 0.764312 | 0.4459 |
| | 0.700 | 0.115564 | 0.415325 | 0.278250 | 0.7812 |
| | 0.800 | -0.181511 | 0.377166 | -0.481249 | 0.6310 |
| | 0.900 | 0.687070 | 0.756008 | 0.908814 | 0.3649 |

| |
|---|
| Column 1: Explanatory variables |
| Column 2: 10 quantiles of the distribution of the dependent variable: Senior bank bond spreads |
| Column 3: Gives the coefficient on the explanatory variables |
| Column 4: The standard error of the value of the coefficients calculated by Eviews |
| Column 5: The t-statstic calculated by Eviews |
| Column 6: Probabilities of rejecting a correct null hypothesis, calculated by Eviews |

According to the above models, equity volatility is an important driver of spread variations in the Norwegian financial bond market when spreads are already above average volatile. If we look at the relationship between Norwegian senior financial bond spreads and the Norwegian equity market, we get the same pattern. Senior financial bond investors clearly care about the equity market when credit spreads are above average volatile. Table 7.2 shows output from running a quantile regression (equation 7.1) on senior financial bond spreads, using only the Norwegian equity index (OSEBX) as explanatory variable. The slope coefficients are highly significant at the 0.6, 0.7, 0.8 and 0.9 quantiles. As would be expected, the relationship is negative; when the stock market improves spreads narrow.

Table 7.2
Quantile Process Estimates
Specification: SENIOR C OSEBX

| | Quantile | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|---|
| **C** | 0.100 | -0.142719 | 0.016469 | -8.665725 | 0.0000 |
| | 0.200 | -0.087118 | 0.015906 | -5.477174 | 0.0000 |
| | 0.300 | -0.037611 | 0.011772 | -3.194983 | 0.0017 |
| | 0.400 | -0.022522 | 0.012268 | -1.835882 | 0.0683 |
| | 0.500 | -0.002849 | 0.012516 | -0.227635 | 0.8202 |
| | 0.600 | 0.041388 | 0.014964 | 2.765898 | 0.0064 |
| | 0.700 | 0.078412 | 0.020238 | 3.874497 | 0.0002 |
| | 0.800 | 0.112110 | 0.021374 | 5.245078 | 0.0000 |
| | 0.900 | 0.209087 | 0.022790 | 9.174691 | 0.0000 |
| **OSEBX** | 0.100 | 0.124608 | 0.177701 | 0.701225 | 0.4842 |
| | 0.200 | -0.257813 | 0.276430 | -0.932653 | 0.3525 |
| | 0.300 | -0.295161 | 0.193644 | -1.524245 | 0.1295 |
| | 0.400 | -0.372854 | 0.204121 | -1.826636 | 0.0697 |
| | 0.500 | -0.367028 | 0.212834 | -1.724478 | 0.0866 |
| | 0.600 | -0.582740 | 0.281335 | -2.071338 | 0.0400 |
| | 0.700 | -0.820635 | 0.366168 | -2.241142 | 0.0265 |
| | 0.800 | -1.049820 | 0.372855 | -2.815627 | 0.0055 |
| | 0.900 | -1.576317 | 0.212428 | -7.420471 | 0.0000 |

Column 1: Explanatory variables
Column 2: 10 quantiles of the distribution of the dependent variable: Senior bank bond spreads
Column 3: Gives the coefficient on the explanatory variables
Column 4: The standard error of the value of the coefficients calculated by Eviews
Column 5: The t-statstic calculated by Eviews
Column 6: Probabilities of rejecting a correct null hypothesis, calculated by Eviews

Spreads on subordinated bonds follow much the same pattern that we identified for senior bond spreads. In panels A and B of table 7.3 we show quantile process results from regressing *changes* in 5 years duration senior financial spreads (above treasuries) on the same five explanatory variables we used for senior bond spreads above; credit extended to non-financial businesses, the slope of the yield curve, unemployment, inflation expectations and equity volatility.

Table 7.3 Panel A
Quantile Process Estimates
Specification:
SUBORDINATED C EQUITY_VOL INFLATION YIELD_CURVE_SLOPE LIQUIDITY UNEMPLOYMENT

| | Quantile | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|---|
| **C** | 0.100 | -0.086306 | 0.025376 | -3.401092 | 0.0009 |
| | 0.200 | -0.024131 | 0.020260 | -1.191080 | 0.2355 |
| | 0.300 | -0.007425 | 0.016179 | -0.458922 | 0.6470 |
| | 0.400 | 0.005437 | 0.015922 | 0.341484 | 0.7332 |
| | 0.500 | 0.018284 | 0.015413 | 1.186315 | 0.2374 |
| | 0.600 | 0.034257 | 0.017305 | 1.979658 | 0.0496 |
| | 0.700 | 0.043655 | 0.018797 | 2.322442 | 0.0216 |
| | 0.800 | 0.078411 | 0.020784 | 3.772666 | 0.0002 |
| | 0.900 | 0.150269 | 0.032866 | 4.572133 | 0.0000 |
| **EQUITY_VOL** | 0.100 | 0.093438 | 0.031898 | 2.929264 | 0.0039 |
| | 0.200 | 0.059382 | 0.025634 | 2.316568 | 0.0219 |
| | 0.300 | 0.042205 | 0.024734 | 1.706341 | 0.0900 |
| | 0.400 | 0.021391 | 0.027800 | 0.769469 | 0.4428 |
| | 0.500 | 0.049086 | 0.037005 | 1.326481 | 0.1867 |
| | 0.600 | 0.111667 | 0.053008 | 2.106602 | 0.0368 |
| | 0.700 | 0.118074 | 0.056131 | 2.103570 | 0.0371 |
| | 0.800 | 0.116662 | 0.050320 | 2.318418 | 0.0218 |
| | 0.900 | 0.139061 | 0.079761 | 1.743476 | 0.0833 |
| **INFLATION** | 0.100 | 8.863484 | 4.087816 | 2.168269 | 0.0317 |
| | 0.200 | 3.432373 | 2.832840 | 1.211636 | 0.2276 |
| | 0.300 | 2.526800 | 2.138064 | 1.181817 | 0.2392 |
| | 0.400 | 2.648148 | 2.224822 | 1.190274 | 0.2358 |
| | 0.500 | 4.732561 | 2.336175 | 2.025774 | 0.0446 |
| | 0.600 | 4.416480 | 2.755665 | 1.602691 | 0.1111 |
| | 0.700 | 6.733248 | 3.068977 | 2.193972 | 0.0298 |
| | 0.800 | 8.781512 | 3.432939 | 2.558015 | 0.0115 |
| | 0.900 | 17.40146 | 5.341211 | 3.257961 | 0.0014 |

Table 7.3 Panel B
Quantile Process Estimates
Specification:
SUBORDINATED C EQUITY_VOL INFLATION YIELD_CURVE_SLOPE LIQUIDITY UNEMPLOYMENT

| | Quantile | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|---|
| **YIELD CURVE SLOPE** | 0.100 | -0.025294 | 0.018537 | -1.364530 | 0.1745 |
| | 0.200 | -0.030232 | 0.014616 | -2.068390 | 0.0403 |
| | 0.300 | -0.030774 | 0.012345 | -2.492858 | 0.0138 |
| | 0.400 | -0.031573 | 0.012020 | -2.626716 | 0.0095 |
| | 0.500 | -0.027636 | 0.011585 | -2.385476 | 0.0183 |
| | 0.600 | -0.027767 | 0.012542 | -2.213898 | 0.0284 |
| | 0.700 | -0.025898 | 0.014196 | -1.824373 | 0.0701 |
| | 0.800 | -0.043113 | 0.015581 | -2.766982 | 0.0064 |
| | 0.900 | -0.079386 | 0.021921 | -3.621511 | 0.0004 |
| **LIQUIDITY** | 0.100 | -0.005213 | 0.015180 | -0.343385 | 0.7318 |
| | 0.200 | -0.013775 | 0.011635 | -1.183991 | 0.2383 |
| | 0.300 | -0.001307 | 0.009432 | -0.138577 | 0.8900 |
| | 0.400 | 0.002969 | 0.008886 | 0.334180 | 0.7387 |
| | 0.500 | 0.002270 | 0.008549 | 0.265495 | 0.7910 |
| | 0.600 | 0.000594 | 0.009133 | 0.065017 | 0.9482 |
| | 0.700 | 0.006404 | 0.010235 | 0.625748 | 0.5324 |
| | 0.800 | 0.010263 | 0.011590 | 0.885511 | 0.3773 |
| | 0.900 | 0.017550 | 0.012352 | 1.420847 | 0.1575 |
| **UNEMPLOYMENT** | 0.100 | 0.006083 | 0.373316 | 0.016294 | 0.9870 |
| | 0.200 | -0.014681 | 0.223577 | -0.065666 | 0.9477 |
| | 0.300 | -0.050713 | 0.214514 | -0.236408 | 0.8134 |
| | 0.400 | 0.169811 | 0.241784 | 0.702324 | 0.4836 |
| | 0.500 | 0.071610 | 0.235784 | 0.303709 | 0.7618 |
| | 0.600 | -0.007048 | 0.235772 | -0.029893 | 0.9762 |
| | 0.700 | -8.59E-05 | 0.243777 | -0.000352 | 0.9997 |
| | 0.800 | -0.098624 | 0.232975 | -0.423326 | 0.6727 |
| | 0.900 | 0.500088 | 0.373242 | 1.339848 | 0.1823 |

Column 1: Explanatory variables
Column 2: 10 quantiles of the distribution of the dependent variable: Subordinated bank bond spreads
Column 3: Gives the coefficient on the explanatory variables
Column 4: The standard error of the value of the coefficients calculated by Eviews
Column 5: The t-statstic calculated by Eviews
Column 6: Probabilities of rejecting a correct null hypothesis, calculated by Eviews

Also for subordinated bonds equity volatility and inflation seem to be the most dominant drivers of spread movements. Equity volatility only seems to matter at the tail of the subordinated spread distribution, whereas inflation matters at the tails but also at the median. The coefficients take on positive values and inflation intuitively enough seems to be what bond investors dislike the most. Interestingly the coefficient on the yield curve slope variable is also significant through most of the distribution of the dependent variable and, as expected, the sign on the coefficient is negative.

Neither liquidity nor unemployment have any direct explanatory power on the spreads in our models. This is not to say however, that we believe unemployment or liquidity is unimportant to bond investors. Recall that we are modelling first differences. In terms of inflation and unemployment, this is the most frequently used version of the Phillips curve relation: the trade-off between unemployment apart from its natural rate and the change in the inflation rate. In relation to bond spreads it seems like unemployment and inflation represent the Phillip curve relation. It seems that if we include both these variables in our regression model, one of them is redundant. In our case the redundant variable seems to be the unemployment variable.

We are a little surprised that unemployment does not matter «in its own right» as a driver of subordinated bond spreads. These bonds are the first to take a hit if the equity capital is lost and consequently bond investors should worry about unemployment. Loss of jobs typically means more default on loans, which threaten bank equity capital. One explanation could be that during the model period of January 2003 to September 2016, most of the time unemployment stayed way below 4 percent and never hit 5 percent. Thus, unemployment was never a real worry to bond investors during this period.

Also after the great financial crises, regulations of financial institutions have become much harsher. As we explained in section 2.1 because of the *liquidity coverage ratio* requirements, the banks will have to keep far more liquidity on their balance sheets, and they need to put up a lot more equity capital. Norwegian banks now hold approximately 15 percent core equity capital, which means that it is less likely they will default on their debt. Since the distance to default has increased, there is less probability for both senior and subordinated bond investors to experience a loss on their investments. This fact might be part of the explanation why bond investors seemingly do not worry too much about unemployment. Even if an increase in unemployment at the margin increases the probability of default, the LCR requirement outweighs this effect, as long as unemployment stays below some threshold.

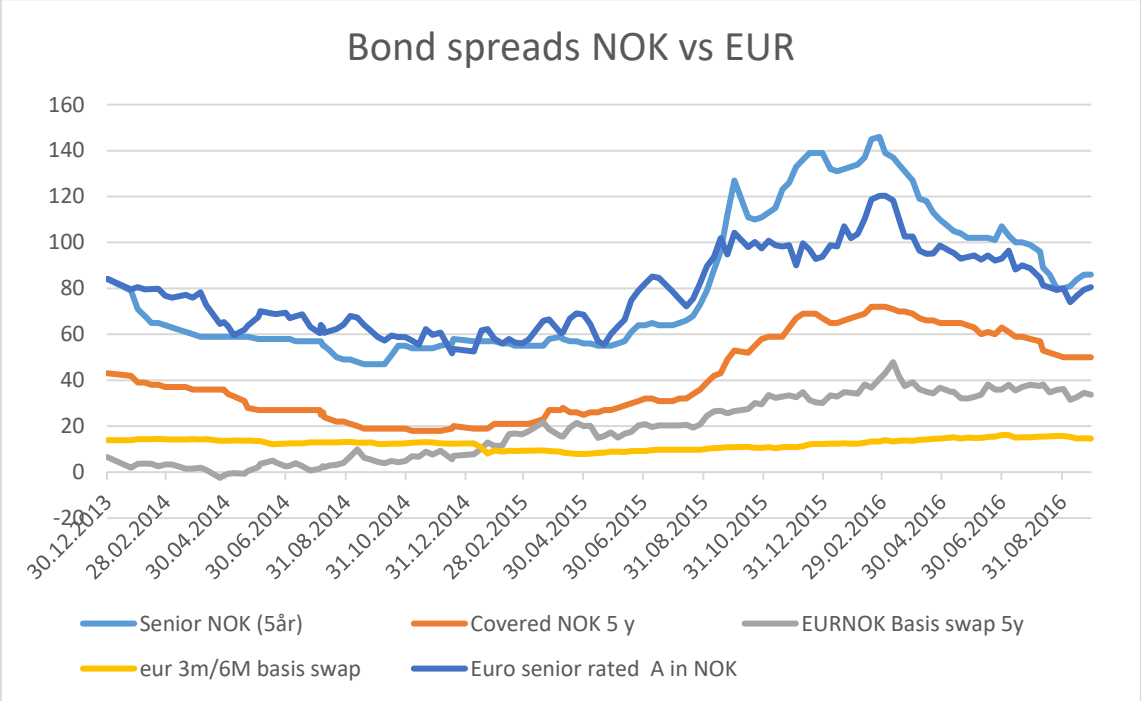
## 8. Conclusions

In this paper, we have described the characteristics of the Norwegian financial bond market. We have characterized the market participants in the traded securities, reviewed key legislative arrangements and explained the financial infrastructure facilitating the price processes. We also suggested a generic model for bond spreads and proposed proxies for explanatory variables of this model. In section 7, we examined the relationship between senior and subordinated financial bonds and their suggested explanatory variables, across the distribution of the dependent variables. We found that the explanatory power of the independent variables was stronger at the tails of the distributions than closer to the median. Intuitively our explanation is that when spread volatility is already high, bond investors are more worried about movements in underlying drivers of spreads, than when market conditions are normal. Specifically we found that spreads on senior bank bonds are affected by equity volatility and inflation, whereas spreads on subordinated bonds are affected by equity volatility, inflation and the yield curve slope.

We were surprised not to find a clear relationship between Norwegian macro liquidity and bond spread movements. What we suspect is that since the financial crises, Norwegian bond spreads have become more dependent on euro-liquidity rather than underlying Norwegian macroeconomic trends. Figure 8.1 illustrates our point.

The difference between 5 year Norwegian senior bond spreads and 5 year European senior bond spreads *measured* in NOK, is *the 5 year EUR/NOK basis swap*, i.e. the cost of *converting* 5 year EUR exposure to similar NOK exposure. The 5 year European senior bond spread converted to NOK is the yield a Norwegian investor will get from buying European senior bonds, while hegding out the currency risk. The euro basis swap represents the risk premium EMU residents require to hold Norwegian denominated securities. If there were no risk premium, Norwegian and European bond spreads in principle should be perfectly correlated; they should be identical.

Figure 8.1. Norwegian versus European bond spreads




It turns out that the correlation between the 5 year EURNOK basis swap spread and the spread on 5 year Norwegian senior financial bonds in the period shown in figure 8.1 (January 2014 – September 2016) was 0,83. Consequently, we believe that over the last three to five years Norwegian financial bond spreads have become ever more closely related to European macroeconomic trends. Norwegian credit spreads are thus in effect a function of European credit spreads, the basis swap and specific Norwegian factors like the oil price or other market or firm specific factors. The basis swap combined with these Norwegian factors will obviously create price discrepancies between Norwegian and European credit markets. As we argued in section 4.1, monetary policy has a huge impact on the basis swap spread. When the ECB launched major quantitative easing policy measures in 2015, the EURNOK basis swap soared, reflecting increasing euro liquidity.

In closing, we mention that the EURNOK basis swap spread is not too frequently traded. Most trades from EUR into NOK are sourced through the EURUSD swap spread and further into NOK through the USDNOK basis swap spread. A thorough analysis of how these convoluted trades affect the relationship between credit spreads is an interesting topic for future research.

**Footnotes**

1) For accounting purposes, hold to maturity bonds are unaffected by interest rate changes.

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