

## Summary

The market for covered bonds is important for bank funding and therefore financial stability. The requirements for banks to hold more capital and liquidity for their operations have been tightened since the financial crisis. These requirements affect the banks' costs of holding securities in the trading book and so their costs of acting as market makers. Market makers play an important role in supporting market liquidity. Market liquidity in turn affects funding liquidity. In theory, higher capital and liquidity requirements should reduce market liquidity, and market participants are attesting that this has in fact happened.

Finansinspektionen (FI) has therefore studied market liquidity for covered bonds using unique transactions data. The selected measure of liquidity, the yield impact, reflects the change in yield to maturity that can be observed between two transactions carried out on the same day for a specific bond. Our results show that this form of liquidity has been unchanged in recent years. We also find that there is a strong correlation between market liquidity in covered bonds and government bonds.

On average, the transaction cost for covered bonds has been just under 2 basis points over the past few years. For government bonds it has been about 1.3 basis points. The fact that this has remained constant for several years despite increasing legal requirements on banks' capital and liquidity does not necessarily mean that the higher requirements have not had any impact, but it may also be due to these possible negative effects having been offset by the Riksbank's increasingly expansionary monetary policy.

Turnover in relation to the outstanding volume of covered bonds has fallen since the financial crisis. This has fallen in line with the ever-lower interest rates. Low yield to maturities probably mean that some turnover is lost as the risk-adjusted return is too low. Given the relatively constant transaction costs we are observing, lower yield to maturities mean that costs as a percentage of expected returns rise sharply. It is likely that as a result, investors have held back from doing business.

In case monetary policy was to be normalised, there might be a risk of deterioration in market liquidity. It is therefore necessary to continue analysing the development of market liquidity in covered bonds.



## Introduction

One of the areas of responsibility of FI is to work for the proper functioning of the markets. The covered bond market is an important source of funding for Swedish banks and its function is critical for the functioning of the financial system. In order for FI to be able to determine how well the market is working, we have analysed the market liquidity for the period from the financial crisis up to the present day.

The fixed income market plays a system-critical role for liquidity and risk management in the financial system. The Swedish fixed income market is an important market that enables central government, municipalities, banks and businesses to finance their operations. Importantly, residential mortgages are funded by the banks issuing covered bonds.<sup>1</sup> This analysis examines the market liquidity and how it has evolved for these bonds.<sup>2</sup>

The market for bonds is usually divided into a primary market and a secondary market. The primary market refers to the market where a borrower issues a security for the first time. The secondary market refers to the market where buyers and sellers of previously issued bonds meet.

The function of the secondary market is important for several reasons. Firstly, it forms the basis for pricing in the primary market. When a borrower first issues a bond, the price is usually based on how the same or similar bonds are priced in the secondary market. A well-functioning secondary market with transparent pricing facilitates the valuation and risk management of assets and liabilities. Above all, the secondary market fulfils an important function in that the owner of a bond can almost immediately convert it into liquid funds.

### DIFFERENT DEFINITIONS OF LIQUIDITY AND HOW THEY RELATE TO ONE ANOTHER

Liquidity can be expressed in various ways. The common denominator is that it is a direct or indirect measure of the availability of liquid funds. IMF (2015) divides liquidity into three elements: monetary liquidity, funding liquidity and market liquidity. Monetary liquidity is the liquidity that a central bank adds to the economy in the form of various facilities, such as loans guaranteed against securities or quantitative easing through the purchase of securities. This in turn often has an effect on funding liquidity.

Funding liquidity describes how easily a participant can finance their operations. Market participants dependent on funding liquidity are those that use leverage. Examples of these include hedge funds and banks with market maker operations. These participants fund their assets essentially by borrowing money, often using securities in their portfolios as collateral. Another element of their funding is how much equity they need to retain for their business or for certain positions. Changes to the borrowing terms of counterparties (including the Riksbank) and the collateral requirements of stock exchanges and clearing houses affect a market operator's capital requirement. Borrowed funds must therefore be supplemented by equity to a greater or lesser extent.

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<sup>1</sup> Covered bonds may be issued after authorisation from FI (Act 2003:1223 on the issuance of covered bonds; FFFS 2013:1).

<sup>2</sup> For a comprehensive description of the market for covered bonds, see Sandström, *et al.* (2013).

The ability of banks to raise capital and the costs involved thus have an impact on funding liquidity. Legal capital requirements can be seen as a form of requirement for how much collateral they must hold against their positions.

One definition of market liquidity is the ability to convert assets into liquid funds without major price changes. The more that can be converted without the price being affected, the deeper the market is said to be. Another way of defining market liquidity is that assets can be converted into liquid funds quickly, regardless of price. For a broader measure of market liquidity, it can be assumed that both definitions must be fulfilled at the same time. In other words, it should be possible to quickly convert assets into liquid funds at a predictable and stable price regardless of market conditions.

In a market that fulfils these definitions, investors will not require compensation for the uncertainty with regard to their ability to convert their assets, a liquidity premium. The lower the liquidity premium, the cheaper funding is for a borrower, thus improving borrowers' funding liquidity. Large borrowers therefore often have different arrangements in place in order to promote liquidity in the secondary market for their securities. These may include contracted market makers, which for a fee undertake to continuously provide bid and offer prices for the borrower's securities. It is also common to use facilities that make it easier for the market maker to fulfil its commitments, such as lending agreements for securities (known as repo agreements). The latter is an example of measures to improve funding liquidity for market makers. Brunnermeier and Pedersen (2009) shows that favourable funding conditions contribute to good market liquidity, and vice versa. For example, increased funding costs or higher margin requirements can result in a need for participants to reduce their positions. The pressure to sell leads to falling prices. When the asset in question falls in value, this reduces the scope for leverage. This in turn can lead to further selling, and so on. On the other hand, good market liquidity can improve funding conditions, such as through low margin requirements. This in turn leads to increased demand. Prices rise and there is increased scope for leverage.

Brunnermeier and Pedersen (2009) also shows that when funding liquidity is good, market liquidity is not directly affected by minor changes in funding. If, however, funding conditions are approaching a given constraint (such as a capital requirement) market participants pull back their activity, weakening market liquidity. This explains why market liquidity is in some cases not affected by a worsening of funding conditions, while in other cases marginal and small changes can quickly weaken market liquidity. When market liquidity then worsens, funding liquidity suffers even more and a spiral of steadily worsening market liquidity and funding liquidity develops. Funding liquidity also links together the market liquidity of different assets. A change in a market operator's funding conditions affects its overall ability to provide market liquidity.

The two definitions of liquidity are therefore strongly linked. In this analysis, we intend to examine how market liquidity has developed. This is nevertheless dependent on funding liquidity.

### STRICTER REQUIREMENTS FOR CAPITAL AND LIQUIDITY

In the years before the financial crisis, funding liquidity was good, which meant good market liquidity. Banks and hedge funds found it easy to fund their assets, often with low margin requirements. In retro-

spect, the funding proved to have been too focused on the short-term and the margins in the form of equity too small in relation to the assets' price development. Some of the assets funded were difficult to turn over in order to repay loans on time.

After the financial crisis, a number of new regulations have been or are about to be adopted. Their purpose is to prevent a similar crisis from unfolding again. Many of the regulations focus on the capital and liquidity of banks.

Banks need to hold more capital for their trading book and to fund it with longer maturities. Both of these factors involve cost. According to the theory (Brunnermeier and Pedersen, 2009), this should worsen the liquidity in the bond market. Market participants believe that this has actually happened.

### ACCORDING TO SURVEYS THE RISK APPETITE OF MARKET MAKERS IS FALLING

The Riksbank conducts a risk survey twice a year where they interview market participants about the functioning of the currency and fixed income markets.<sup>3</sup> Between 70 and 80 market participants are polled in the survey and the response rate is typically 85–90 per cent. The respondents consist of market makers (approximately 28 per cent of the sample), investors and borrowers.

In the autumn of 2013, many participants indicated a reduced risk appetite among market makers, in particular in the fixed income market. Reasons given for this were the effects of regulations, with Basel III mentioned. In the spring of 2014, both market makers and investors in the fixed income market said that the market makers' willingness to take risk had continued to decline. The respondents believed that this was due to the upcoming capital adequacy requirements. In the surveys of the autumn of 2014, the spring of 2015 and the autumn of 2015, many market participants said that they were finding market makers' willingness to take risk to be lower. The market participants felt that market makers did not want to hold as large inventories of assets as before, which they believed was due to capital adequacy requirements.

## The Swedish fixed income market

In recent years, the bond market both in Sweden and globally has grown significantly in terms of outstanding volumes. Turnover in the secondary market has not followed this trend.

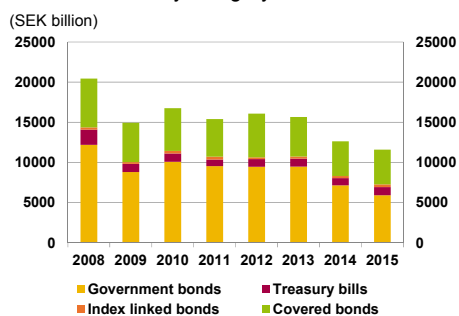
The banks, which traditionally acted as market makers, in recent years have increased their focus on return on equity within their markets departments. This may be a result of stricter capital and liquidity requirements. In the Riksbank's risk surveys, banks claim to have reduced their trading books in recent years.

Swedish banks are heavily reliant on market funding and covered bonds are an important part of this. The banks are also major investors in covered bonds. Around a quarter of their outstanding volume is owned by Swedish banks, mostly in liquidity portfolios. Reduced liquidity in the market for covered bonds could lead to higher funding costs for the banks, which would have an impact on household mort-

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<sup>3</sup> See, for example, the Riksbank's risk survey, autumn 2015

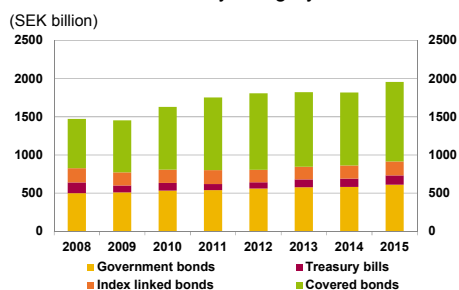
Diagram 1: Turnover in the Swedish fixed income market, by category



Source: Sveriges Riksbank

Note: Mortgage bonds refer to benchmark bonds. The bonds are covered bonds from 2007–2008. 2015 is annualised.

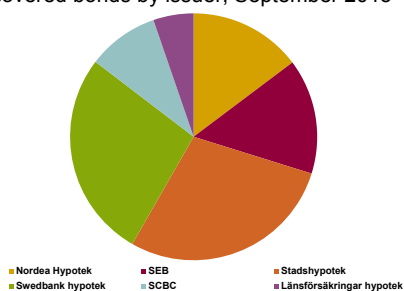
Diagram 2: Outstanding volume in the Swedish fixed income market by category



Source: Swedish National Debt Office and Handelsbanken

Note: Mortgage bonds refer to benchmark bonds. Volume is expressed as an annual average.

Diagram 3: Distribution of outstanding volumes of covered bonds by issuer, September 2015



Source: Statistics Sweden

gage costs. This could also affect the banks' ability to convert their liquidity portfolios when they need to free up liquid funds.

Turnover in the Swedish fixed income market was unchanged in absolute terms during the years following the financial crisis, but showed a decline in 2014 (see Diagram 1). The biggest fall was in the turnover of government bonds. The turnover of covered bonds for which turnover data is readily available from the Riksbank (so-called benchmark bonds) also fell slightly over the period. At the same time, there was an increase in the outstanding volumes, in particular in covered bonds (see Diagram 2).

The market for covered bonds is now the single largest bond market in Sweden. The total outstanding volume is over SEK 2,000 billion, of which around SEK 1,500 billion is denominated in Swedish krona. In comparison, the national debt amounts to SEK 1,500 billion, distributed across all types of debt and currencies. Nominal government bonds in Swedish krona total just under SEK 600 billion.

Stadshypotek and Swedbank hypotek account for more than 50 per cent of the outstanding stock of covered bonds (see Diagram 3). SEB is the issuer that has increased its covered debt the most, at an average rate of 15 per cent per annum from 2010 to 2014 (the other banks are around 0–5 per cent).

#### Interest rate risk transformation

In the autumn of 2014, 73 per cent of households chose variable interest rates on their mortgage and of the total stock, 57 per cent of mortgages have variable interest rates (Statistics Sweden). In order to manage the short fixed-interest term chosen by households, an issuer of covered bonds with a fixed coupon rate usually enters into an interest rate swap with the dealer at the same time as the issue. In the swap, the issuer usually receives a fixed coupon rate and pays a variable coupon rate that change every three months. This is done in order to convert the fixed coupon on the bond to a variable rate that better corresponds to the customer's mortgage interest rate. The issuer's funding cost is then the 3-month STIBOR plus (minus) the difference between the interest rate swap and the bond's fixed coupon rate. The issuer's funding cost is thus not a direct function of long bond yields, but a function of the difference between the interest rate swap and the issuer's traded yield to maturity.

The derivatives market is therefore very important for the issuers in managing their interest rate risk. There are also a number of futures on interest rates listed on NASDAQ that are actively traded by investors.<sup>4</sup>

## MARKET STRUCTURE

The market for covered bonds can basically be divided into two groups, a benchmark market and a syndicated market. In the syndicated market, trading takes place on the secondary market without a bank being committed by an agreement to continuously provide bid and offer prices for the bond. The banks nevertheless provide market making services to the extent they consider it profitable in order to nurture customer relationships or to win new primary market issues. Unlike the benchmark market, there is no established repo market for these

<sup>4</sup> These futures accounted for 31 per cent of turnover in 2014, but a large proportion was term changes for futures at maturity and does not involve any "new" turnover.

securities, and the issuers offer no special repo facilities to the dealers as is the case in the benchmark market.

### The benchmark system

The system of benchmark bonds has existed for over thirty years in Sweden and is built around a number of issuers and contracted dealers, who are the only ones allowed to buy bonds directly from the issuer. The bonds are mostly sold “on tap”, meaning that the issuer increases the outstanding volume of a bond already issued by selling bonds directly to the dealers.

Each issuer has defined in its dealer agreement what constitutes a benchmark bond, even if there is no standard definition, and the dealer’s (market maker’s) commitment with regard to these rules. What constitutes a benchmark bond is determined, among other things, by the maturity and the outstanding volume meeting certain conditions. The dealer normally commits to provide indicative bid and ask prices in various information systems, and, on request, tradeable prices to customers for a bond when it meets the benchmark criteria. As there is a binding agreement to provide tradeable prices for benchmark bonds, they can be expected to have better liquidity than other covered bonds.

The issuers of benchmark bonds are Länsförsäkringar hypotek, Nordea hypotek, SCBC (Swedish Covered Bond Corporation, actually AB Sveriges Säkerställda Obligationer, a subsidiary of SBAB), SEB, Stadshypotek and Swedbank hypotek. Landshypotek and Skandiabanken are authorised to issue covered bonds but they do not use a benchmark system. The institutions that have benchmark bonds in Swedish kronor also use the syndicated market for their issues, mainly in other currencies.

The dealers are the four major banks<sup>5</sup> plus Danske Bank. There is therefore a strong interconnection, particularly because issuers and dealers often operate within the same corporate group. However, the two activities are carried out in different departments, with the treasury function at each bank responsible for borrowing and the market departments acting as market makers. Danske Bank does not issue covered benchmark bonds in Swedish krona. Of these issuers, SBAB and Länsförsäkringar hypotek do not have any dealer operations.

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#### What are the economics of a market maker?

The market makers have committed to provide bid and offer prices in the market on a continuous basis. In simplified terms, their income consists of the fees they receive from the issuers, the net result of financial transactions (including risk management of the trading book) and the return of the trading book. Brokerage fees are not normally payable in the fixed income market. In simplified models, it can sometimes also be said that market makers earn the difference between the quoted bid and offer prices. This is not entirely accurate, as market makers need to trade in the market in order to risk manage their trading book and the flows they receives. As a result, they also pay a transaction cost. In the event of large market movements and unilateral customer flows (lots of sellers, for example), the trading book can change significantly in value, sometimes negatively.

The market makers’ costs include salaries, systems, support functions, contributions to the stability fund and the funding costs of the trading book. Sup-

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<sup>5</sup> Handelsbanken AB, Nordea AB, SEB AB and Swedbank AB

port functions include, for example, risk control, back office and the accounting function.

A market maker's funding cost is affected by funding liquidity. The direct funding costs depend on the type of asset in the trading book. This is partly due to the fact that a market maker seeks to fund its trading book as efficiently as possible. One of the keys to this is to use short-term loans backed by bonds, so-called repo transactions. If the market maker has sold bonds they do not have in the trading book, they need to borrow them in order to be able to deliver to the buyer. The risks of the operation also affect the proportion that must be funded using equity. The greater the risk, the higher the capital requirement. Shareholders' return on equity is therefore an indirect cost of funding the trading book.

Costs have probably risen in a number of areas in recent years. Reporting requirements have resulted in greater system intensity. Control functions have been extended. Funding costs have risen as market makers are forced to fund themselves for longer terms. The capital required for the business has also increased. A constant net result today leads to a lower return on equity than before the financial crisis.

The revenue side is more difficult to comment on. As bond prices have risen in recent years, it can be assumed that the revenue side has benefited from gains in the trading book.

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## Price impact, yield impact and liquidity risk

In the following analysis, we examine the actual cost of trading. This will give us an idea of whether the market makers have increased the spread between bid and offer prices in order to compensate for the increased costs that the higher capital requirements may have brought.

The turnover information that is publicly available is aggregated for each bond.<sup>6</sup> This means there is no reporting of individual trades to market participants. As a basis, we instead use the transactions reported daily to FI for transactions carried out in the securities markets.<sup>7</sup> This provides us with a unique opportunity to analyse the completed transactions. For a description of how we process data, see Appendix 1.

In order to measure the transaction costs related to liquidity, we have chosen to use a modified version of Amihud's (2002) liquidity measure, which is called price impact (Dick-Nielsen *et al.*, 2012b). The price impact (PI) can be described as the absolute return between two successive transactions,  $i-1$  and  $i$ , on day  $d$  for bond  $k$ :

$$PP_{d,i,k} = \frac{|p_{d,i,k} - p_{d,i-1,k}|}{p_{d,i-1,k}}$$

As we are interested in price changes that have a link to liquidity and not to new information, we exclude absolute returns that take place

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<sup>6</sup> The market makers report the total daily volume traded per bond to the Riksbank and NASDAQ. They also report the highest, lowest and average price they traded at.

<sup>7</sup> Investment firms are obliged to report transactions in financial instruments listed for trading on a regulated market or a multilateral trading facility (MTF). See Act (2007:528) on securities markets and FI's regulations (FFFS 2007:16).

between two different days and absolute returns that are greater than 1 per cent. Generally speaking, a high price impact indicates that the price has been significantly affected by a transaction, which means that the transaction cost is high and the bond may be illiquid. Unlike Dick-Nielsen *et al.* (2012b), we analyse all covered bonds separately when we calculate the price impact. In other words, we do not group bonds with the same cash flow. The downside of our more conservative approach is that it slightly reduces the number of useful observations for calculating the price impact. It does, however, take into account the fact that the buyer and the seller might care about who issued a particular bond, and we can also measure the difference in liquidity between issuers. Another consequence of our method is that we are unlikely to see a similarly large number of transactions that generate a zero price impact, which happens when the price has not changed between two transactions.

In Sweden, bonds are traded by convention on yield to maturity and not on price. The yield to maturity is the *annual* return an investor can expect to receive if they buy the bond, reinvest the coupon in the bond and hold it to maturity. Maturity affects how price-sensitive the bond is to a change in the expected annual return. In order to normalise our price impact, we therefore divide the price impact by the remaining time to maturity, expressed in years:

$$YP_{d,i,k} = \frac{PP_{d,i,k}}{(\text{time to maturity in days}/365)_{d,k}} * 100$$

This is a simplification, but we have chosen to do so for practical reasons. We then get a term-independent measure of the price impact, which we call yield impact, YI.

To measure how much liquidity has varied over a given time period, we calculate the difference between the highest and lowest quartile of the yield impact distribution:<sup>8</sup>

$$\text{Liquidity risk} = YP^{75\%} - YP^{25\%}$$

This difference shows how much liquidity has varied over a fixed period of time and therefore provides a measurement of the uncertainty concerning the level of liquidity. A high value indicates a wide yield impact distribution during the period.

The spread between the quoted indicative bid and offer yields of benchmark bonds from the market makers has remained constant since the financial crisis at 0.04 per cent, i.e. 4 basis points. There has therefore not been any increase in the indicative transaction cost in recent years, despite indications from the market that liquidity has deteriorated. *Ex ante* we can expect that the actual cost of trading will not exceed 4 basis points in any case. If this were to be the case, the market makers would probably have increased the spread between the quoted bid and offer yields.

## Liquidity has been relatively stable in recent years

<sup>8</sup> We calculate the liquidity risk of the price impact in the same way.



Our study of the yield impact shows that liquidity has remained unchanged in recent years. During the financial crisis in 2008, the average yield impact for covered bonds was elevated, indicating worse liquidity (see Table 1). As the financial crisis subsided, liquidity improved to a relatively stable level, taken as an annual average. The pattern is similar for government bonds.

**Table 1: Annual measures of liquidity**

<b>Yield impact</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>
Covered bonds	2.95	3.17	2.24	2.20	1.91	1.88	1.89	1.85
Benchmark	2.90	2.92	2.16	2.16	1.86	1.73	1.74	1.75
Non-benchmark	3.15	4.24	3.02	2.38	2.29	3.31	3.08	3.07
Government bonds	2.46	1.88	1.72	2.16	1.76	1.38	1.21	1.30

<b>90th percentile</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>
Covered bonds	8.32	8.42	6.40	6.11	5.23	5.36	5.06	5.09
Benchmark	8.44	8.04	6.31	6.01	5.05	4.91	4.73	4.87
Non-benchmark	8.00	11.73	8.23	6.46	6.69	9.49	8.71	9.14
Government bonds	5.40	4.27	4.50	5.47	4.31	3.51	3.09	3.02

<b>Liquidity risk</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>
Covered bonds	3.63	3.99	2.82	2.79	2.50	2.41	2.25	2.19
Benchmark	3.69	3.98	2.84	2.78	2.48	2.25	2.15	2.14
Non-benchmark	3.36	4.17	3.22	2.77	2.94	4.35	3.24	2.85
Government bonds	2.58	2.04	1.99	2.62	2.06	1.62	1.36	1.42

<b>Observations</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>
Covered bonds	12,549	12,499	15,806	18,173	16,508	12,365	8,540	9,077
Benchmark	10,157	10,181	13,084	15,374	13,946	10,626	7,318	8,110
Non-benchmark	2,392	2,318	2,722	2,799	2,562	1,739	1,222	967
Government bonds	20,618	21,414	26,815	36,446	36,713	31,322	18,566	10,808

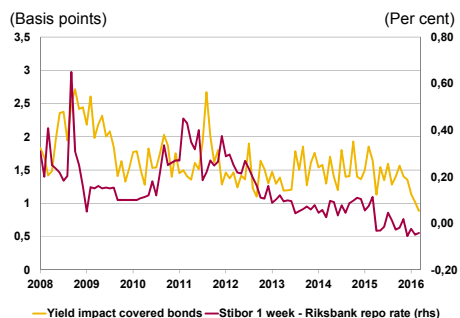
Source: FI

Note: Table 1 summarises the annual results in the form of the selected measures of liquidity. The year 2015 includes only the first three quarters. The measures are calculated as an average of the measures of liquidity for each bond included in the analysis: average yield impact, 90th percentile of the yield impact and liquidity risk. We also show the number of observations for the different categories. Results are expressed in basis points (1/100 per cent).

Since the end of the financial crisis, market makers have published indicative bid and offer yields for covered bonds with a 4-basis-point spread and for government bonds with a 2-basis-point spread. Our results show that the average transaction cost in recent years has been less than 2 basis points in covered bonds and approximately 1.3 basis points in government bonds. The effective transaction cost of covered bonds has therefore been just under 50 per cent of the published spread for most of the period. The 90th percentile of the yield impact gives an idea of the worse outcomes. This has improved continuously since the financial crisis subsided and hovered around 5 basis points in 2014–2015.

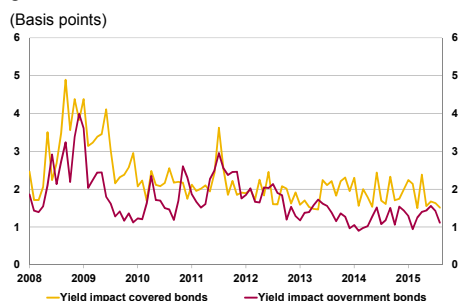
Liquidity risk is, as described above, a measure of the variation in the yield impact during the measurement period. It can also be seen as a

Diagram 4: Yield impact for covered bonds (left axis) and short-term bank borrowing minus the Riksbank's repo rate (right axis)



Source: FI and Bloomberg

Diagram 5: Yield impact on covered bonds and government bonds



Source: FI

measure of the distribution of the yield impact in a given period. A low value indicates stable liquidity, while a high value indicates substantial variation in liquidity. This measure has also improved since the financial crisis and remained relatively stable at just over 2 basis points for the last 3 years. This suggests that liquidity has been relatively predictable.

We therefore find that, contrary to both what the theory says and what market participants claim, liquidity has not deteriorated; our measure of liquidity – the yield impact – has remained unchanged. However, there may be other reasons why market liquidity has not yet been affected.

The Riksbank has lowered the repo rate considerably and also introduced quantitative easing in the form of the purchase of government bonds, which may have benefited financial liquidity. Normally, the difference between short-term loans and yields on longer bonds increases when official interest rates are lowered. The Riksbank's cuts of the repo rate have reduced the cost of short-term loans for funding the trading book. In addition, the value of the trading book has risen in line with falling market yields, which has probably contributed to the profitability of market makers.

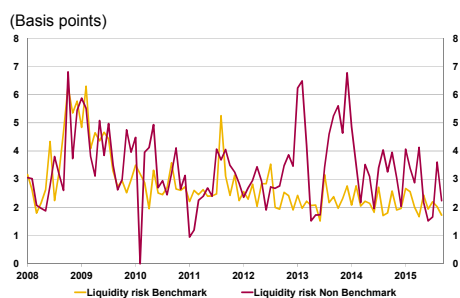
The banking system deposited a net SEK 81 billion with the Riksbank at the end of September 2015. In September 2014, SEK 3 billion was deposited<sup>9</sup>. This means that liquid funds in the financial system increased significantly as a result of the Riksbank's monetary policy. All in all, this may indicate that the reason why market liquidity remained relatively constant is that the Riksbank's actions have compensated for any effects of regulatory changes.

Diagram 4 shows the yield impact for covered bonds and the interest rate differential between the 1-week STIBOR and the Riksbank's repo rate. The difference can be seen as a measure of the cost of funding an investment in a covered bond at the Riksbank compared with borrowing money without collateral in the interbank market. During periods of tighter funding conditions, scarcity of funds will cause interest rates to rise for short-term loans in the interbank market relative to the Riksbank's repo rate. As the supply increases, there is less need to borrow and thus interest rates fall. Since the Riksbank began its quantitative easing measures in the spring of 2015, the financial system has acquired a larger surplus of liquidity. This has led to the 1-week STIBOR being below the Riksbank's repo rate during some periods. Funding liquidity has been good from this perspective, with market liquidity improving slightly in recent months as a result. To study the relationship more closely, we performed a multiple regression with control variables. We found that the difference between STIBOR and the repo rate has a positive effect on the yield impact. The result is significant with a 90 per cent confidence interval.

Diagram 5 shows the monthly yield impact for government and covered bonds. It can be seen that government bonds exhibit more stable liquidity at a lower level. The differences between the two asset classes have varied over time, however. The market liquidity of the two asset classes exhibits a strong correlation, as demonstrated by Brunnermeier and Pedersen (2009).

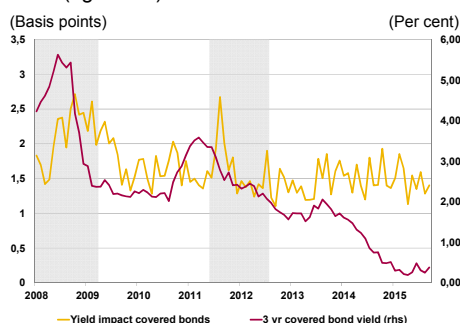
<sup>9</sup> SCB, assets and liabilities of monetary financial institutions by institution, account item and currency.

Diagram 6: Liquidity risk in benchmark bonds and non-benchmark bonds



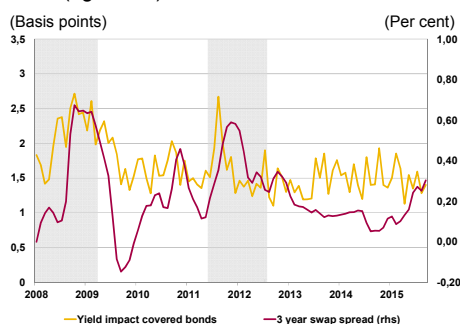
Source: FI

Diagram 7: Yield impact on covered bonds (left axis), and interest rate on a 3-year covered bond (right axis)



Source: FI and Bloomberg

Diagram 8: Yield impact on covered bonds (left axis), and swap spread on a 3-year covered bond (right axis)



Source: FI and Bloomberg

Table 1 clearly shows that the liquidity of benchmark bonds is normally better than for non-benchmark bonds. This is to be expected, as benchmark bonds have contracted market makers. Benchmark bonds also have more standardised contract terms (such as maturities) and larger outstanding volumes compared with non-benchmark bonds. These factors have been mentioned in the international debate as ways of promoting liquidity in the bond market. The effective transaction cost the customer encounters is approximately 1–2 basis points higher for non-benchmark bonds. The exception is 2011–2012, when the differences were smaller. Poorer liquidity should lead to investors demanding a greater return for investing in non-benchmark bonds.

Liquidity is also more stable measured in terms of liquidity risk for benchmark bonds (see Diagram 6). This is natural for a system with market makers who have committed to provide liquidity. In the absence of a formal mandate to provide market maker services, liquidity in non-benchmark bonds becomes more dependent on the interest and ability of a bank to provide a bid or offer price.

### MARKET FACTORS AND LIQUIDITY

Diagram 7 shows the market development for covered bonds in absolute terms in the form of yield to maturity and in Figure 8 as a spread to interest rate swaps. The latter is a good way of identifying more specific price effects on covered bonds disregarding fluctuations in general interest rates. It also shows the average yield impact per month for covered bonds.

The grey areas indicate two episodes of elevated stress. The markings are not precise and should be seen as indications of events that could potentially have affected liquidity. Nor should the periods be considered exhaustive. A large number of other factors were in play during the measurement period. Among other things, quantitative easing from the world’s central banks benefited funding liquidity. At the same time, authorities and governments around the world introduced a number of regulations to control the risks in the banking system and on the financial markets, which, according to Brunnermeier and Pedersen (2009) and the Riksbank’s risk surveys, may have had the opposite effect on funding liquidity. As this has happened simultaneously and in several moments over a rather long time window, it is not possible to define a clear period.

The crises we have chosen to identify are:

- January 2008 – March 2009  
The US mortgage crisis escalated and Lehman Brothers went bankrupt in September 2008. Swedbank and SEB had problems in the Baltic States and Ukraine. Market liquidity worsened and yields on covered bonds rose relative to more risk-free fixed income instruments (swap spread increased, Diagram 8).
- June 2011 – July 2012  
A number of countries in Europe had problems with their public finances. Concerns intensified during the summer of 2011. In May 2012, it emerged that JP Morgan had lost large sums on credit default swaps (what became known as the “London Whale” affair after the trader’s nickname). The greater focus on credit risks led to an increase in the yields on covered bonds relative to interest rate swaps and a worsening of liquidity. In July 2012, ECB President Mario Draghi announced that they were

ready to do “whatever it takes”. The liquidity in the market improved over the following year.

Diagram 7 clearly shows that the yield impact has remained relatively constant in recent years, while yields on 3-year covered bonds have fallen. Therefore, transaction costs do not seem to be strongly correlated with interest rates. Instead, falling yield to maturities mean that transaction costs have risen (sometimes sharply) relative to the expected return. If the yield to maturity is 0.25 per cent and the yield impact is 2 basis points (0.02 per cent), the transaction cost accounts for 8 per cent of the expected return. If the yield to maturity had instead been 2.5 per cent, the transaction cost would have been 0.8 per cent of the expected return. The transaction costs’ increasing share of the expected return is a very plausible explanation for the decrease in turnover (as shown in Diagram 1).

## Regressions

To gain a better understanding of how our liquidity measure is affected by stress periods, we use regression models with different dummy variables, which identify a number of crises. We restrict the sample to covered benchmark bonds. We do this because we have chosen to use a measure of the benchmark bonds’ outstanding volumes as an explanatory variable in the regression. The measure is expected to have a negative effect (that is, a negative coefficient) on the price impact/yield impact. The reason is that larger bond issues are assumed to have a better distribution among investors and therefore a higher turnover, which should lead to better liquidity. Finally, we include transaction volume in order to examine how the size of a transaction affects our liquidity measure.

The regression for the price impact is defined as:

$$PP_{t,i,k} = \alpha + \beta'_{crises} \mathbf{X}_{crises,t} + \gamma \times \log(weight)_{t,k} + \delta \times \log(tot\_quantity)_{t,k} + \varepsilon_t$$

and the yield impact as:

$$YP_{t,i,k} = \alpha + \beta'_{crises} \mathbf{X}_{crises,t} + \gamma \times \log(weight)_{t,k} + \delta \times \log(tot\_quantity)_{t,k} + \varepsilon_t$$

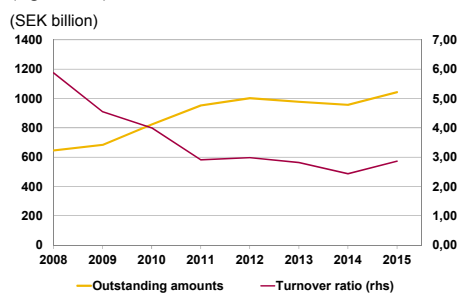
where  $\beta_{crises,t}$  and  $\mathbf{X}_{crises,t}$  are two (2x1) vectors of coefficients and dummy variables respectively, which define the two selected stress periods. The two other variables are  $\log(weight)$ , which are log-transformed index weights for bond  $k$  in Handelsbanken’s index for covered benchmark bonds, and  $\log(tot\_quantity)$ , which is a log-transformed trade quantity for transaction  $i$  and bond  $k$ .

### Regression results

Table 2 shows the results of the regressions for the price impact and the yield impact. A positive value for the parameters means that the price impact or the yield impact increases due to the variable; in other words liquidity has deteriorated.

Of the two crises we have defined, the financial crisis, *sub-prime\_dummy* in the table, has the greatest effect on both the price impact and the yield impact. The sovereign debt crisis of 2011–12 is not as significant from an economic perspective as the parameter estimates are lower, even though it is still positive; in other words, the

Diagram 9: Outstanding volumes for covered benchmark bonds (left axis) and turnover ratio (right axis)



Source: Handelsbanken and the Riksbank

Note: The figures refer to benchmark bonds and turnover in long mortgage bonds. The turnover rate for 2015 is annualised.

price impact and the yield impact increased. Both parameters for crises' dummy variables are statistically significant.

Table 2: Results of the regression analysis on benchmark bonds

Variable	Price impact Parameter estimate	Yield impact Parameter estimate
Intercept	0.141*	2.30*
Log_weight	-0.025*	-0.18*
Log_tot_quantity	-0.003*	-0.13*
Subprime_dummy	0.048*	2.22*
Debt_crisis_dummy	0.010*	0.25*
Adj-R <sup>2</sup>	0.042	0.028

Source: FI

Note: \* The variable is statistically significant with at least 95% probability. Price impact as a percentage, yield impact in basis points.

The outstanding volume per benchmark bond was defined as a variable called *log\_weight*. The negative coefficient indicates that the greater the outstanding volume of a bond, the lower its price impact and yield impact (i.e. the bond is more liquid). This is statistically significant and confirms the theory that liquidity is promoted by larger outstanding volume. For an issuer, there may be reasons to focus issuance to a smaller number of bonds in order to avoid paying too much in liquidity premiums. This reduces the borrowing cost. An investor in need of liquid assets, such as a UCITS fund<sup>10</sup> or a bank that wants to hold bonds in a liquidity portfolio, probably prefers to invest in bonds with a greater outstanding volume.

Although we have chosen a liquidity measure that does not use the volumes of transactions, we have still included the variable in our regression, *log\_tot\_quantity*. The transaction volume proves to have a negative effect on the transaction cost, which is consistent with the results of Dick-Nielsen *et al.* (2012b) for the Danish market. Such a negative relationship can arise if the dealer agreements base the remuneration per dealer on market share. In addition, in an OTC market where customers do not pay commission, it can be important to have information about the transactions carried out. This means that a large market share, and thus information, is desirable. The market makers therefore pay better for larger flows.

## Turnover has not followed the increase in outstanding volumes

Since 2004, outstanding volume of covered benchmark bonds have increased from SEK 400 to 1,000 billion, while turnover fell slightly from the peak years of 2008–2010. This has led to a falling turnover ratio (see Diagram 9).<sup>11</sup> Outstanding debt is therefore currently traded significantly fewer times a year than before and during the financial crisis.

<sup>10</sup> A UCITS fund is a fund authorised under the Act (2004:46) on investment funds, which in turn is based on the EU's UCITS directive.

<sup>11</sup> Turnover ratio means the turnover divided by the outstanding volume on the market.

**Table 3: Turnover and transactions by year**

	2008	2009	2010	2011	2012	2013	2014	2015
Turnover (SEK billion)	3,792	3,107	3,291	3,131	3,592	3,277	2,981	2,236
Transactions (number)	43,204	48,726	56,264	53,560	50,446	42,870	34,627	30,213
Average transaction (SEK million)	87.8	63.8	58.5	58.5	71.2	76.4	86.1	74.0

Source: The Riksbank and FI.

Note: Turnover refers to cash transactions in long- and short-dated mortgage bonds. Transactions are those transactions reported to FI. 2015 includes only the first three quarters.

Reported turnover and the number of transactions have fallen since the peak years (see Table 3). The average transaction size has increased slightly. The fact that turnover and the number of transactions are falling suggests that some transactions are not being carried out, which may be a sign of deteriorating market liquidity. Intuitively, however, an increase in outstanding volumes should have boosted turnover.

There may be a number of reasons why turnover is falling, one of which may be the ability to trade larger volumes. However, as the average transaction size has not fallen, it would appear that investors have not generally migrated to smaller trading sizes. Another very likely explanation may instead be that low interest rates mean the expected return is not attractive enough. Investors are therefore choosing to carry out fewer transactions. For example, some types of transactions perhaps become unprofitable, or do not provide sufficient return relative to risk. If a transaction cost also has to be paid, the business case deteriorates further. Given the historically low interest rates, this may well be a very important explanation for the falling turnover. In fact, the turnover rate is closely following the trend in interest rates.

## Concluding remarks

Based on our chosen measure of market liquidity, we cannot see any indications that the market liquidity of covered bonds or government bonds has deteriorated in recent years. There is a strong correlation between the liquidity in the two markets, as the market makers' funding liquidity affects their overall ability to contribute to market liquidity.

In the responses to the Riksbank's surveys, market participants claim that liquidity had worsened in the market. However, as liquidity can take different forms, it is important to clearly define what is meant. Our chosen measure of liquidity measures how much the yield to maturity is affected by a transaction; a form of depth in the market. Another aspect of market liquidity is how quickly a position can be turned over. With the data we have available, and given how trading is organised, this is a difficult variable to measure. It could be what market participants refer to when they claim that liquidity has worsened.

The number of transactions per year in our sample and the total turnover in the market has fallen from its peak years. The average transaction size has not decreased. However, turnover is not always a good indicator of market liquidity. There was large turnover during the

financial crisis, but the market was far from functioning properly. The ever-lower interest rates go hand-in-hand with the falling turnover rate. Certain types of transactions may have become too expensive to carry out given the expected return. With a constant transaction cost, increasingly lower interest rates will erode the expected return on an investment, which prompts investors to reduce their transaction intensity.

For covered bonds, the transaction cost (in terms of yield impact) has averaged nearly 2 basis points in recent years, which is lower than the market makers' indicative difference between bid and ask rates of 4 basis points. With the current low interest rates, the transaction cost has increased sharply in proportion to the expected return. Market makers are probably unable to reduce the difference between their bid and ask rates in line with the falling interest rates. This is because they have fixed costs that are independent of interest rates, such as salary and system costs. More stringent capital and liquidity requirements may have led to an increase in the cost of maintaining a trading book. However, this is not reflected in a higher requested transaction cost.

In theory, the more stringent requirements should have worsened the banks' funding liquidity. The fact that we are unable to observe any deterioration in the market liquidity may be because the impact we would expect in theory either does not exist or is negligible. It may also be because the monetary policy stimulus in recent years has had the opposite effect and thus masked a deterioration. There may be other explanations for why liquidity has not deteriorated according to our measure. One reason may be that there is strong competition among the market makers, who find it difficult to increase their prices to customers.

Another explanation may be that the borrowing requirements of the banks give them an interest in promoting liquidity in the market for covered bonds. If the market maker provides a high level of liquidity for the bank's bonds, the bank will pay a low liquidity premium on its borrowing on the primary market. This may give the bank an overall incentive to continue to provide market liquidity despite increased costs for market making activities.

Market liquidity may be adversely affected when the monetary policy stimulus is withdrawn. The financial crisis of 2008–09 and the sovereign debt crisis of 2011–12 led to a worsening of market liquidity. Should some form of new crisis arise, it may be assumed that liquidity will be adversely affected.

Benchmark bonds with established market makers are more liquid than non-benchmark bonds and government bonds are more liquid than covered bonds. Both these results are in line with expectations. There is a clear connection between the outstanding volume of bonds and their liquidity, with larger volumes promoting liquidity. This indicates that an issuer can concentrate its borrowing in fewer bonds to achieve a larger outstanding volume per bond, thus minimising the liquidity premium. An issuer can also prioritise benchmark bonds with established market makers.

The transaction volume has a negative effect on the yield impact during the measurement period. In other words, the market makers have favoured large transactions at the expense of smaller ones. This may be the result of the market structure and competition. The market makers' remuneration from the issuer may be based on market share. A large market share may also have intrinsic information value. Un-

like the stock market, trading customers do not pay commission on the transaction volume, with the market makers' profitability dependent instead on their risk management. Information can be an important advantage in this situation.



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## Appendix 1

### DATA

Our study is carried out using data from the following sources:

1. Bloomberg: information about issuers and all covered bonds
2. Thomson Reuters EIKON: information about issuers and all covered bonds
3. FI's transaction reporting system (TRS): data on transactions occurring during the day

The TRS data contains a number of misreported transactions that may affect our results. The most common errors are the reporting of interest rates or volumes instead of prices, or reporting a nominal base amount of 100 instead of the transaction price. We therefore adjust or purge the data using the following procedure, which is similar to Dick-Nielsen et al. (2012b). We exclude:

1. Transactions flagged as "cancelled"
2. Long covered bonds issued by SEB, as these may be assumed to have been issued in order to create a long yield curve to manage FI's rules for the traffic-light model. Outstanding volumes of these are relatively small and turnover limited. The number of market makers providing prices for these is also limited.
3. Transactions with a volume greater than 50 per cent of the total volume issued, so as to avoid including "on tap" issues. These are assumed to be unrepresentative of the secondary market
4. Aggregated transactions with a value of less than SEK 1,000,000, and individual transactions with a value of less than SEK 100,000. These are insignificant from a broader liquidity perspective – small transactions will not affect the capacity for large banks to manage volumes during stress periods
5. Transactions where the price is lower than 75 or higher than 175; these prices are probably misreported
6. Transactions that generate a same-day return greater than 1 per cent, in other words a price impact greater than 1 per cent
7. Repo transactions: when two transactions, one of which is a buy and the other a sell, have the same date, time, transaction size, reporter and counterparty, but different prices.

Transactions that take place between two investment firms will be reported twice. To avoid duplicate reporting, we also exclude transactions reported as "SELL" between two investment firms.