

Long-term benchmark rates in the Norwegian bond market

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Government securities have traditionally been used as benchmarks for long-term interest rates. Today the market for interest rate swaps is also used. The difference between yields on government bonds and swap market rates - the swap spread - can provide information about the properties of these markets as reference markets. This article considers factors that may influence variations in the swap spread in Norway. An econometric analysis shows that in the period 1997-2003, the swap spread varied with developments in the spread between short-term money market rates and government bond yields, price developments in equity markets and the issuance of Eurobonds denominated in NOK. The results provide support for the use of the swap market as a benchmark market when pricing corporate bonds.

1. Introduction

In financial markets it is usual to price financial instruments relative to comparable investment alternatives (relative pricing). When pricing a bond, one can use the market rate of comparable bonds as the basis, and price components that are specific to the individual bond. For example, the yield on a corporate bond could be priced as the yield on a government bond of the same duration¹ with a premium corresponding to the credit and liquidity risk associated with the corporate bond. The yield on the government bond can then be regarded as the benchmark for the corporate bond.

Pricing relative to a benchmark contributes to consistent pricing of underlying factors that are common to different bonds, and at the same time simplifies pricing. Relative pricing also makes it easier to compare prices for different bonds. However, smoothly functioning and effective pricing is contingent on the existence of suitable benchmarks. In Norway, the government bond market and interest rate swap market are the most relevant reference markets for long-term rates and hence for the pricing of corporate bonds.² In the article we consider various factors that influence the choice of whether to use government bond yields or swap rates as long-term benchmark rates in Norway. The assessment is based partly on a theoretical discussion, and partly on an econometric model of developments in the spread between the rates in the two markets – the swap spread.

2. The role of a benchmark instrument

The basic premise for the choice of a benchmark instrument is that the value of the instrument is fundamental-

ly similar to that of the instrument that is to be priced. The reference instrument should contain few value components that are specific to the instrument. In other words, an appropriate benchmark instrument should reflect as "purely" as possible components that are relevant to the value of the instrument that is to be priced. If we assume that the yield on a corporate bond consists of a required risk-free real rate of return, inflation expectations and compensation for credit risk³, the requirement for an appropriate benchmark rate for the bond will be that it covaries as closely as possible with these components. The yield on the corporate bond must be adjusted for factors that are specific to the corporate bond and any components of the benchmark rate that are not relevant to the corporate bond.

Government bonds as benchmarks

Government bond yields have traditionally been used, both internationally and in Norway, as fundamental benchmarks for the pricing of corporate bonds. A large outstanding volume, long and spread maturity profile and the absence of credit risk have made government bonds appropriate for reflecting the market's required real rate of return and inflation expectations.⁴ Moreover, government bonds are homogeneous instruments that are available to all investor groups, and they are sold in transparent markets. When government bond yields are used as benchmarks for pricing corporate bonds, a premium must be estimated for the credit risk associated with the corporate bond, since there is no credit risk associated with the yield on government bonds.⁵

The Norwegian government bond market is small by international standards. It is also small relative to macro-

* With thanks to Guttorm Egge, Tom Bernhardsen, Per Atle Aronsen, Johannes Skjeltorp, Dag Henning Jacobsen, Sindre Weme and colleagues in the Department for Market Operations and Analysis for useful comments.

¹ The duration of a fixed yield bond is the average time it takes for all cash flows (yield coupons and principal) to fall due for payment.

² An alternative could be corporate bonds with low credit risk, such as asset-backed securities or securitised loans. However, the issuance of these securities has only recently been allowed in Norway, and there is no liquid market for these bonds today.

³ Here we disregard other premia due to liquidity risk, etc.

⁴ For a discussion of the government bond market as a benchmark for required real rate of return and inflation expectations, see for example Hein (2003).

⁵ In addition adjustments must be made for any differences in the liquidity premia of the bonds.

Interest rate swaps and the market for interest rate swaps

An interest rate swap is a contract between two parties to exchange interest payments. Normally such an agreement involves the exchange of a fixed rate (the swap rate) for a short-term money-market rate (3- or 6-month NIBOR). The swap rate is fixed such that the value of the contract is zero when the agreement is made. The net present value of the fixed rate payments is therefore equal to the net present value of the expected interest rate payments based on the short-term rate. Once the contract has been signed, the market value of the contract will vary with changes in market rates.

The cash flows in an interest rate swap contract are based on an underlying principal, but the principal is not exchanged between the parties to the contract. The credit risk associated with the contract is therefore limited to the exposure resulting from developments in the market value of the contract. Credit risk may be further reduced through the use of collateral, netting in the event of bankruptcy, rating triggers² and cross default clauses³. As banks are the principal participants in the interest rate swap market, swap rates will to some extent reflect credit risk in the banking sector. This risk accounts for some of the difference between government bond yields and swap rates (see Chart).

Since the market for interest rate swaps is a derivatives market which does not involve the purchase and sale of the underlying assets, interest rates in the swap market are usually less influenced by supply and demand than yields in the bond market, where the outstanding volume is limited. Nevertheless, variations in supply and demand are not without importance for pricing in the swap market. Transaction flows in the swap market influence market-makers' expectations regarding interest rate developments. If, for example, many participants want to receive a fixed rate in the swap market, this may indicate that many participants consider the swap rate to be too high compared with their expectations of developments in short rates. As a reaction to such transaction flows, the market-maker will therefore revise his own expectations, and adjust down the fixed rate.

In a well-functioning swap market, equilibrium will be reached, so that market participants' aggregate information and expectations will be embodied in interest rates. At the same time, various factors may result in prices not reflecting these expectations and hence not aggregating information perfectly in the short term. For example, market-makers' risk limits may influence interest rates. If a market-maker enters into many agreements for payment of a fixed swap rate, and this results in an overrun of the market-maker's risk limits, he may be forced to revise rates downwards in order to balance the risk. This may be the outcome even if the market-maker's expectations are unchanged.

¹ In the event of bankruptcy, the net position is settled among the counterparties.

² Swap agreements are settled at market value in the event of changes in counterparties' ratings.

³ Swap agreements are settled at market value in the event of counterparty's default in relation to a third party.

economic aggregates for Norway such as GDP.⁶ This is because the public sector borrowing requirement is limited. For the same reason, the Norwegian government bond market is less liquid⁷ than most other bond markets. Because of the poor liquidity and low outstanding volume, Norwegian government bond yields may be considerably influenced by variations in supply and demand that do not reflect changes in the required real rate of return or inflation expectations. This reduces the suitability of Norwegian government bonds as benchmarks for long-term rates and corporate bonds.

Swap rates as an alternative to government bond yields

In the late 1990s, government borrowing in many countries was reduced because of government budget surpluses.⁸ The result was reduced liquidity in the countries' government bond markets and market participants looked around for alternative benchmark instruments. Among the alternatives to government bonds are semi-government bonds and government-guaranteed bonds, interest rate swaps, investment grade corporate bonds and bonds issued by supranational organisations.⁹ In

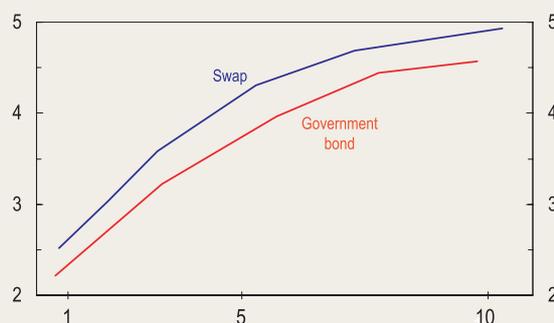
⁶ In Norway, the volume of outstanding government bonds was equivalent to 11 per cent of GDP in 2001. The average for the OECD countries was just over 40 per cent.

⁷ In a highly liquid market, large transactions can be carried out without influencing prices to any particular extent, and the bid-ask spread is small.

⁸ This is true of the US, Canada, the UK, Belgium, Spain and Italy, among others.

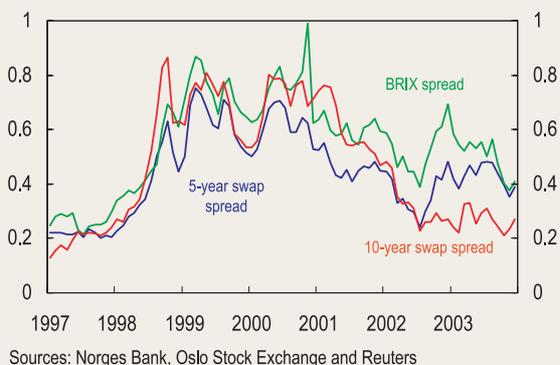
⁹ Such as the World Bank and the European Investment Bank.

Chart 1 Yield curves in the government securities and swap markets, 30 December 2003. Yield in per cent and maturity in years.



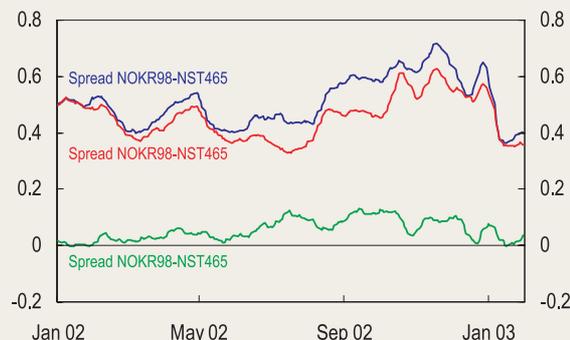
Sources: Norges Bank and Reuters

Chart 2 Developments in swap spreads with different maturities and in the BRIX spread. Percentage points. Monthly figures. 1997-2004.



Sources: Norges Bank, Oslo Stock Exchange and Reuters

Chart 3 Developments in the spread between corporate bond NOKR98 and government bond NST465, the corresponding spread against the swap rate with the same maturity and the spread between the swap rate and NST 465. Percentage points. 10-day moving average. January 2002 – January 2003.



Sources: Norges Bank and Oslo Stock Exchange

most countries, interest rate swaps have emerged as the most appropriate alternative.

Information from market participants indicates that interest rate swaps are used extensively as a reference for long-term rates and pricing of corporate bonds. This applies both internationally and in Norway. Interest rate swap markets have grown strongly in recent years, and in a number of countries the liquidity of these markets is greater than that of government bond markets.

Pricing of corporate bonds

The Norwegian market for corporate bonds is small. Few companies issue bonds compared with other countries, and the amount outstanding is usually relatively low. Moreover, turnover of most bonds is very low. Thus, few indices for corporate bonds can provide a continuous and satisfactory picture of developments in the corporate segment of the Norwegian bond market. This makes it difficult to determine which references are used in the corporate bond market.

Banks are the largest borrowers in the corporate bond market. Since banks are also the largest participants in the swap market, the credit risk component of the yield on bonds issued by banks is closely linked to the credit risk component of swap rates. Covariation between swap rates and yields on corporate bonds can therefore be explained in terms of both variations in the required real rate of return and inflation expectations and variation in the credit risk associated with market participants' risk profile.

Chart 2 shows developments in spreads for swaps with maturities of 5 and 10 years and the spread between the yield on bonds in the BRIX index and in the ST4X¹⁰ government bond index on the Oslo Stock Exchange (the BRIX spread) in the period 1997 to end-2003.

The chart indicates a high degree of covariation between these spreads through the period. The BRIX index is based on a selection of listed bank, insurance, mortgage company and industrial bonds, and has a duration of 3 years. Since 2002, the index has contained almost exclusively bank bonds. All else being equal, one would expect the BRIX spread to be wider than the swap spread, because credit risk components are larger in the bond market, where also the principal is exchanged between seller and buyer.

Chart 3 presents an example of how the yield on a corporate bond (NOKR98) develops relative to government bond NST 465¹¹ and the swap rate with the same maturity as NST 465.¹² The chart also shows the swap spread with the same maturity in the same period. We see that NOKR98¹³ follows the swap rate more closely than the government bond yield for most of the period. This is reflected by the fact that the spread between NOKR98 and the swap rate changes relatively little through the period, and similarly that the spreads between government bond yield and NOKR98 and the swap rate, respectively, are very largely parallel. This was also the case in the period in autumn 2002 when the swap spread widened appreciably, partly due to extensive demand for short bonds in NOK. This effect on the pricing of NST 465 in autumn 2002 is an example of the varying quality of the government bond market as a benchmark. The yield on bond NOKR98 shadowed swap rates closely during this period, and did not appear to reflect the strong demand for interest-bearing investments in NOK¹⁴ that was expressed in the government bond market.

Whereas the yield on a bond issued by a bank can be assumed to shadow swap market rates because of underlying similarities in credit risk, there is no direct connection with the credit risk in the swap market for an

¹⁰ ST4X is an index composed of government bonds. The duration of the index is 3 years.

¹¹ NST 465 has a coupon of 5.75 per cent and matures on 30 November 2004. The outstanding volume is NOK 38 750 million.

¹² If a swap rate with the same maturity as NST 465 is used, the swap rate's term structure works in the same way on both spreads with NOKR98.

¹³ NOKR98 has a coupon of 5.85 per cent and matured on 16 June 2004. The outstanding volume is NOK 5 244 million. The bond was issued by Norgeskredit AS, which is part of the Nordea group.

¹⁴ Variations in the credit rating of Norgeskredit may also have contributed to variations in the yield on NOKR98.

industrial bond. However, credit risk in the banking sector depends on banks' loss risk, which depends in turn on the risk in the banks' loans to the corporate and household sector. Increased risk in, for example, industrial companies, will therefore normally feed through to the banking sector. It is therefore reasonable to expect covariation between swap spreads and industrial bond spreads, even though industrial bonds are not priced relative to swap rates. The market pricing of bank or industrial bonds therefore does not provide an adequate basis for deciding which market is used as a reference for inflation expectations and required real rate of return in the pricing of corporate bonds. According to market participants, however, swap rates are the preferred reference. This raises the question of which factors determine the difference between the swap rate and the sum of required real rate of return and inflation expectations. The swap spread provides an expression of this difference, as government bond yields are assumed to reflect the required real rate of return and inflation expectations. If swap rates are used as a reference, it is desirable to know whether the factors that determine the swap spread are also of relevance for the pricing of corporate bonds. In the following sections we will focus on the question of which factors determine developments in the swap spread.

3. Components of the swap spread

From an arbitrage perspective, the swap spread can be determined analytically by considering the following portfolio:

- Short sale of 10-year government bonds
- Investment of the income from the sale in 6-month Treasury bills which are continuously rolled over.
- Entry into a 10-year interest rate swap contract to receive a fixed swap rate and pay a floating 6-month money market rate (NIBOR) on a principal equivalent to the income from the sale of the government bonds.

The value of this portfolio is zero at the time of establishment, and the payment flows in the next 10 years are as follows: a 10-year government bond rate is paid annually, and a 10-year swap rate received, while 6-month Treasury bill interest is received and 6-month NIBOR is paid. In other words, the 10-year swap spread is received annually against semi-annual payment of the NIBOR spread. Since the portfolio initially has a value of zero, a theoretical relationship can be established between the size of the swap spread and expectations regarding the size of the NIBOR spreads through the term to maturity of the swap contract. The swap spread can thus be regarded as a series of NIBOR spreads. It is therefore reasonable to expect that changes in the

NIBOR spread will covary with changes in the swap spread.

The NIBOR spread depends on the difference in credit risk associated with investment in short-term government paper (Treasury bills) and in the interbank market. In other words, the credit risk involved in the swap spread also depends on the credit risk in the interbank market.

Other factors that may influence the swap spread

In the following we list factors that may influence the swap spread. Some relate to transaction flows in swap and government bond markets via various market mechanisms, as described in the box above. The discussion is primarily an assessment of how the various factors may influence the swap spread.

The stock market

Developments in stock markets may influence yields on government bonds and swap rates and thereby the swap spread through several channels.

Portfolio allocation between the asset classes equities and fixed income instruments is influenced by developments in the stock market. A fall in stock markets will normally result in increased demand for interest-bearing assets and hence a fall in yields. Similarly, an upturn in stock markets may motivate capital flows from the fixed income to the equity markets, and result in a rise in interest rates. In periods, a high degree of covariation is therefore observed between developments in the equity market and long-term interest rates. Since the swap market is not an investment market, it is reasonable to expect developments in equity markets to have only a limited effect on swap rates through the portfolio allocation effect. An upturn in equity markets can therefore be expected to result in a narrowing of the swap spread, and vice versa.

Rising equity prices will often be a result of an improved economic outlook. An upturn in equity markets may therefore indicate that the prospects for corporate earnings have improved and that the credit risk is reduced. It is therefore possible that the credit risk component in the swap rates may decline in pace with an upturn in equity markets, which may contribute to a narrowing of the swap spread.

Developments in equity markets may also influence the willingness or ability of investors to bear risk. An upturn in equity markets may accordingly result in an outflow of capital from government bond markets, and thereby in an increase in government bond yields. Since such effects can be expected to influence swap rates to a lesser degree, the swap spread will narrow. In government bond markets with a low degree of liquidity, such as the Norwegian market, such transaction flows may

conceivably be of particular importance to government bond yields and hence to the swap spread.

The slope of the yield curve

The difference between short and long rates can be expected to be important to supply and demand in the interest rate swap market. A yield curve with a positive slope (long-term rates are higher than short rates) means that the fixed swap rate over time is expected to be lower than the floating rate - since the value of the swap contract is zero at the time when the contract is made. When a borrower's expectations do not differ from the market rates, borrowers should therefore be indifferent as to whether they prefer long- or short-term fixed interest rates. However, when the yield curve becomes steeper, one often sees a greater desire to receive a fixed interest rate in the swap market. A steeper yield curve may therefore contribute to lower swap rates, and a narrower swap spread.¹⁵

If the slope of the yield curve is positive, net payment flows in the first part of the term of the swap contract will go from the recipient of the floating interest rate to the recipient of the fixed rate, and can be expected to go the opposite way towards the end of the contract period.¹⁶ In a market with a positively sloping yield curve, the recipient of a floating interest rate will therefore normally expect to incur credit risk early in the swap term. Because compensation is required for this risk, it may result in a lower fixed interest rate in the swap market and hence a narrower swap spread.¹⁷

At the same time, the slope of the curve provides information about economic developments. A declining (inverted) yield curve will normally indicate expectations of weaker economic developments. This will contribute to a general increase in credit risk and hence a widening of the swap spread. Similarly, a steeper yield curve is normally an expression of a better growth outlook and a lower credit risk, and hence narrower swap spreads.

The yield differential between Norway and other countries

Demand for bonds denominated in Norwegian krone depends partly on the yield differential between Norway and other countries. A wide yield differential normally increases demand for bonds denominated in NOK. In isolation, this will contribute to lower yields on bonds. Because of a possible scarcity of government bonds, the decline in yields may be sharper than the decline that would reflect changes in the required real rate of return and inflation expectations. Swap rates are expected to be less strongly influenced by the yield differential, since this is a market for changes in interest rate exposure and not for investment of liquidity. An increased interest rate

differential is therefore expected to contribute to an increase in the swap spread.

Market uncertainty /volatility

An increase in market rate volatility often reflects increased uncertainty regarding interest rate movements. A change in uncertainty among market participants may change the balance between supply and demand for fixed interest rates. Greater uncertainty may be expressed through more borrowers wanting to pay a fixed interest rate, to hedge against disadvantageous interest rate increases. Increased demand for fixed rates in the swap market contributes to swap rates rising and to the swap spread increasing.

Issuance of government bonds

The outstanding volume in the Norwegian government bond market is relatively low, and the liquidity in the market is limited. A limited supply of government bonds may lead to lower yields than required real rates of return and inflation expectations would indicate. There is therefore reason to believe that, in the short term, issues of government bonds contribute to higher government bond yields, and thereby reduce the swap spread.

Issues of Eurobonds in NOK

Through 2001 and 2002 there was substantial issuance of Eurobonds denominated in NOK, which are bonds denominated in NOK issued outside Norway. High demand for investment in NOK, partly because of the wide yield differential, made it profitable to issue Eurobonds rather than to borrow directly in the issuers' domestic markets. In most cases the issuers had no need for liquidity or exposure in NOK. They therefore used interest rate swaps to change their exposure from fixed to floating interest rate payments. They then entered into currency swap contracts to receive USD or EUR against payment of NOK. The issuers thereby converted fixed rate loans in NOK into floating rate loans in USD or EUR. This contributed to a substantial, one-sided demand for fixed interest rates in the interest rate swap market. It is therefore reasonable to expect that issues of Eurobonds will contribute to a widening of the swap spread.

Chart 4 shows the volume of Eurobonds issued in the period 1997 to 2003. The bulk of the Eurobonds had a maturity of 4-6 years, and the effects on the swap spread are expected to have been greatest in this maturity segment. While pressures in the swap market contributed to lower swap rates, issuance activity may also have reduced demand for Norwegian government bonds. This may have resulted in higher government bond yields and thereby contributed to further reducing the swap spread.

¹⁵ The steeper the yield curve, the stronger this effect will be.

¹⁶ Here we are disregarding accruals of interest payments through the year.

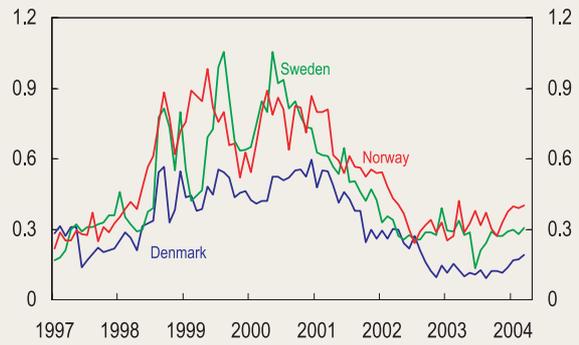
¹⁷ If the yield curve is inverted (long-term rates lower than short-term) a recipient of a fixed interest rate will incur the credit risk early in the contract period. Compensation will take the form of a higher required fixed interest rate in the swap, thereby contributing to higher swap rates and a broadening of the swap spread.

Chart 4 Cumulative gross issue of Eurobonds denominated in NOK in the period 1997–2003. In billions of NOK.



Source: Reuters

Chart 5 10-year swap spreads in 3 Nordic countries. Percentage points. Monthly figures. January 1997 - March 2004



Sources: Norges Bank and Reuters

4. Econometric model of the swap spread

The importance of each of the factors for changes in the swap spread can be estimated by means of an econometric model of the swap spread.

Since corporate bonds, according to market participants, are priced using swap rates as a benchmark, we do not include the credit spread as an explanatory factor in the model. This means that developments in credit risk are mainly included in the model via the NIBOR spread, and more indirectly through stock market developments (see discussion above).

We include two dummy variables¹⁸ related to the financial market turbulence in autumn 1998, since these can be regarded as exogenous shocks to the market. To reduce the effects of any autocorrelated explanatory variables, we have also included the lagged value of changes in the swap spread.

Other countries are only included indirectly in the model through the yield differential. This probably reduces the explanatory power of the model, since the swap spreads in the Norwegian market show a clear correlation with swap spreads in other countries (see Chart 5). If the correlation is caused by international swap rates serving as reference rates for Norwegian swap rates, factors abroad will influence the Norwegian swap spread. For example, changes in the slope of the yield curve in other countries may influence the swap spreads in these countries, and thereby influence swap spreads in the Norwegian market.

There is probably also a direct relationship between swap spreads in different countries because financial markets are strongly integrated. Many banks are involved in determining the floating rate on interest rate swaps in a number of countries. Nordea, for example, is involved in fixing interest rates in all the Nordic countries. It is therefore reasonable to expect high covariation between the swap spread in the Norwegian market and in the other Nordic markets (see Chart 5).

As Table 1 shows, the explanatory variables are either flow variables or stock variables in the form of difference terms. We estimate two different models. Both are simple linear regression models which satisfy ordinary statistical criteria. In the first (Model 1) we include all ex-ante relevant explanatory variables, without lagged values. This model provides a basic impression of the explanatory value of the variables, and a priori might apply if a swift market adjustment takes place. We then present a reduced model (Model 2) produced by means of a “general-to-specific” reduction method. After each estimation of Model 2, insignificant explanatory variables are excluded until only significant explanatory variables remain. In our estimation of Model 2 we have included three lagged values of the explanatory vari-

Table 1. Summary of factors expected to influence changes in the swap spread.

Variable	Explanation	Expected effect
Government bonds issue 10Y	Value of monthly volume issued of 10-year Norwegian government bonds	-
Government bonds issue 5Y	Value of monthly volume issued of 5-year Norwegian government bonds	-
Δ Slope 2-10Y	Change in spread between 10-year and 2-year swap rates from interest rate swap contracts quoted on Reuters	-
Δ Yield differential with German 10Y	Change in yield differential between 10-year Norwegian and German government bonds	+
Δ OSEBX	Monthly return on the Oslo Stock Exchange Benchmark Index	-
Volatility 2Y	Equally weighted moving monthly standard deviation of 2-year swap rates	+
Eurobonds issues	Volume in Eurobonds issued in NOK. Eurobonds are defined here as bonds issued outside Norway in NOK	-
Δ Nibor6m-ST2X	Change in the spread between 6-month money market rates (NIBOR) and the yield on government paper in the ST2X index on the Oslo Stock Exchange. The ST2X index has a duration of 6 months	+

¹⁸ The steeper the yield curve, the stronger this effect will be.

ables. The regression performed is the ordinary least squares method. The variables in the model are defined in Table 1.

Data

We use average monthly data from the Oslo Stock Exchange, Reuters, Bloomberg, EcoWin and Norges Bank in the estimation. The data cover the period from January 1997 to December 2003, i.e. a total of 84 months. This period includes periods with substantial variations in swap spreads, for example in connection with the turbulence in financial markets in 1998. Developments in the period resulted in a considerable increase in swap spreads in most countries. In autumn 1998, Norwegian 5- and 10-year swap spreads increased in the course of a few months from 30 basis points to 60 and 85 basis points, respectively. The spread remained wide for a number of years afterwards. Since summer 2002 the swap spread has been wider in the 5-year than in the 10-year segment (see Chart 2).

Results

When the 5- and 10-year swap spreads are estimated according to Model 1, there are few significant explanatory variables. The bulk of the explanatory power stems from the dummy variables, which have a relatively high partial R^2 . There may be several reasons why the explanatory power of the variables is low; for example, there may be omitted variables. Moreover, the model is static, hence it does not capture changes in the relations between the explanatory variables and the swap spread. The manner in which the swap market functions has undergone substantial changes in the period we are looking at. This may be a reason why the relationships the model is supposed to explain have not been static.

Moreover, the effect of international developments is only included indirectly in the model's explanatory variables.

There are also probably lag effects in the relationships between the explanatory variables and the swap spreads. This may be due to the fact that it takes time from when market participants identify arbitrage possibilities until they are exhausted, or possibly to other frictions in the markets. This might for example apply to the activity in the Eurobond market. In order to capture such relationships, we include lagged variables in the reduced model (Model 2).

Table 2 shows which explanatory variables and coefficients are included in the reduced model of changes in 5- and 10-year swap spreads, respectively (Model 2).

The reduced models contain far fewer explanatory variables than we included initially. They omit issues of government bonds, changes in the slope of the yield curve, changes in the yield differential against Germany and the volatility of the interest rate market. The model for changes in 5-year swap spreads only gives significant explanatory power to returns in equity markets, the lagged variable for changes in swap spreads and the dummy variables. In the model for changes in the 10-year spread, changes in the NIBOR spread and issues of Eurobonds are also significant explanatory variables.

With the exception of equity market returns in the 10-year model, the variables in the models that prove to be significant are in lagged form. This may be due to chance, but may also indicate that it takes time for the various factors that influence swap spreads to feed through. These dynamics may also vary with different swap market maturities. The lag structure in the model may also be influenced by our use of monthly averages for the explanatory variables. All the explanatory variables have the same sign in the model as expected.

Table 2. Test results for Model 2

	$\Delta 5Y\text{Swapsread}$		$\Delta 10Y\text{Swapsread}$	
	Coefficient (t-value)	Partial R^2	Coefficient (t-value)	Partial R^2
Constant	0.0011 (0.24)	0.0007	0.0142 (2.06)	0.0528
$\Delta 5Y\text{Swapsread}_{t-1}$	0.2176 (2.23)	0.0607		
$\Delta 10Y\text{Swapsread}_{t-1}$			0.1951 (2.17)	0.0586
ΔOSEBX			-0.2356 (2.58)	0.0806
$\Delta \text{OSEBX}_{t-1}$	-0.1622 (-2.02)	0.0501		
$\Delta \text{Nibor6m-ST2X}_{t-1}$			0.2272 (2.62)	0.0830
Eurobond $_{t-1}$			-0.0009 (-2.41)	0.0713
Dummy1	-0.1434 (-3.18)	0.1163	-0.2261 (-4.55)	0.2144
Dummy 2	0.1886 (4.16)	0.1836		
N		82		82
$R^2/\text{Adj. } R^2$		0.3151 / 0.2795		0.4116 / 0.3729
Σ		0.0440		0.0483
DW		2.06		1.96

5. The importance of the components of the swap spread for choice of benchmark

The qualitative difference between using government bonds and interest rate swaps as a benchmark for long-term rates depends on whether the factors that determine developments in swap spreads are relevant to the application of the reference rate in question here. In theory, variations in required real rates of return and inflation expectations should affect the government bond and interest rate swap markets in the same way. Differing developments in these rates must therefore be attributable either to variation in other components of the swap rate or to imperfections in price formation in one or both of the markets.

The model indicates that for the period 1997 to 2003 the factors that determine the swap spread are developments in equity markets, the NIBOR spread and issues of Eurobonds. The explanatory variables may affect the swap spread both through variations in components of the swap spread and through market imperfections. In the reduced models, there is a negative relationship between developments in the equity market and changes in the swap spread. It is difficult to determine whether it is the effect of portfolio allocation between the equity market and the fixed income market, or the effect of changes in expected and actual credit risk which contributes most to the change in the swap spread, as both influence the swap spread in the same direction. If the changes in the swap spread are due to imperfections in the government bond market, swap rates will be a better benchmark for real interest rates and inflation expectations than government bond yields. Changes in the swap spread as a result of changes in credit risk are more problematic. A widening of the swap spread as a result of increased credit risk in the banking sector will not necessarily be relevant to the pricing of a corporate bond. Overall, the estimated relationship between developments in the equity market and changes in the swap spread contribute to strengthening the swap market as a benchmark for the pricing of corporate bonds.

As expected, issues of Eurobonds have a negative effect on the swap spread. Contrary to expectations, however, the explanatory power is significant in the 10-year segment, but not in the 5-year segment.¹⁹ This may indicate that liquidity in the government bond market was lower in the 10-year than in the 5-year segment. As mentioned above, Eurobond issues affected the swap spread through two channels: partly through participants' increased desire to receive a fixed interest rate in the swap contract, partly through the reduction of any scarcity components in the pricing of government bonds. Lower swap rates as a result of one-sided flow in the swap market reduce the suitability of swap rates as a benchmark for the pricing of corporate bonds. The component that concerns less scarcity of government bonds

should in principle not be relevant to the pricing of corporate bonds.

The NIBOR spread is a significant explanatory variable in the model for changes in the 10-year swap spread. Since the NIBOR spread can be taken as an expression of the risk in the banking sector/system, it is relevant to the pricing of bonds whose risk profile is related to the risk in this sector. This component of the swap spread may be irrelevant to the pricing of other bonds.

6. Conclusion

In Norway the swap market is the most relevant alternative to the government bond market as a benchmark market. The purpose of this article is to illustrate differences between using these two markets as a benchmark in the Norwegian bond market. The differential between the interest rates in the swap market and yields in the government bond market, the swap spread, can provide some indication of the qualitative difference between the use of these two markets as a reference for developments in long-term rates. In the period 1997 to 2003, our model indicates that the differential between government bond yields and swap rates varied with developments in the NIBOR spread, equity markets and issues of Eurobonds. The results show that the swap market may be suitable as a benchmark for corporate bonds, even though some of the components that explain changes in the swap spread and of limited relevance to the pricing of some types of corporate bond.

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¹⁹ We expected that the swap spread would be more strongly affected in the 5-year than in the 10-year maturity segment.