MSc Thesis, Spring 2014
Stockholm School of Economics
Department of Finance

The Liquidity of Swedish Covered Bonds compared to Swedish Government Bonds

Patrik Schölander (40410) **Nikolay Zhechev (40419)**

Supervisor: Peter Englund

Abstract: In the Swedish context covered bonds are a young financial development that quickly became crucial for the financial stability of the country. The intended goal of this paper is to compare the liquidity of this type of debt to the liquidity of Swedish government bonds, which generally is considered a very safe asset. For this purpose we test the price impact, as well as the liquidity risk of both markets. Overall, we conclude that the liquidity of short term covered bonds is not very inferior compared to that of short term government bonds under normal conditions, however in stress periods, such as the financial crisis in the autumn of 2008, the liquidity of short term government bonds are higher. We also find that short term bonds are more liquid than long term bonds in both markets and long term covered bonds demonstrate higher liquidity than long term government bonds over time. Finally, we observe that the liquidity risk of all markets except for short term government bonds rises during the crisis and later returns to its pre-crisis levels. We also find, the quite counterintuitive result, that larger trades do not have a larger price impact. We compare most of our findings to those of Dick-Nielsen et al (2012) for Denmark in order to get insight of the relative performance of the Swedish covered bond market to the Danish one.

Key Words: liquidity, covered bonds, government bonds, liquidity coverage ratio, price impact, liquidity risk

Acknowledgements: We would like to thank our supervisor Peter Englund as well as Jonas Söderberg and his colleagues from the Swedish Central Bank for the suggestions and the support in the preparation of this paper

1. Introduction

In 2004 a new type of asset class related to the housing market was introduced in Sweden – covered bonds. While these securities are backed by mortgages just as the Mortgage-Backed-Securities (MBS), which acquired negative fame after the collapse of the sub-prime mortgage market in the USA several years ago, covered bonds are a considerably more conservative and respectively safer asset class. The Swedish covered bond market quickly became one of the largest in Europe (forth behind Germany, Denmark and Spain) and even exceeds the size of the Swedish market for government bonds (Sandström et al, 2013). Today, Swedish banks finance a large part of their mortgage lending with covered bonds. Further, approximately half of their market funding and one quarter of the total funding happens through covered bonds (Sandström et al, 2013).

The liquidity of the covered bonds market is an interesting research area because it provides an insight into the extent to which banks can finance themselves through these instruments, as well as the price they need to pay in order to do that. This topic is also important to examine due to the way banks use this asset class. As of now, banks own around one-fifth of the total outstanding volume of Swedish covered bonds. They hence hold their own and each other's secured debt in the form of covered bonds, largely as a liquidity buffer. In March 2013 covered bonds represented more than 20 % of the liquidity buffers of Swedish banks (a total value of just under 400 billion SEK) (Sandström et al, 2013). These buffers are intended to be used in a situation when the banks are in urgent need of liquid funds. However, in case a general confidence crisis in the Swedish banking system emerges, several banks could try to increase their possession of such funds at the same time. The liquidity of the market would therefore to a great extent determine whether these banks can liquidate the asset in order to meet their short term obligations. An inability to do that could trigger a new financial crisis due to the systemic risk that the banking system represents for the financial architecture of the country.

The monitoring of assets is absolutely necessary in order to safeguard the stability of the financial institutions. In Sweden covered bonds are generally issued with much shorter maturities than mortgage contracts (Nykredit markets, 2013). This creates a risk of incapability of the banks to renew their mortgage funding continuously. The short-term funding through covered bonds for long-term mortgages represents a liquidity risk for the lending institutions.

The reason for this is that in periods of stress on the international capital markets investors' appetite decreases which can hurt the banks' capabilities to receive funding through covered bonds.

There is very limited past research on the liquidity of Swedish covered bonds which motivated us to further investigate this topic. Insights in this matter would prepare better investors and policy makers for a potential future turmoil, especially bearing in mind the lessons from the recent global financial crisis of the late 2000s.

To our knowledge, rigorous analysis focusing on the liquidity of covered bonds has been performed only on the Danish market. Studies of the Danish Central Bank found that Danish benchmark covered bonds are as liquid as Danish government bonds during periods of stress (Buchholst et al, 2010; Dick-Nielsen et al 2012). In this paper we take a similar approach and compare the liquidity of Swedish covered bonds with that of the domestic government bonds, because they are perceived as the most liquid asset class next to cash. For the purpose of our study we take into account all unique transactions with Swedish covered and government bonds done between January 2008 and February 2014. We have formally separated our analysis into five sub-periods - the time frames before and during the global financial crisis in late 2008, followed by the recession period, the European sovereign crisis of 2010-12 and the post-crisis periods starting from the beginning of 2013. By taking this approach we test how the liquidities of the two types of debt perform in both normal and stress periods. Further, we have split both asset classes into short and long term segments in order to conclude whether maturity is a major factor that determines their liquidity. Our analysis is based on the price impact liquidity measure as well as on the liquidity risk that the different bonds are exposed to. A statistical analysis aiming to investigate the liquidities of transactions with different trade sizes in the various sub-periods is also executed. Finally, we test whether trade size influences the price impact over the different sub-periods.

Based on our results we conclude that in normal periods short term covered bonds demonstrate relatively comparable liquidity levels to short term government bonds. However, in periods of stress, such as the 2008 financial crisis, the liquidity of short term covered bonds decreased more than that of government bonds. Apart from that, maturity seems to be an important factor for liquidity as short term bonds appear more liquid than long term bonds, an observation valid for both asset classes. Another interesting observation is that long term covered bonds are more liquid than long term government bonds. The financial crisis is found to serve as an uncertainty catalyst, because all markets except for the short term government bonds one are characterized by a higher liquidity risk then. Finally, our results cast doubt on Amihud (2002)'s assumption that larger trade sizes should have proportionally larger pricing impact, as they do not show such a tendency and in some cases we even observe the opposite effect.

The structure of our paper goes as follows. In section 2 we present briefly the historical development and the main characteristics of covered bonds as an asset class. We describe the relevance of covered bonds for the liquidity coverage ratio imposed by the Basel III standards and critically discuss the interventions of the ECB in the market in recent years. Then we narrow the scope by providing fundamental details about the Swedish covered bond market and its performance during the financial crisis. The last part of this section is devoted to a short overview of the limited past research on the liquidity of covered bonds. In section 3 we discuss the theoretical framework of the concept of liquidity as well as of the measures to capture liquidity that we apply in our analysis. Section 4 provides details about the data that we used in our test and the cleaning process that we performed in order to achieve more meaningful results. The next section describes thoroughly the methodology that we used and its application on our data sample. Section 6 aims to present and discuss the results from our analysis. In section 7 we briefly list the main conclusions and limitations of our study as well as our proposals for future investigations on this subject.

2. Covered Bonds

In this section we present the fundamentals of covered bonds both internationally and in Sweden, their historical development and previous research on their liquidity. We also cover the relation between this asset class and Basel III and describe some important interventions of the ECB and the Swedish Central Bank in the market.

i. Historical development of the covered bond

The history of covered bonds dates back to the late 18th century when German covered bonds (Pfandbriefe) were established. Considered exceptionally safe, no single German Pfandbrief has defaulted up to now, which has made this type of securities particularly popular among risk-averse investors (Werner and Spangler, 2014).

One can trace the origin of this type of bonds to Europe, where "…several European countries had an old dated legislation for covered bonds as an instrument to fund both mortgages and public sector credit." (Martin et al, 2013). While for many decades covered bonds issuances remained exclusively within the limits of the European continent over the last decade this type of financing has gained popularity in North America, Asia and Oceania placing states, such as USA, Canada, New Zealand among the countries where a covered bond market is present (Schwarcz, 2011). Furthermore, according to a number of industry professionals covered bonds represent the main alternative to replace structured investment vehicles ("SIVs") and highly leveraged "ABS CDO" securities, which have lost the trust of capital markets participants after their recent negative impact on the world financial architecture (Schwarcz, 2011).

While in the past covered bonds tended to be kept until maturity by investors, in more recent times they rose in significance which was expressed in increased amounts of trading on the secondary markets. This happened mainly after the creation of the first Jumbo covered bond in 1995. Important characteristics of the Jumbo covered bonds are: a minimal issue size of EUR 1 billion; a minimal size of the trances it can be divided into of EUR 125 million; the simultaneous availability of at least five market-makers responsible for determining bid-ask prices during normal trading hours (9am to 5pm) (Börse Frankfurt, 2014). This type of covered bonds was created with the purpose to increase the liquidity of the covered bond market as a step to diversify the investor base with international investors (European Central Bank (Eurosystem), 2008).

ii. Main characteristics

Covered bonds resemble other types of bonds in many aspects, such as having a fixed maturity and repayment of the notional amount at maturity (Sandström et al, 2013). While there is not a concrete internationally recognized definition for covered bonds, common characteristics that define them are the following:

- Unlike other bonds that are backed by contracts between borrowers and investors, there is a special legislation for covered bonds, which varies across countries. The obligations of the credit institution are subject to supervision by public or other independent bodies (European Central Bank (Eurosystem), 2008).

- Bondholders have a claim against not only the underlying credit pool, but also the issuer. This claim has a priority over unsecured debt issued by the credit institution (Martin et al, 2013).

- These bonds are backed by a dynamic covered pool, whose quality must be maintained over time, i.e. assets are continuously added/ replaced (Martin et al, 2013)

- In contrast to mortgage-backed securities assets in the cover pool and their credit risk are present on the balance sheet of the credit institution (Sandström et al, 2013).

- An issuer is also required to possess appropriate risk management systems, which to assess and control various risks attributed to the covered bond market, such as credit risks, currency risks, interest rate risks, operational risks, liquidity risks and other market risks (Werner and Spangler, 2014)

Due to the extra safety implied by the listed above characteristics covered bonds are seen as an excellent alternative for investors with low risk appetite who still wish to benefit from slightly higher yields than those for government bonds. Covered bonds are generally associated with low risk and the majority of them are AAA rated (European Central Bank (Eurosystem), 2008). Furthermore, as a result of the clear legislative framework and increased transparency due to the debt showing on the balance sheet, covered bonds are easy to monitor by supervising bodies (European Central Bank (Eurosystem), 2008). For these reasons covered bonds became the largest bond market with private issuers in Europe in the last decade, estimated to be worth appr. € 2 trillion in 2007 (European Central Bank (Eurosystem), 2008). In the years prior to the global financial crisis the European covered bond market was dominated by German and Danish issuers, contributing with more than half of all issuances, followed by Spanish, French and British credit entities (European Central Bank (Eurosystem), 2008) Apart from that covered bond are increasingly used as a tool for financing mortgages and in countries, such as Denmark, Sweden, Spain and some CEE countries more than 30% of all mortgages are financed by them (European Central Bank (Eurosystem), 2008).

iii. Relation to Basel III standards

Covered bonds are included in the Basel III requirements for the liquidity coverage ratio (LCR) of EU banks, which defines the minimal high quality liquid assets that a bank is obliged to possess in order to be able to meet its short-term obligations. According to the current legislation covered bonds rated AA- or higher are treated as Level 2A assets, a class of assets that can cover up to 40% of the high quality liquid assets the bank is required to have. Moreover, the value of such covered bonds that can account for meeting the Basel III LCR requirements amounts to 85% of the total value of these bonds. This is a very high proportion which underlines the perceived safeness of highly rated covered bonds. The only assets that can be considered for the LCR purposes with 100% of their value are Level 1 capital. Level 1 capital can be coins, banknotes, qualifying central bank reserves and sovereign debt (government bonds) (Bank for International Settlements, 2013).

A discussion paper published by the European Banking Authority outlines the proposed criteria for defining what the liquid assets in the LCR under the draft for capital requirements regulations (CRR) are. Aiming to organize the various asset classes in the different levels the EBA underlines that definitions "…will be formulated at the level of asset classes, and not individual assets or ISINs" (European Banking Authority, 2013). Further, "Finding evidence that a certain asset class is liquid in a specific EU jurisdiction does not imply that the same asset class would be liquid in all EU jurisdictions". In other words substantial evidence must be found in order that a given asset class qualifies for a certain level and one of the ways to organize the classification would be by evaluating the asset class according to criteria related to its risks. For example a potential hypothesis would be that "only AAA rated covered bonds can be treated as Level 1 assets for the purpose of meeting the 60% threshold for such assets" (European Banking Authority, 2013). The proposed rules for the LCR have a number of opponents, led by Denmark, where covered bonds are a main tool for securing the liquidity of banks. According to the Governor of the National Bank of Denmark Per Callesen Danish covered bonds have proven their capability to serve as a liquidity buffer for Danish banks and the new rules might lead to very negative consequences for the stability of the Danish financial system. Furthermore, he argues that the new requirements would inevitably make the banking sector more reliant on the Central Bank instead to lead to a stronger and more self-sustaining banking sector (Callesen, 2014). Apart from that in a statement to the EBA the Danish Central Bank implies that Danish sovereign bonds are not appropriate for liquidity buffers as they are mostly issued with very long maturities (Moshinsky, 2013). One should also consider the implication of this move on the liquidity of government bonds, because once they are stocked in the banks a reasonable expectation would be that their liquidity falls, while that would not happen in the case of covered bonds as they are currently used for this purpose.

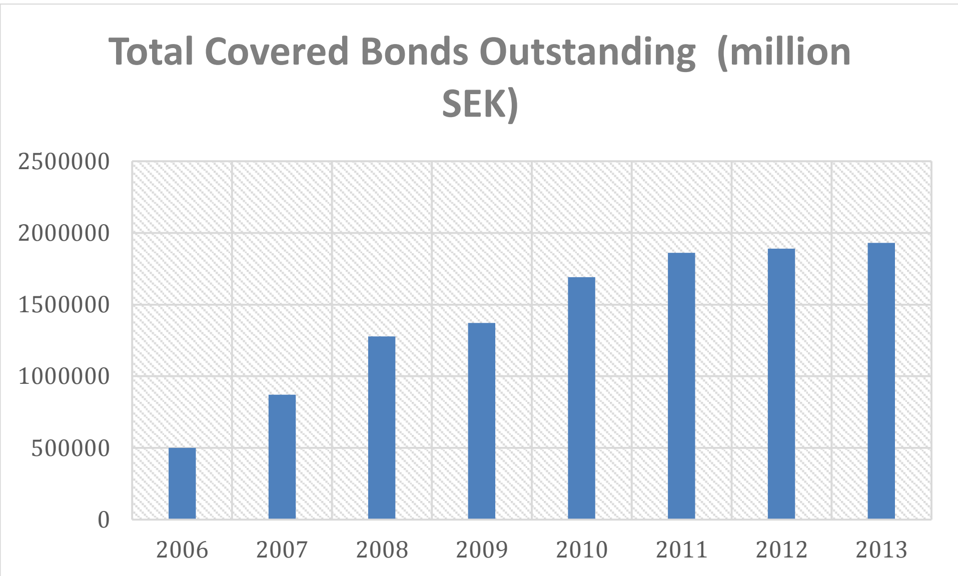
iv. ECB's covered bond purchase program

After the collapse of Lehman Brothers and the financial turmoil in the last months of 2008 the European Central Bank decided to intervene in the covered bond market after the first signs of widening of spreads between covered bonds and government bonds in Europe. This decision was motivated by the quickly growing importance of this market for financing of euro area banks, as well as the relative safety of covered bonds compared to ABS due to the stable collateral they have (European Central Bank (Eurosystem), 2011). The announced in May 2009 Covered Bonds Purchase Program (CBPP) amounted to € 60 billion and aimed to affect the market through four channels (similarly to other programs used by central banks to revive a market) – announcement (the announcing of a large scale program aims to calm down investors), "portfolio balance" effect (purchases of covered bonds decrease the relative supply in the market, which moves the prices upwards and respectively the yields downwards), liquidity premium effect (boosting liquidity through two way transactions) and "real economy" effect (the purchases of covered bonds are placed in the real economy) (European Central Bank (Eurosystem), 2008). Among the important characteristics of the program was that direct purchases of covered bonds happened both the primary and the secondary markets. Further, the CBPP was mainly aimed at bonds with issue volumes of € 500 Million and above and ranked AA or above. Overall experts conclude that the program achieved the desired effects and even made some new investors interested in the covered bonds market (European Central Bank (Eurosystem), 2008). However, some disruptions in the market occurred again after a while and only a year after the end of CBPP1 a new CBPP2 amounting to € 40 Billion was announced. (Draghi, 2011). Its goal was to improve the opportunities for funding for credit institutions which subsequently to encourage lending to enterprises. (European Central Bank, 2012). The program ended in the beginning of 2012 when there were signs that it has met its objectives (European Central Bank, 2012).

v. Covered bonds in Sweden

Following the example of other European countries from the last two decades, Sweden created a special legislation for covered bonds in 2004 (Sandström et al, 2013). In order to get licensed to issue covered bonds Swedish credit institutions had to convert all their mortgage bonds into covered bonds. All Swedish banks did that over the period 2006-08 (Sandström et al, 2013). Since then, the total outstanding amount of Swedish covered bonds has been growing (see fig.1). As of the beginning of 2014 the total outstanding volume of Swedish covered bonds amounts to 1.940 Billion SEK, equal to slightly more than 50% of the Swedish GDP and considerably higher than the total outstanding volume of Swedish government bonds (1.190 Billion SEK) (Marklund, 2014).

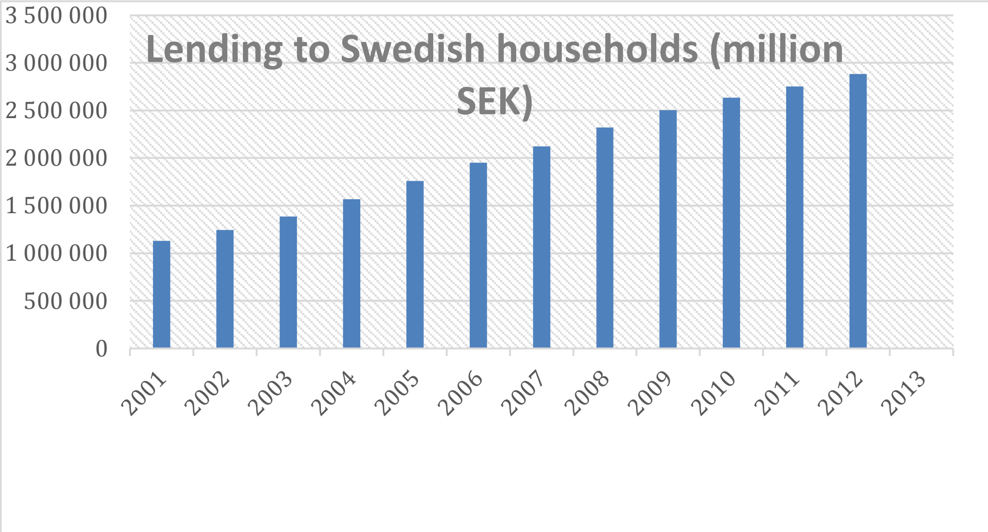
Fig.1



Source: Association of Swedish Covered Bond

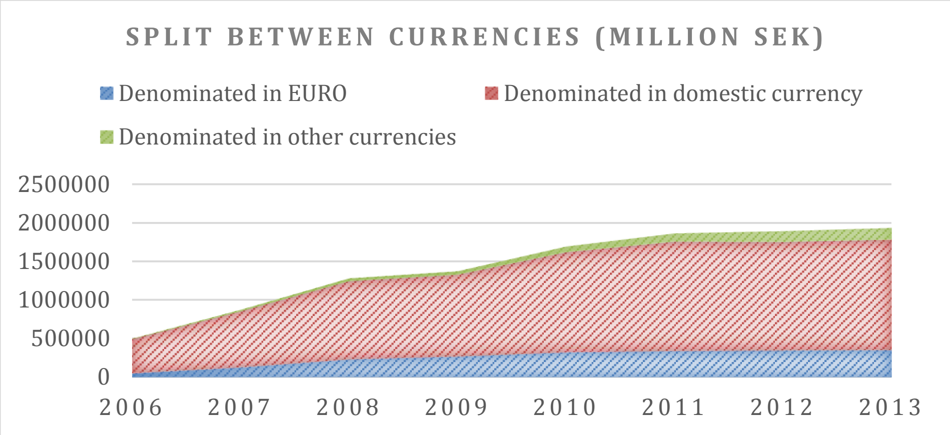
With regards to the specificity of the Swedish covered bonds legislation, here the cover pool may only consist of mortgage loans and loans to parties considered particularly secure (Lampe and Stenström, 2008). Therefore it is not surprising that the high growth of the covered bonds outstanding closely follows the boom in lending to households in Sweden (see fig.2). A probable explanation for the increased lending is that home ownership levels as well as the home prices have been rising in recent years (Riksbanken, 2013).

fig.2



Source: Association of Swedish Covered Bond

Swedish law is strict regarding the value of the assets that back the loan, i.e. the loan-to-value ratio of the covered bonds. For residential properties the maximal value of this ratio should be 75%, for agricultural properties – 70% and for commercial properties – 60% (in Denmark the loan-to-value ratio for residential properties is 75 % or 80% and in the UK, France and Spain – 80%) (Sandström et al, 2013; European Covered Board Council, 2013). Currently the Swedish covered bond market is the fifth largest in the world when it comes to bonds backed by all asset types and forth largest globally with regards to bonds backed by mortgages. (Sandström et al, 2013). Further, about three quarters of Swedish covered bonds are denominated in Swedish Krona and appr. 18% in Euro. (fig.3). Banks in Sweden get about half of the market funding and one quarter of the total funding through covered bonds (Sandström et al, 2013).



Source: Association of Swedish Covered Bond

Covered bonds in Sweden are issued by seven banks and financial institutions (Stadshypotek AB, Swedbank Mortgage AB, Nordea Hypotek AB, Skandinaviska Enskilda Banken AB, The Swedish Covered Bond Corporation, Länsförsäkringar Hypotek AB and Landshypotek Bank AB) (Nykredit Markets, 2013). What is specific for the Swedish covered bond market as opposed to other markets is the presence of *on-tap* issues on the primary market and market-makers. (Swedish Association of Covered Bond Issuers, 2014). On-tap issues are issues within the same bond that are issued after the initial bond issuance. This issues happen under the same conditions like the original issue, only the yield is changed according to the current market situation. (Sandström et al, 2013). That increases the opportunities for better asset-liability management on the issuers' side (Swedish Association of Covered Bond Issuers, 2014). The six active market-makers support the liquidity in the Swedish covered bond market. They must quote two-way pricing in case that an issue amounts to 3 billion SEK or more (i.e. if the bond is a benchmark bond). (Swedish Association of Covered Bond Issuers (2014); Danske Markets (2011)). The market-makers in the government debt market and those in the covered bonds market operate in a different way. Market-makers for sovereign debt usually quote prices for three benchmark bonds and that happens on an electronic interbank system developed by Nasdaq OMX which only market-makers can trade on (i.e. the market can be classified as an interdealer market) (Danske Markets, 2011). On the other hand, the activities of market-makers in the covered bond market are based on bilateral agreements with the mortgage institutions and occur predominantly over the phone, when they provide the two-way quotes, information about customer demand and spreads (Danske Markets, 2011).

vi. The covered bonds market in Sweden during the financial crisis

The financial turmoil after the collapse of Lehman Brothers in September 2008 required decisive actions from central banks across the world in order that the stability of the financial stability was not jeopardized. We already discussed in detail the two programs that the ECB initiated in order to stimulate the covered bonds markets in the Eurozone. While those were targeting the Eurozone and presumably had an indirect positive impact on the stability of the EU financial system as a whole, they did not have a direct impact on the covered bonds market in Sweden, where 75% or covered bonds are denominated in Swedish Krona. In Sweden the uncertainty led to a substantial increase in demand for government bonds, which were perceived as the safest investment available (Sandström et al, 2013). The quote-driven market-making system managed to resist the increasing amount of sales of covered bonds, however a more sustainable solution had to be invented, because market-makers ended up with constantly increasing stocks of covered bonds which they were trying to exchange among each other (on the interdealer market) (Sandström et al, 2013).

The Swedish Central Bank was also quick to react to the turmoil and in October 2008 it announced an administered by the National Debt Office program amounting to SEK 1500 bn, which aimed to guarantee the debt issued by qualifying institutions (Mayer Brown, 2009). Out of them 500 bn could be used to guarantee covered bonds with maturities of three to five years (while for other debt it was with a maximal maturity of three years) (Mayer Brown, 2009). The initiative was realized through placing short term bills on the market in order to meet the demand for them (the value of bills issued reached just over 200 billion SEK) (Sandström et al, 2013). Then the proceedings from these issues were used from the National Debt Office to provide loans with the same term as these bills to banks with covered bond as collateral. Also, in order that the interdealer market was supported the banks agreed to reduce the minimal trading lots from 50 Million SEK to 10 Million SEK and to increase the bid-ask spreads for them from 4 to 10 basis points). (Sandström et al, 2013). While the impact of these measures was generally positive when this loan facility was discontinued in the autumn of 2010 the selling pressure on Swedish covered bonds reemerged. According to practitioners the reason for that was "the uncertainty on the market about the funding situation of banks that led to poorer pricing and reduced demand for bonds" (Marklund, 2014).

vii. Literature review

Despite the enormous size of the covered bond markets in many European countries and their importance for the financial stability of the respective countries only a limited number of studies on covered bonds have been conducted. Surprisingly, there are almost no studies focusing on measuring the liquidity of these markets despite the numerous reasons why this is of importance. A possible explanation could be the relatively short time since they were introduced in most of the countries where they are present nowadays. A number of the academic papers study the characteristics of covered bonds, their structure contrasted to mortgage backed securities, historical evolution, differences between countries, etc. However, to the best of our knowledge a study examining the liquidity of Swedish cover bonds is yet to be performed.

With regards to measuring liquidity of covered bonds the Danish market is the most researched. Buchholst et al (2010) use four different measurements aiming to compare the liquidity of Danish covered bonds and the liquidity of Danish sovereign bonds before, during and after the recent global financial crisis. The general conclusion of their findings is that Danish benchmark covered bonds are not less liquid than Danish government bonds even during periods of market stress. Moreover, the average results of the different measurements indicate that while the Danish sovereign bonds were more liquid than their counterparts prior to the financial crisis this has altered and post the crisis both assets classes have comparable liquidity for both short- and long-term bonds. Dick-Nielsen et al (2012) elaborate further on this study using a complete data sample reflecting on the wholesale trading of Danish covered and government bonds from November 2007 until the end of 2011. On average they reach to very similar conclusions, indicating that the liquidity of sovereign bonds after the financial crisis is only very slightly higher than that of covered bonds and that during the peak of the financial crisis the liquidity of government bonds fell to even lower levels than the liquidity of covered bonds. To a certain extent this somewhat counterintuitive observation could be attributed to the effects of the Eurosystem's covered bonds purchase program, which resulted in a quick tightening of covered bonds spreads and narrowing of bid-ask spreads in the secondary market not only in the Eurozone, but also in other countries, such as the United Kingdom (European Central Bank (Eurosystem), 2011). Another major and rather counterintuitive finding is that large trade sizes do not necessarily affect the liquidity; in fact in most cases smaller trade sizes are associated with lower liquidity.

Perraudin (2014) uses the bid-ask spreads as a measure to compare the liquidity of covered bonds with that of Asset-Backed-Securities (ABS) in different countries in order to critically examine the research of the European Banking Authority (EBA) (an EU regulatory body with focus on inspecting and improving the EU financial system). This measure serves to determine the classification of different asset classes for the LCR. He reaches to the conclusion that "on average covered bonds bid-ask spreads are narrower than for ABS", which means that covered bonds are more liquid. However, he also points out that the most liquid ABS are somewhat close and in some cases, such as the peak of the sovereign crisis in 2011-12, even better than some covered bonds in terms of liquidity. This is generally the case for some non-mortgage-backed ABS with short maturities when compared to some non-Pfandbrief covered bonds.

While it is a common perception that government bonds are the most liquid securities and trade the tightest the recent global financial crisis and the debt crisis in the Eurozone have pointed out certain flaws in that assumption. Indeed, covered bonds in some peripheral Eurozone countries (Spain, Portugal, Ireland, Italy) have recently recorded even tighter spreads that their respective sovereign bonds (European Covered Board Council, 2013). Apart from that this has been reflected in the ratings set by rating agencies – in both Spain and Italy some covered bonds receive a higher rating than the government debt (European Covered Board Council, 2013).Furthermore, a number of covered bonds have registered a lower volatility between 2010-2013 than their government counterparts, which could be to a certain extent explained by the different investor bases for those securities. The European Covered Board Council (2013) argues that covered and government bonds are actually interlinked, because a possible default on the sovereign debt would subsequently lead to higher unemployment which would result in falling housing prices (and mortgages are the main underlying asset pool for covered bonds outside of Germany). In the core countries in Europe government bonds have shown better liquidity, which could be also attributed to the fact that they had lower haircuts than those in covered bonds (European Covered Board Council, 2013).

3. Theoretical framework

In this section we will describe liquidity and the implications of it, we will also discuss some measurement that are supposed to capture the liquidity of a market.

i. Liquidity

While liquidity is a hard to quantify concept a liquid market is often described as a market where it is possible to sell an asset quick without reducing the price much if at all. Therefore, liquidity can be seen as the amount by which a seller has to reduce the price in order to be able to sell the asset (Keynes, 1930). The most liquid asset by its nature is cash as it can be immediately traded against goods or services without any reduction in price. Further characteristics of liquid assets are the ease of trading them, the low transaction costs and the ability to sell even large amounts without sacrificing value (Sarr and Lybek 2002). However, due to the fundamental difference between a market in "quiet" times and in situation of market stress, there exists no universal concept of liquidity. While an asset may be very easy to trade in normal times and correspondingly classified as liquid, it might appear illiquid in periods of market stress (Baker, 1996). Therefore an asset's market's liquidity is expressed in the easiness of selling large volumes quickly without major changes of price in the absence of new information (Sarr and Lybek 2002).

Past studies on liquidity have used a great deal of approaches to attempt to measure it. To some of the measurements for liquidity that have been applied belong: yield or return spreads (Sarig and Warga (1989) and Blume et al. (1991)); volume (Kamara (1994) and Alexander et al. (2000)), bid-ask spread (Schultz (1998), Hong and Warga (2000) and Gwilym et al. (2002)).

While liquidity can be addressed in a variety of different aspects, there are several factors that are essential for in an in-depth analysis and evaluation of the liquidity of a given market. Sarr and Lybek (2002) describe five important measurements for liquidity - tightness, immediacy, depth, breath and resiliency. They add two new measurements to the three Kyle (1985) had already identified, namely "breadth" and "immediacy".

- *Tightness* refers to low transaction costs, such as the bid-ask spread in a quote-driven market (Sarr and Lybek 2002). Kyle (1985) qualifies this measurement as "the cost of turning around a position over a short period of time".
- *Immediacy* explains how fast an order can be executed and therefore provides insight into the efficiency of trading, clearing and settlement systems (Sarr and Lybek 2002). Grossman

and Miller (1988) and Kamara (1994) describe the immediacy risk as the risk that the quoted prices and the actual price at which the transaction occurs may not coincide.

- *Depth* is a term that Kyle (1985) associates the depth of a market with the size of an order that can change the transaction price. In a later study Sarr and Lybek (2002) explain the "depth" measurement as the existence of abundant orders, either actual or easily uncovered of potential buyers and sellers, both above and below the current price the asset is trading at (Sarr and Lybek 2002).
- *Breadth* refers to the notion that large orders have a low impact on the price (Sarr and Lybek 2002). This description is quite similar to the way Kyle (1985) earlier classifies the "depth" measurement (Santoso et al, 2010).
- *Resiliency* of a market means that new orders flow quickly to correct order imbalances, which tend to move prices away from what is warranted by fundamentals. Moreover, resilience is a characteristic of markets that is of relevance regardless of the direction of the trend of the market – a highly resilient market should be able to respond both to positive and negative imbalances in order to retain the status-quo (Thomas, 2006).

However, we would like to underline that not all of these factors can be tested unambiguously only by using quantitative tools as each situation is to a certain extent unique, therefore qualitative characteristics must be considered as well. For this reason it is vital to understand the structure of the market which is the subject of the analysis in order to reach trustworthy conclusions (Sarr and Lybek 2002).

ii. Measurements to capture liquidity

Price impact - According to Sarr and Lybek, 2002 price-based measures are a very good test for the "resilience" of a market. In other words they can test whether changes of prices of the transactions happen more gradually in a liquid market than in an illiquid one. The price impact measure examines how much a single trade can move the price of the transactions (Dick-Nielsen et al, 2012). Common intuition implies that that the price impact will be higher in an illiquid market (i.e. one trade will have a bigger influence on price then) and vice versa. Kyle (1985), who assumes a positive correlation between the volume of the transactions and the impact on their price. Goyenko et al (2008) test empirically various liquidity measures. They call the price impact of a trade "the cost of demanding additional instantaneous liquidity" and define 9 measurements that capture it. One of the most used measurement for price impact is the illiquidity measurement developed by Amihud (2002) (since 2009 over 100 published papers in the Journal of Finance, the Journal of Financial Economics and the Review of Financial Studies have used the illiquid measurement for their analysis) (Lou et al, 2014). The Amihud illiquidity measurement is based on the absolute value change between transaction in relation to trade size; more precisely the measurement is looks so;

$$Ahmihud\ Illiquidity\ Measurement = \frac{\frac{P_j\ -\ P_{j-1}}{P_j}}{Quantity}$$

However it should be noted that the theoretical background for the measurement is not waterproof and researchers have troubles to map it to theory (Chordia et al 2009).

Liquidity risk - Since from an investor's point of view is essential to evaluate the potential risks associated with a certain trade, which could influence the required rate of return, in our study we measure the liquidity risk of the covered and government bond markets in Sweden. Acharya and Pedersen (2005) describe liquidity risk as the result from unpredictable fluctuations in the liquidity of the market across periods. They reach to a conclusion that a persistent low liquidity may lead to low momentary returns and high future returns. Moreover, a high liquidity risk is related to unstable results of the price impact liquidity proxy, which raises the uncertainty among investors (Dick-Nielsen et al, 2012).

4. The Data

In the section we provide details about the source of the data, what is consists of and the cleaning process we executed.

i. Individual transaction data

The analysis in this paper is based on individual MiFID transaction data that we have accessed through the Swedish Financial Supervisory Authority (Finansinspektionen) Our sample period starts on 1 January 2008 and ends on 28 February 2014. We have also complemented the transaction data with additional information from NASDAQ OMX, regarding the issue and maturity date of the assets.

As we are interested in the banks' ability to sell covered bonds and government bonds in periods of market stress, we have included only the trades that exceed 10 million SEK. The intuition behind that is to focus on the wholesale trades and avoid a distortion of the analysis by the retail trades. The MiFID legislation does not include reporting of primary issues of covered bonds, therefore we only measure the second market liquidity.

Prior to the data cleaning process we performed, the covered bonds data for the observed period amounted to 303594 individual transactions and the government bond data - to 809 650 transactions. The dataset covers all trades in covered benchmark bonds and in all government bonds. As previously discussed, benchmark covered bonds are all the listed on the NASDAQ OMX covered bonds that can be traded through the market-makers. (Sandström et al, 2013).

ii. MiFID data

Directive 2004/39/EC, called the "Markets in Financial Instruments Directive" (MiFID), was adopted by the European Union in April 2004 and since November 2007 its member countries are obliged to follow it. The directive states that when credit institutions and investment firms trade on a regulated market they have to report the transaction to a competent authority, which in the case of Sweden is the Swedish Financial Supervisory Authority. The variables that should be included in the report are the following:

- *Instrument identification* – the International Securities Identification number (ISIN), which identifies the traded bond. The ISIN code is unique for every bond.
- *Trading date time* – the exact time, the date and the time-zone of the trade.
- *Quantity* – the number of bonds that were included in the trade.
- *Currency* – the currency the price of the bond is quoted in.
- *Buy/Sell indicator* – the variable, showing whether the transaction is a buy or a sell transaction from the perspective of the reporting firm.

- *Trading capacity* – identifies on whose behalf the reporting firm has executed the transaction.
- *Reporter identification* – a unique code that identifies the firm that is reporting the transaction.
- *Counterparty ID* – a code that uniquely identifies the counterparty in the transaction.
- *Client Name* – this is voluntary to report, and if reported, it should include the client's name.

We were granted access to all variables with the exception of client name, Counterparty ID and reporter identification. The Swedish Financial Supervisory Authority motivated its decision to not share these three categories with us with its general policy on non-disclosing these parameters.

iii. Data cleaning process

In order to be able to analyze the data we have transformed it in several steps; below follows a detailed explanation on the approach we have taken when cleaning the raw data:

- As we are interested in looking at liquidity of covered and government bonds from the perspective of the banks, we have chosen to exclude retail trades in order to not lose focus on the wholesale trades of the bond instruments. We have excluded all trades below 10 million SEK with the intention to decrease the risk of distortion of our analysis.

- If the reporting firm has been an Agent and therefore reported from the counterparty's perspective, we have changed the Buy/Sell indicator to the opposite in order to show the true perspective of the transaction.

- In order to exclude outliers, which otherwise would distort the results, we have eliminated all trades where prices were below 50 or higher than 150.

- If a trade has occurred between two investment firms, both parties have to report the transaction. Therefore transactions between two investment firms would be reported twice. In order to adjust for the structure of the reporting system, we have chosen to exclude the buy side of transactions between two investment firms. More precisely, we removed the buy side of the double reporting when two trades were recorded at the same date, time, quantity and price but with one trade recorded as a "sell" and one as a "buy".

- Even though repurchases should not be reported we have identified a large number of repos and excluded them. We have done so when we noticed two transactions at the exact same time with same quantities but at slightly different prices when one is indicated "buy" and the other one is a "sale".

- We manually identified the trades which had a price impact of more than 100 basis points (1 %) and removed all of them in order to avoid a distortion of our analysis.

5. Methodology

In this section we describe how we perform the analysis of the data in order to measure liquidity.

i. Definitions

We have chosen to interpret the results by splitting our sample into several sub-periods: a pre-crisis period, a crisis period, a recession period, a sovereign crisis period and a post-crisis period. We define the start of the crisis period as one month before the bankruptcy of Lehman Brothers. The time before that will therefore be referred to as pre-crisis (1 January 2008 – 15 August 2008). It is to a certain extent arbitrary to decide when the period of the financial crisis in Sweden ended. However, as we would like to be able to compare our findings with the very limited earlier research on liquidity of covered bonds, we assume that the initial part of the financial crisis ended by 15 December 2008. This approach allows us to compare our results with the study performed by Dick-Nielsen et al (2012) on the liquidity of Danish covered bonds. Therefore we define the crisis period as the time frame between 15 August 2008 and 15 December 2008 (similar to Dick-Nielsen et al (2012)). The time between 15 December 2008 and 30 April 2010 we call the recession period. Our reasoning for that is that even though the initial phase of the financial crisis had been over, Sweden still had to fight with the uncertainty caused by the crisis and suffered a recession during almost the whole period (SCB, 2011).

Further, we again also choose this time period in order to be able to compare out results with the ones of Dick-Nielsen et al (2012).

The sovereign debt crisis is first affected the Eurozone in 2009. It started when a group of Eastern and Central European banks needed a bailout (Wagstyl, 2009). The crisis however intensified in late 2009 and early 2010 when investors got deeply concerned about the rising debt levels of governments reflected in the downgrading of the government debt in several European countries (Matlock, 2010). In October 2012 there were only three countries with yields of over six percent on the 10-year sovereign bonds and in early January 2013 Ireland, Spain and Portugal were able to issue new government bonds, which showed that investors had started to have faith in these countries again (Barley, 2013). The exact duration of the period is arbitrary, however as for the previous periods we classify the sovereign crisis from 1 May 2010 until the end of 2012 in order that we can compare our results with those registered in Denmark. We have the same staring point as Dick-Nielsen et al (2012), however as our sample period is longer, our end date is one year later than theirs. We refer to the phase thereafter as post-crisis even though a lot of problems still exist.

ii. Classification of short term bonds

We have chosen to define short term bonds as all bonds that have less than two years to maturity. This implies that a long term bond becomes a short term bond two years before it matures. Our reasoning for this choice is that the trading pattern changes when the bonds are close to maturity. Especially in the case of government bonds, trading intensifies when the bond is approaching maturity.

iii. Classification of long term bond

We classified the long term bonds as bonds with maturity with more than two years to maturity. The reasoning for this is the same as above.

iv. Price impact

We use the same price impact measurement as Dick-Nielsen et al (2012) and the measurement is very similar to the Amihud (2002) liquidity measurement which is based on the research from Kyle (1985). We do, however, not assume a positive linear relationship between price impact and trading volume. We choose to not divide the price impact with quantity at all as it was shown in our analysis that this approach improves the methodology in evaluating the price impact. We are aware that it is counterintuitive to say that quantity does not have any effect on price impact, however as we cannot find any relationship between quantity and price impact we measure the price impact for a given transaction as:

$$Price\ impact_{t,i,k} = Absolute\ value * \left(\frac{P_{t,i,k} - P_{t,i-1,k}}{P_{t,i-1,k}}\right)$$

In the price impact measurement *i* refers to the x^th^ transaction in bond *k* at date *t*. The price impact measurement measures the absolute price movement between two adjacent transactions. The intuition behind it is that in a more liquid market a trade would not affect the price much and to the contrary, in an illiquid market a transaction would affect the price more. In order to minimize the impact of new information, which would changing the price (not due to the liquidity of the market), we require for the calculation of the measurement that the two transactions are executed within the same day.

We have also chosen to exclude all trades with a zero price impact as that is a consequence of the reporting system, where trades sometimes are handed between investment firms and one charges a commission which does not show up in the transaction data. Had we included them, it would seem like the transactions have not changed the price at all, but this would not show the true picture (due to the commissions paid). For this reason, in order to improve the analysis of the liquidity, we exclude the trades which have a zero impact.

v. Liquidity risk

In addition to the level of liquidity, liquidity risk is also an important factor for investors. Investors are sensitive about the risk that an asset could become illiquid when liquidity is needed (Archarya and Pedersen 2005). Similar to Dick-Nielsen et al (2012), we account for liquidity risk by using a liquidity risk measurement that takes the quintile range in the distribution of price impacts over a given month. More precisely we define it as:

$$Liquidity\ risk = Price\ Impact^{75\%} - Price\ Impact^{25\%}.$$

The intuition behind this measurement is that when the liquidity risk is high the price impact varies a lot. This makes the level of expected liquidity uncertain from the investor's point of view which is the liquidity risk of the asset (Archarya and Pedersen 2005).

vi. Regression one – liquidity in sub periods

We performed a regression on the price impact measurement with dummies for the sub periods defined above where the intercept is the pre-crisis level of liquidity.

$$Price\ Impact_{t,i,k} = a + \beta_1 * Crisis_t + \beta_2 * Recession_t + \beta_3 * Sov\ Crisis_t + \beta_2 * Post\ Crisis_t + \epsilon_{t,i,k}$$

In the price impact regression i refers to the x^{th} transaction in bond *k* at date *t*. The dummy for the crisis period is 1 between the 15 August 2008 until 15 December 2008 and 0 elsewhere. For the recession period the dummy is 1 between 15 December 2008 and 30 April 2010 and 0 elsewhere. The dummy for the sovereign crisis period is 1 between 1 May 2010 and 31 December 2012 and 0 elsewhere. The dummy for the post-crisis period is 1 between 1 January 2013 and 28 February 2014 and 0 elsewhere.

vii. Regression two – liquidity of different trade sizes in the defined sub periods

For the second regression we use the same independent and dependent variables as in the previous regression. We do however, split up the sample dependent on the trade relative trade size before running the regression. We first divide the sample in four categories according to type of debt and maturity: short term covered bonds, short term government bonds, long term covered bonds and long term government bonds. Then we split the trades for each category in four equal parts depending on the size of the trade: the lowest 25 %, 25 - 50 %, 50-75 % and the largest 75 % of the trades respectively. Thereafter we run the regression for the relative trade size in the same manner as in the first regression. The motivation for performing this test hides is our interest to examine the performance of different trade sizes over time.

viii. Regression three – liquidities relation to trade size

The study on the Danish market reveals was no relationship between trade size and price impact, and correspondingly, Dick-Nielsen et al (2012) did not opt to scale the price impact with the quantity as the Amihud (2002) measurement stipulates. However, common intuition predicts that trade size has an effect on liquidity, implying that it is as easy, or even easier, to sell a larger position than a smaller one. Therefore, we run a regression in order to see whether an indisputable relationship between price impact and trade size holds in the Swedish market.

The structure of the regression consists of division of the trades between all the sub periods and regressing them against each sub period for all asset classes. In total we perform 16 regressions to investigate the relationship described above. The dependent variable in this regression is price impact in the specified sub period and the independent variables are the relative trade sizes within the sub period. We have used dummies for the relative trade sizes and the intercept is the liquidity of the small trades:

$$Price\ Impact_{t,i,k} = a + \beta_1 * medium\ small_t + \beta_3 * medium\ large_t + \beta_3 * Large_t + \epsilon_{t,i,k}$$

In the price impact regression i refers to the x^{th} transaction in bond *k* at date *t*. The dummy for the medium small is 1 for the trades in the 25 -50^{th} percentile in the specified sub period and 0 elsewhere. The dummy for the medium large is 1 in the trades in the 50-75^{th} percentile and 0 elsewhere. The dummy for the large is 1 in the trades that is larger than the 75^{th} percentile and 0 elsewhere.

6. Results

In this section we present a statistical as well as a graphical analysis of the liquidity in different sub-periods. In that way we aim to foster the understanding of the liquidity in the covered bond market.

i. Statistical analysis of liquidity in sub periods

In the first part we show and analyze the regression for the price impact. We particularly compare our results with the ones in the study on the Danish market performed by Dick-Nielsen et al (2012).

Table 1: Regression output - price impact in subperiods (basis points)

The table is presenting the the results from the regressions for the 4 different asset classes. The regressions have price impact as the dependent variable and the sub periods as the independet variables. The parameters (expect for the interception) show how the sub periods are related to the intercept.

		Intercept (Pre-Crisis)	Crisis	Recession	Soverign Crisis	Post-Crisis
Short Term Cov	Parameter	2,976	2,433	2,995	0,653	0,899
	Standard error	0,102	0,185	0,131	0,111	0,146
Short Term Gov	Parameter	3,227	0,667	0,390	0,285	-0,343
	Standard error	0,048	0,073	0,070	0,057	0,066
Long Term Cov	Parameter	6,010	4,667	3,179	0,961	-0,382
	Standard error	0,140	0,218	0,163	0,149	0,158
Long Term Gov	Parameter	10,025	3,870	1,421	**-0,179**	-2,799
	Standard error	0,085	0,153	0,106	0,094	0,103

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level. See appendix A for more detailed regression tables

a. Short term bonds

We observe almost the same levels of liquidity for short term covered and government bonds before 15 August 2008 (the liquidity of covered bonds exceeds that of government bonds by less than half a basis point). The price impact for covered bonds is a little lower than 3 basis points (0.03 %) while for government bonds it is slightly higher than 3 basis points. The limited academic research on liquidity of covered bonds leaves us with very few past studies to compare our findings with. However, by looking at the test by Dick-Nielsen et al (2012) on the Danish market we notice a similar relationship between short term covered and government bonds in the pre-crisis period there; the only difference is that in Demark government bonds have a slight edge in terms of liquidity.

During the crisis we acknowledge that the liquidity of both types of debt decreases. The price impact increases by 2.4 basis points (0.024 %) for covered bonds and less than 0.7 basis point (0.007 %) for the government bonds. In contrast to the Swedish market, where government bonds outperform their counterparts during the crisis period, in Denmark covered bonds show better results for liquidity than government bonds. During the crisis period the price impact on covered bonds trades there increases only by 3 basis points compared to an increase of over 11 basis points for government bonds (Dick-Nielsen et al, 2012). However, we should take into consideration that the result for covered bonds is not statistically significant in the Danish study. The contrasting results between the two countries are a consequence of the considerable differences between the covered bond markets in Sweden and Denmark. In Denmark the market is more sophisticated and a lot larger than in Sweden (140 % of GDP vs just over 50 % of GDP respectively) (Dick-Nielsen et al, 2012); Marklund, 2014). An important implication of this observation is that if the Swedish market continues to grow in size and importance for the Swedish financial stability, its liquidity in a future crisis might improve its robustness.

One should also not disregard the intervention aiming to increase the liquidity of Swedish covered bonds during the crisis period. Its inability to completely neutralize the drop in their liquidity implies that this trend would have been even worse if the authorities had not reacted to the selling pressure. Therefore the numbers in the regression table to some might even overestimate the "true" liquidity in this period. Furthermore, another factor that saved the covered bond market was its quote-driven nature with dedicated market-makers which is a precondition for more resilience of liquidity as opposed to order-driven markets. One the other hand, the intervention in the Danish covered bond market was on a considerably smaller scale, especially when we account for the superiority of its size compared to the Swedish one. In the short term segment of the markets it was expressed in 3.6 billion EUR invested by the Danish Social Pension fund in Danish short term covered bonds in December 2008, a quite small step that mainly aimed a psychological effect to calm investors (Buchholst et al, 2010).

The better liquidity in Swedish government bonds compared to covered bonds could be explained with the "flight to safety" phenomenon after the collapse of Lehman Brothers. The liquidity of the government bond market was enhanced by the action of the National Debt Office to issue short term bills in order to finance the support for the covered bonds market. On the other hand, it is possible that due to the novelty effect that covered bonds still had in 2008 investors might have misunderstood the difference between them and assets backed securities and therefore perceived the covered bonds more risky than they actually are. This could explain the relatively many foreign investors (especially those with short-term investment horizons) who left the market around that time (Sandström et al, 2013).

During the period we define as "recession" liquidity of Swedish covered bonds slightly plunges as the price impact increases by ca. 0.5 basis points to a little less than 6 basis points. In contrast, in the case for government bonds the liquidity actually increases from the crisis period. Nevertheless, we can state that both markets remain fairly liquid. For this period Dick-Nielsen et al (2012) find that the price impact for Danish short term covered bonds increases by ca. 1.2 basis point, a better result than for short term government bonds, where the increase amounts to ca. 3.8 basis points. This effect could be partly explained by the injection of appr. 6 billion EUR by the Danish Social Pension Fund into the short term covered bond market, which similar to the previous period aimed mainly to reassure investors that the authorities would support the market in case such a need arises (Buchholst et al, 2010).

During the sovereign crisis the liquidity of both asset classes increases, however more for covered bonds. The price impact in this period is almost the same for both types of debt (ca. 3.5 basis points). During a similar period that, however, spans across a shorter time frame (until end of 2011 instead of 2012), Dick-Nielsen et al (2012) find that in Denmark the price impacts are 7.5 and 5.2 basis points for short term covered and government bonds respectively (i.e. the difference between their liquidities is not extremely large either).

During the post-crisis period in Sweden government bonds perform slightly better as their price impact decreases by approx. 0.6 basis points compared to the previous period. Furthermore, during the post-crisis period the liquidity in government bonds is even higher than in the pre-crisis period with a price impact of just less than 3 basis points. For covered bonds it increases by about 0.3 basis points from the earlier period to slightly less than 4 basis points. Unfortunately, we cannot compare our findings with the results of another piece of research as we not aware of any studies on the liquidity of covered and government bonds in this time frame.

Our analysis for the short term covered and government bonds shows that generally both types of debt remain fairly liquid over time. In times where the markets are “quiet” covered bonds appear to remain almost as robust as government bonds in terms of liquidity. However, we see that short term government bonds outperform covered bonds in this aspect in crisis times. These results are quite contradicting to those of Dick-Nielsen et al (2012) who arrive at the conclusion that covered bonds were characterized by even better liquidity during the financial crisis than the government bonds. We believe that the differences between the markets in the two countries are largely due to the different characteristics of the markets in Denmark and Sweden. In Denmark the covered bonds market is more than four times the size of the government bonds one, while is Sweden the difference in scales is not as large (Nykredit, 2007; Sandström et al, 2013). Further, foreign investors own only about 15% of the total volume of

Danish covered bonds, while their share in Danish government bonds amounts to 29% as of January 2012. (Danske Markets, 2012). Therefore the home bias could have also supported the covered bonds market in that stress period to a larger extent than the government bonds one. In contrast around 35 % of the total volume of Swedish covered bonds are in possession of foreign investors and the escape especially of the speculative capital was felt more noticeably in the short term covered bonds segment (Sandström et al, 2013).

b. Long term bonds

As far as long term Swedish bonds are concerned, covered bonds had a higher liquidity compared to government bonds in the pre-crisis period. Here the difference is more pronounced than for short term bonds as long term covered bonds have a price impact of 6 basis points while government bonds - of 10 basis points (i.e. 4 basis points difference). The higher liquidity of covered bonds could be explained with the shorter maturity of long term covered bonds compared to long term government bonds. This is possibly a consequence of the general tendency that bonds become more liquid when they approach maturity (as the risk of default correspondingly diminishes). Dick-Nielsen et al (2012) reach to similar findings for the relationship between the liquidities of short term bonds compared to long term bonds. However the difference there is smaller – they register a price impact of 11.7 basis points for long term covered bonds and 10.1 basis points for long term government bonds in Denmark.

The crisis has a similar effect on both bond markets in Sweden - the liquidity of both asset classes measured by the change in price impact of trades worsens by 4-5 basis points. The increase in price impact for long term covered bonds is only ca. 0.8 basis points higher than that for government bonds, which is a smaller difference compared to the short term segment of the market, where as we already discussed the increase of price impact for covered bonds is ca. 2 basis points higher than that for government bonds. A reason that at least partially explains this phenomenon is the affinity of some or the largest players in the covered bond market – insurance companies and pension funds to long term as opposed to short term covered bonds (Sandström et al, 2013; Danske Markets, 2012). Since they have long term horizon they did not rush to sell-off their holdings to the extent some investors in the short term segment did. Moreover, the majority of the foreign speculative capital that left Sweden was also focus in the short term bonds, therefore the impact of the sell-off from their side was weaker on long term covered bonds. Dick-Nielsen et al (2012) find that the increase in price impact of covered bonds in the Danish market amounts to just under 1 basis point and for government bonds - 5.6 basis points. The better performance of covered bonds was enhanced by the initiative of the Danish authorities to convince pension funds to not sell their long term covered bonds holdings expressed in a signed on 31 October 2008 agreement between the Ministry of Economic and Business Affairs and the Danish Insurance Association (Buchholst et al, 2010). However, the result for government bonds in the Danish study is not completely indicative for their performance as it is not statistically significant.

The gap between liquidities of the two asset classes in Sweden starts to close throughout the recession period, as the price impact of government bond decreases by ca. 2.5 basis points, while price impact for covered bonds - by 1,5 basis points. The price impact of covered bonds amounts to ca. 9.2 basis points compared to 11.4 for government bonds. Dick-Nielsen et al (2012) observe a similar trend: the liquidity of government bonds increases more than for covered bonds and the price impact gets even lower for the government bonds during the period. It should, however, be noted that the Danish results are not significant on the 5 % level.

In Sweden the sovereign crisis affects the liquidity of both types of bonds in a similar fashion - the price impact decreases by 1.6-2.2 basis points. At this stage government bonds even exceed their liquidity levels from the pre-crisis period. To a certain extent this could be triggered by the increased interest from investors from the Eurozone to Swedish government debt, as it was considered to be a safer alternative of the domestic sovereign bonds of those investors. Dick-Nielsen et al (2012) find that the liquidity in the Danish market is lower for covered bonds compared to the recession period (price impact increases by 2.9 basis points) and slightly higher (0.7 basis points decrease in price impact.) for government bonds. Similarly to Sweden, in this period the liquidity of Danish government bonds reaches slightly better levels than in the pre-crisis period, which could be explained by a similar to the Swedish case intuition. However, we would like to note that for government bonds the result is not significant and the test for Denmark cover only the period to the end of 2011.

During the post-crisis period both covered and government bonds show their highest level of liquidity. For long term government bond the price impact decreases by ca. 3 basis points and amounts to a little more than 7 basis points. For covered bond the decrease is smaller - by 1.4 basis points, resulting in a price impact of ca. 5.6 basis points. As previously stated unfortunately there is not another study that encompasses this period which we can compare our results to.

In general, long-term covered bonds seem to have a slight edge over long term government bonds in terms of liquidity. In our view one of the main explanations for this tendency is that long term covered bonds are generally issued with shorter time to maturity than for government bonds. On the other hand, there are strong signs of a trend towards improving of the liquidity of government bonds over time and they appear to have performed slightly better during stress periods, such as the crisis and the recession, which is mainly due to their perceived safeness.

i. Liquidity for different trade sizes in the sub periods

In this section we analyze how trade size affects liquidity over time. The liquidity in different trade sizes could be of interest for large bond holders as their trades are probably concentrated in the large trade sizes.

Table 2: Regression output - liquidity dependent on trade size short term covered bonds (basis points)

This table shows the results for the regressions where we have used price impact as the dependent variable and the sub periods as the independent variable for different trade sizes of our data sample. We have split up the transaction dependent on their relative size . Therefore, in this table, it is possible to see how the liquidity is changing over time within different trade sizes. The parameters (expect for the interception) show how the sub periods are related to the intercept.

Trade size		Pre crisis	Crisis	Recession	Sov crisis	Post crisis
<0,25 %	Parameter	5,633	3,746	0,964	-2,004	-2,014
	Standard error	0,267	0,421	0,32	0,286	0,397
25-50 %	Parameter	2,219	1,472	2,138	0,659	1,198
	Standard error	0,178	0,311	0,218	0,19	0,232
50- 75 %	Parameter	2,082	1,005	4,061	1,525	1,786
	Standard error	0,163	0,328	0,228	0,182	0,252
>75 %	Parameter	2,585	1,411	4,335	1,765	2,01
	Standard error	0,206	0,397	0,276	0,222	0,29

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level. See apendix B for more detalied regression tables

Table 2 summarizes our results on the performance of different trade sizes with short term covered bonds in the five sub-periods we have divided our sample into. In the pre-crisis period the smallest trades seem to be slightly less liquid than the 75% biggest trades in the sample (by ca. 3 basis points). During the crisis the price impact for the smallest trades' jumps by ca. 3.7

basis points, a trend that turns completely during the recession and the sovereign crisis when liquidity of these trades actually improves by ca. 3 basis points in each of these periods. In the post-crisis period liquidity remains unchanged compared to the previous period. In contrast, the largest trades are comparatively more liquid in the pre-crisis and the crisis periods, but perform considerably worse during the recession. In the last two periods their liquidity never returns to the values from the pre-crisis. Moreover, we would like to underline the statistical significance of all of our results for short term covered bonds. The sharper decrease in liquidity of short term covered bonds during the crisis could be partly explained by the agreement of market-makers to reduce the minimal trade lot for short maturities from 50 million SEK to 10 million SEK and widen the bid-ask spreads more than twice (from 4 to 10 basis points)(Sandström et al, 2013). This stabilized the trading in the inter-dealer market, and thus could have contributed to increase in the liquidity of the smallest trade sizes in the next two periods. However, a general trend after 2008 is a decrease of the transactions on the inter-dealer market in Sweden (Sandström et al, 2013). Being more risk averse in the aftermath of the global financial crisis, market-makers are more reluctant to keep large holdings of covered bonds, which is a precondition for possible future distortion of large transaction volumes. This could explain the higher increase of price impact of the largest transactions compared to the smallest transactions in the periods post the financial crisis.

Unfortunately due to the unavailability of the counterparties which did the transactions in our sample we cannot provide a direct comparison for Sweden to the conclusion that in the Danish market the inter-dealer market remained more liquid than the dealer-client market during the crisis (Dick-Nielsen et al, 2012).

Table 3: Regression output - liquidity dependent on trade size short term government bonds (basis points)

This table shows the results for the regressions where we have used price impact as the dependent variable and the sub periods as the independent variable for different trade sizes of our data sample. We have split up the transaction dependent on their relative size . Therefore, in this table, it is possible to see how the liquidity is changing over time within different trade sizes. The parameters (expect for the interception) show how the sub periods are related to the intercept.

Trade size		Pre crisis	Crisis	Recession	Sov crisis	Post crisis
<0,25 %	Parameter	4,276	**-0,203**	0,416	0,454	**-0,229**
	Standard error	0,135	0,174	0,185	0,154	0,179
25-50 %	Parameter	2,558	0,696	0,373	0,512	-0,308
	Standard error	0,09	0,13	0,124	0,103	0,118
50- 75 %	Parameter	2,999	1,244	**0,176**	0,233	-0,331
	Standard error	0,0965	0,148	0,138	0,111	0,127
>75 %	Parameter	3,195	0,829	0,515	**-0,146**	-0,476
	Standard error	0,071	0,138	0,116	0,0895	0,107

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level. See apendix B for more detalied regression tables

As we can see in table 3 in the case of short term government bonds the smallest trades are again the most illiquid in the pre-crisis period, however the difference compared to the larger trade sizes is smaller than for short term covered bonds (1-2 basis points). During the remainder of our sample the price impact for the smallest transaction sizes changes negligibly (by less than 0.5 basis points) in all periods. It is interesting to note that in the crisis and the post-crisis periods their liquidity measured by price impact registers a minimal improvement compared to the pre-crisis period, however these results are not statistically significant. The trend for minimal price impact changes for the different trade sizes throughout the different time periods appears to be valid for all the other trade sizes as well, because in almost all periods the price impact change amounts to less than 1 basis point).

Table 4: Regression output - liquidity dependent on trade size long term covered bonds (basis points)

This table shows the results for the regressions where we have used price impact as the dependent variable and the sub periods as the independent variable for different trade sizes of our data sample. We have split up the transaction dependent on their relative size . Therefore, in this table, it is possible to see how the liquidity is changing over time within different trade sizes. The parameters (expect for the interception) show how the sub periods are related to the intercept.

Trade size		Pre crisis	Crisis	Recession	Sov crisis	Post crisis
<0,25 %	Parameter	11,929	6,103	**0,461**	-3,699	-5,985
	Standard error	0,42	0,582	0,464	0,437	0,461
25-50 %	Parameter	5,15	3,479	2,573	1,056	**-0,187**
	Standard error	0,202	0,318	0,244	0,22	0,238
50- 75 %	Parameter	4,565	2,966	3,23	2,181	0,895
	Standard error	0,238	0,366	0,283	0,255	0,27
>75 %	Parameter	4,475	3,997	3,942	2,099	1,598
	Standard error	0,288	0,441	0,331	0,302	0,312

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level. See apendix B for more detalied regression tables

The long term covered bonds segment reveals slightly different tendencies compared to the short term covered bonds one as it is evident from table 4. The smallest trades had considerably higher price impact in the pre-crisis time frame when plotted against the three quarters with the largest trade sizes, which were almost equally liquid then (12 basis points vs 4-5 basis points). During the crisis a quite large price impact affects negatively the liquidity of the smallest trade sizes (6 basis points) while afterwards this trend reverses for the rest of the periods, when price impact decreases by 2.3-5 basis points. With regards to the top three quarters of the sample in terms of trade sizes we observe very similar liquidities in the pre-crisis period. We can see a trend towards slightly better liquidity in the remainder of the sample, however we acknowledge that the increase in liquidity happens at a smaller pace than for the smallest trade sizes. Further, the liquidities of all trades but the quarter with the smallest trade sizes never reach their pre-crisis levels (the post-crisis results for the 25-50 % trade size is statistically insignificant). In our view the decrease in liquidity of the smallest trade sizes during the crisis and its subsequent increase in the other periods could be partly explained by a similar intuition as in the case for short term covered bonds. It is important to note that the reducing of the minimal trade lot that market-makers agreed to in 2008 was even greater for long maturities than for short maturities (from 100 million SEK to 10 million SEK) (Sandström et al, 2013).

Table5: Regression output - liquidity dependent on trade size long term government bonds (basis points)

This table shows the results for the regressions where we have used price impact as the dependent variable and the sub periods as the independent variable for different trade sizes of our data sample. We have split up the transaction dependent on their relative size . Therefore, in this table, it is possible to see how the liquidity is changing over time within different trade sizes. The parameters (expect for the interception) show how the sub periods are related to the intercept.

Trade size		Pre crisis	Crisis	Recession	Sov crisis	Post crisis
<0,25 %	Parameter	12,549	4,214	1,542	1,018	-2,611
	Standard error	0,244	0,409	0,283	0,26	0,284
25-50 %	Parameter	10,464	4,441	1,867	**-0,367**	-1,69
	Standard error	0,187	0,311	0,228	0,205	0,224
50- 75 %	Parameter	9,517	2,818	**0,211**	-1,606	-3,522
	Standard error	0,134	0,251	0,179	0,154	0,169
>75 %	Parameter	8,798	3,026	**0,106**	-1,571	-3,982
	Standard error	0,122	0,248	0,162	0,138	0,149

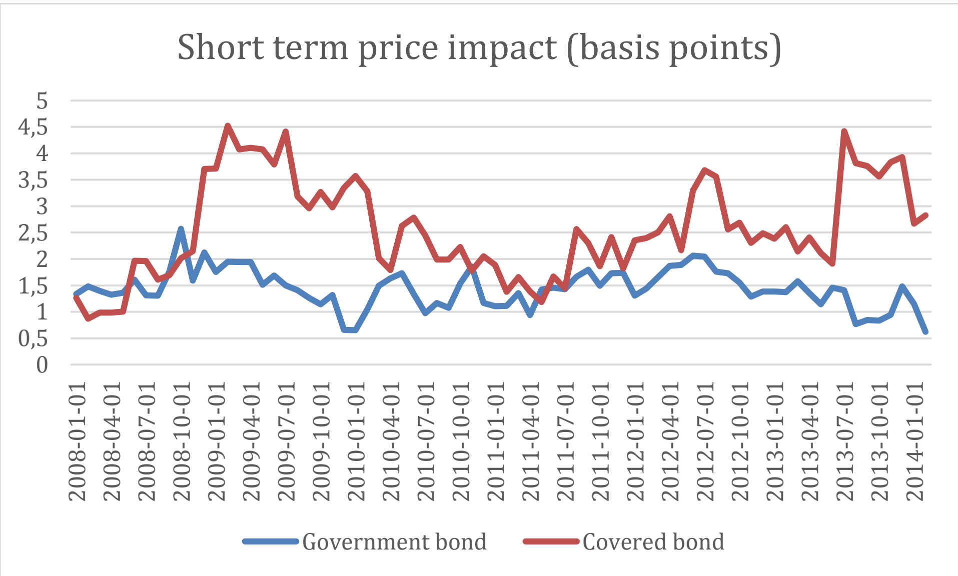
Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level. See apendix B for more detalied regression tables

Again as for short term government bonds, in the sample for long term government bonds we find out that the smallest trade sizes are the most illiquid, however the difference is not as pronounced as for long term covered bonds (12.5 basis points vs 9.5-10.5 basis points for the three quarters of the sample with the largest trade sizes). The crisis affects the half of the sample with smaller trade sizes in a more negative way compared to the one with larger trades (even though the difference lies within 1-1.5 basis points). Throughout the remaining three periods one can notice a tendency towards an increase in liquidity for all trade sizes. It is evident that the price impact is not extremely different for any of the trade sizes over all periods (remains within the range of 1-2 basis points).

ii. Graphical analysis of liquidity in sub periods

In this section we present a graphical analysis of our results in order to further increase the understanding of the liquidity of the two asset classes over time.

a. Short term price impact

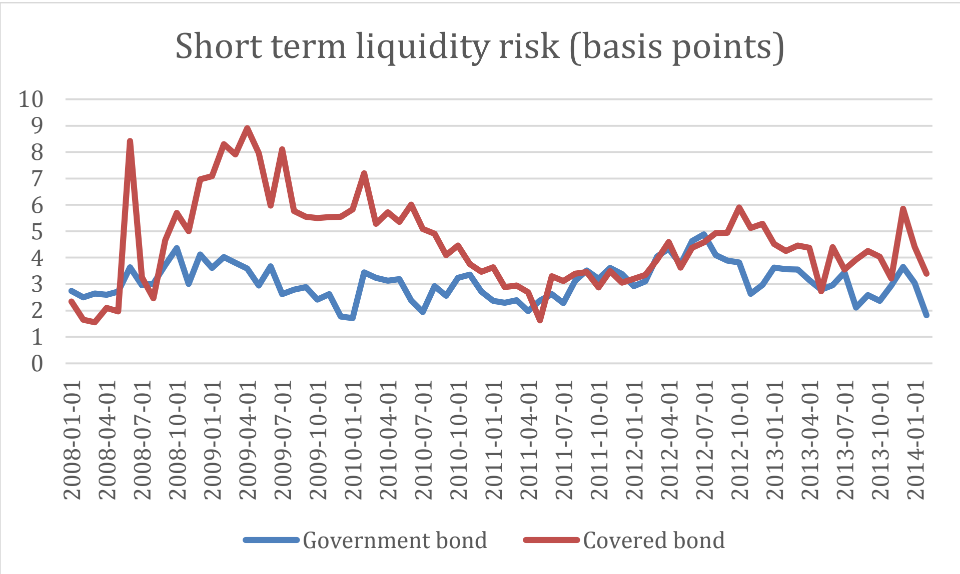


Source: Swedish Financial Supervisory Authority; own calculations

The liquidity of the short term segments of the two debt types, measured by price impact, is to a great extent similar in the pre-crisis period. Then the spread widens immediately after the beginning of the financial crisis, reaching ca. 2.5 basis points. At this time government bonds are notably more liquid, a trend that persists during the recession period, even though there are signs of narrowing that spread. Just after the beginning of the sovereign bond crisis the liquidities of both types of debt equalize. That persists for a period of about one year (until middle of 2011) after which government bonds become again visibly more liquid until the end of our sample period. This effect appears to be more pronounced at the beginning of the post-crisis period when the spread widens to ca 3.5 basis points. A general observation is that over time the liquidity of short term covered bonds is considerably more volatile than that of short term government bonds.

Dick-Nielsen et al (2012) perform a similar test on the Danish covered and government bonds markets; however they use weekly intervals in their tests, while we measure the price impact on a monthly basis. This choice explains the higher volatility visible on the graph that visualizes the comparison of the markets. In the short term segment of the markets in the pre-crisis period they similarly to our test on the Swedish sample observe almost the same liquidity levels for covered and government bonds. However, in contrast to our finding that during the financial crisis in late 2008 government bonds in Sweden become more liquid, they notice a rise in the liquidity of covered bonds in Denmark during that period. During the recession period that relationship between both markets in Denmark remains flat with similar liquidity levels in both markets. Their results for Denmark are different compared to ours in Sweden for the start of the sovereign crisis: they register a slight increase of the liquidity of covered bonds while we see the opposite trend in Sweden.

b. Short term liquidity risk



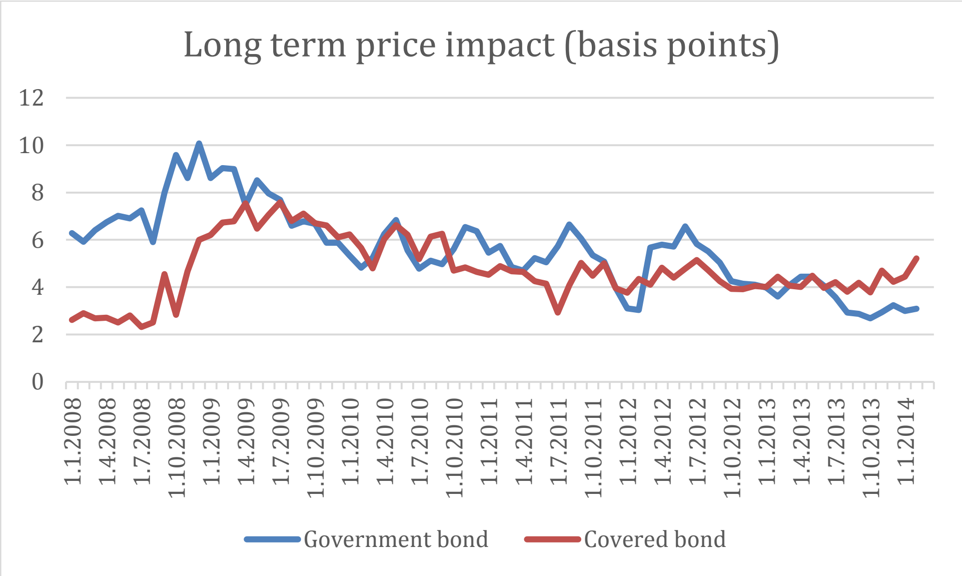
Source: Swedish Financial Supervisory Authority; own calculations

Another measure we examine is liquidity risk. We notice a pattern, that the liquidity risk of short term covered bonds is more volatile than that of short term government bonds over time. However, here with very small exceptions we can see that government bonds have smaller liquidity risk than covered bonds from the end of the financial crisis until the end of the sample period. An exception from this trend represent the approximately one year long period between the middle of 2011 and middle of 2012 when the liquidity risks of both types of debt are almost the same.

In Denmark the results of Dick-Nielsen et al (2012) are substantially different. Covered bonds there have a smaller liquidity risk than government bonds during the crisis and most of the recession. During the financial crisis in Denmark there is a growth of uncertainty which explains the increased liquidity risks in both markets. However the higher rise in liquidity risk for government bonds at that time is a sign that investors were slightly more certain what price they wanted to pay for covered bonds (Dick-Nielsen et al, 2012). During the sovereign crisis period the liquidity risks of both markets in Denmark are volatile and in different time frames they either rise or fall below each other.

A general trend that we notice is that during the financial crisis the rise of liquidity risk in Swedish short term covered bonds follows that of their pricing impact. This effect could be explained with the increased uncertainty in investors at that time in the covered bonds market and their attempts to obtain government bonds instead of covered bonds. On the other hand, during this period the liquidity risk of government bonds remains constant similar to their price impact. This trend was to a certain extent strengthened by the issuance of short term bills by the National Debt Office in order to satisfy the demand of investors. Furthermore, we can see that the liquidity risks of both markets returned to their pre-crisis levels at the end of 2011, a development noticed also by Dick-Nielsen et al (2012) in the Danish market.

c. Long term price impact

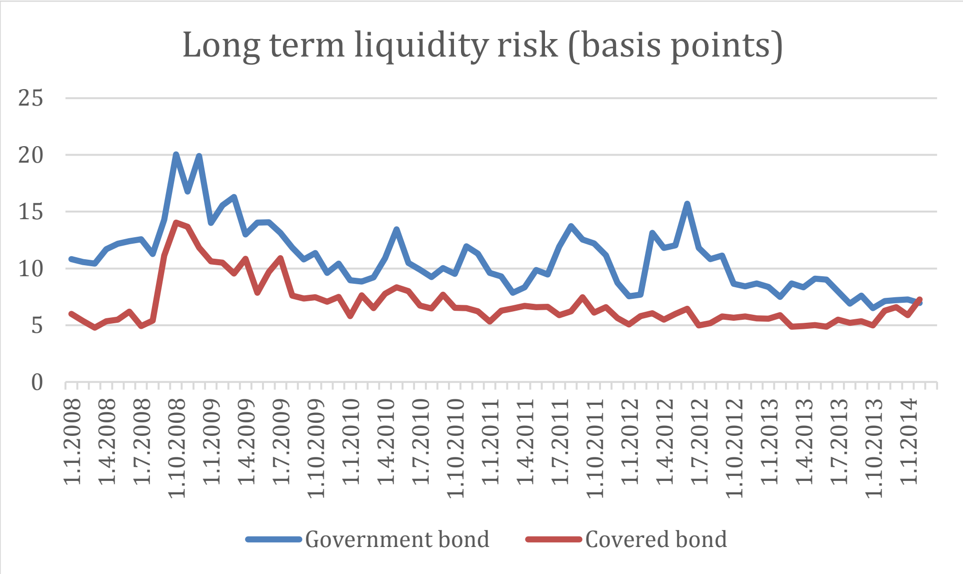


Source: Swedish Financial Supervisory Authority; own calculations

The results of the price impact test on long term bonds are different in the different periods we observe. While covered bonds perform significantly better before and during the financial crisis there is almost no difference in the liquidity of both asset classes during the recession. During the sovereign crisis the roles change several times – at the end of 2010 and in the first half of 2011 covered bonds are consistently more liquid. In the last quarter of 2011 the levels of liquidity are again very similar, however during the first half of 2012 covered bonds appear slightly more liquid. In the post-crisis period the liquidity of both instruments in again very close, however since the second half of 2013 we can notice a general trend towards more liquid government bonds. An interesting observation is that the liquidity of both types of debt after the financial crisis remains quite low until the end of our sample period.

In Denmark in the pre-crisis period we cannot declare a winner in terms of higher liquidity, however during the crisis and the first three quarters of 2009 covered bonds appear more liquid. At the end of the year government bonds liquidity rises above the value for covered bonds, however the roles change again at the beginning of the sovereign crisis and until the end of the sample period of the study no asset classes manages to maintain superior levels of liquidity than its counterpart. (Dick-Nielsen et al, 2012).

d. Long term liquidity risk



Source: Swedish Financial Supervisory Authority; own calculations

Looking at the liquidity risk, the long term bonds from our sample generate different results compared to the short term ones. Covered bonds are characterized by a consistently lower liquidity risk than that of government bonds, however the spread is quite small (within 1 basis point most of the time). A general conclusion for the whole sample period is that the relationship between the liquidity risks of the long term segments of both markets is consistently flat. Volatilities of the risks are also not substantially different, yet one can notice a slightly higher volatility of the risk for n

In contrast to our results Dick-Nielsen et al (2012) register observe numerous changes of the asset class with the smaller liquidity risk during the pre-crisis and the crisis periods. In the first three quarters of 2009 government bonds there have a smaller liquidity risk, however in the beginning of the sovereign crisis their risk rises above the levels for covered bonds. The trend turns again in the last six months of the observed sample when the liquidity risk of government bonds remains consistently below the one for covered bonds.

We can conclude that during the pre-crisis and the crisis the increase of the liquidity risk of long term bonds follows that of their price impact. In contrast, during the recession and the beginning of the sovereign crisis the liquidity risk of government bonds remains higher and does not follow the drop of their price impact compared to covered bonds. At the end of 2011 both risks reach or even go below their pre-crisis values, which contradicts to the findings of Dick-Nielsen et al (2012) for Denmark that both long term liquidity risks exceed their levels from the beginning of 2008 (especially in the case of covered bonds).

i. Liquidity and trade size

In this sector we analyze how the trade size affects liquidity in different sub periods. We do this in order to investigate how we should use the price impact measurement. Our finding, that trade size does not affect the price impact the way Amihud (2002) predicts, motivated us to not divide the price impact with quantity.

Table 6: Regression output - Price impact in relation to trade size short term covered bonds (basis points)

This table shows the impact trade size has on price impact. We ran the regression with price impact as the dependent variable and trade size as the independent variables. We did this for all five sub periods. The parameters (expect for the interception) show how the sub periods are related to the intercept.

		Intercept (<25 %)	**25-50 %**	**50-75 %**	**>75 %**
Pre crisis	Parameter	5,179	-3,035	-3,183	-2,594
	Standard error	0,202	0,286	0,286	0,286
Crisis	Parameter	10,074	-5,434	-6,964	-6,265
	Standard error	0,447	0,632	0,632	0,632
Recession	Parameter	7,11	-2,794	-1,864	**-0,265**
	Standard error	0,224	0,317	0,339	0,302
Sov crisis	Parameter	3,619	-0,736	**-0,0173**	0,794
	Standard error	0,0713	0,101	0,101	0,101
Post crisis	Parameter	3,481	**0,0334**	**0,407**	1,135
	Standard error	0,167	0,237	0,237	0,237

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level.
See appendix C for more detailed regression tables

Our test using the trade size as an independent variable in order to measure the impact of trade size on market liquidity yields somewhat interesting results (table 6). For most periods liquidity is higher for trade sizes that do not fall under the 25% smallest trades. Further, the difference between the liquidity changes for the 25-50%, 50-75% and >75% of the biggest trades remains within the boundaries of ca.1 basis point over time. For this reason, there are not stable grounds for distinguishing formally between the changes of the liquidities of these sizes. An interesting observation is that the smallest trade sizes seem to influence the pricing impact more than the others in stress periods (during the crisis they generate ca. 5 basis points increase vs 2.5-3.8 basis points decrease in pricing impact for the 75% largest trades; during the sovereign crisis the corresponding values are ca. 3.5 decrease vs 1-2 basis points increase in pricing impact compared to the recession).

Dick-Nielsen et al (2012) conclude that large trade sizes had greater impact on the short term Danish covered bond market than small trade sizes during the crisis. However, the pricing impact of large trade sizes there is smaller than the effect the Amihud measure predicts it to be, i.e. the pricing impact of a DKK 200 Million trade is far less than ten times higher than that of a DKK 20 Million trade.

Table 7: Regression output - Price impact in relation to trade size short term government bonds (basis points)

This table shows the impact trade size has on price impact. We ran the regression with price impact as the dependent variable and trade size as the independent variables. We did this for all five sub periods. The parameters (expect for the interception) show how the sub periods are related to the intercept.

		Intercept (<25 %)	25-50 %	50-75 %	>75 %
Pre crisis	Parameter	3,912	-1,18	-0,971	-0,588
	Standard error	0,0992	0,14	0,14	0,14
Crisis	Parameter	3,796	**-0,0134**	0,602	**-0,195**
	Standard error	0,103	0,145	0,145	0,145
Recession	Parameter	4,565	**-0,479**	-1,491	-1,819
	Standard error	0,121	0,172	0,172	0,172
Sov crisis	Parameter	2,836	0,875	1,433	0,388
	Standard error	0,0596	0,0846	0,0839	0,0843
Post crisis	Parameter	3,215	-0,261	-0,595	-0,468
	Standard error	0,0728	0,103	0,103	0,103

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level.
See appendix C for more detailed regression tables

The results for short term government bonds are generally very similar (table 7). We again cannot find a clear linear relationship between trade size and price impact in any of the periods. Here the fluctuations in liquidity for the different trade sizes are even smaller than for short term covered bonds.

In the case of Denmark the differences in terms of price impact of small and large trade sizes are also generally very small over the different periods (Dick-Nielsen et al (2012)).

Table 8: Regression output - Price impact in relation to trade size long term covered bonds (basis points)

This table shows the impact trade size has on price impact. We ran the regression with price impact as the dependent variable and trade size as the independent variables. We did this for all five sub periods. The parameters (expect for the interception) show how the sub periods are related to the intercept.

		Intercept (<25 %)	25-50 %	50-75 %	>75 %
Pre crisis	Parameter	9,805	-4,704	-5,055	-5,421
	Standard error	0,299	0,423	0,423	0,423
Crisis	Parameter	18,234	-9,293	-10,65	-10,281
	Standard error	0,538	0,762	0,761	0,761
Recession	Parameter	12,645	-4,813	-4,69	-4,319
	Standard error	0,195	0,275	0,275	0,275
Sov crisis	Parameter	8,348	-2,111	-1,621	-1,774
	Standard error	0,0955	0,135	0,135	0,135
Post crisis	Parameter	5,821	-0,773	**-0,237**	**0,24**
	Standard error	0,0975	0,138	0,138	0,138

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level.
See appendix C for more detailed regression tables

We applied analogical methodology to long term covered and government bonds (table 8). The general conclusion extracted from the short term markets is reinforced by our test on long term covered bonds. Again throughout all periods differences between the price impacts of different trade sizes are negligible. Dick-Nielsen et al (2012) reach to a very similar conclusion for the long term government bonds in Denmark.

Table 9: Regression output - Price impact in relation to trade size long term government bonds (basis points)

This table shows the impact trade size has on price impact. We ran the regression with price impact as the dependent variable and trade size as the independent variables. We did this for all five sub periods. The parameters (expect for the interception) show how the sub periods are related to the intercept.

		Intercept (<25 %)	25-50 %	50-75 %	>75 %
Pre crisis	Parameter	9,48	**-0,234**	1,002	1,41
	Standard error	0,152	0,214	0,214	0,214
Crisis	Parameter	16,787	-2,251	-4,165	-5,08
	Standard error	0,315	0,45	0,441	0,445
Recession	Parameter	14,167	-1,75	-4,023	-5,11
	Standard error	0,136	0,193	0,193	0,193
Sov crisis	Parameter	13,674	-3,246	-5,701	-6,365
	Standard error	0,083	0,117	0,117	0,117
Post crisis	Parameter	9,908	-1,53	-4,007	-5,191
	Standard error	0,0963	0,136	0,136	0,136

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level.
See appendix C for more detailed regression tables

In the long term government bonds sample we can notice a slight tendency towards higher liquidity of the half of the registered trades with the bigger sizes after the crisis (table 9). However, here the differences compared to change in the impact of the 25-50% trades are not large (ca. 1 basis point in the pre-crisis period, 2-3 basis points. during the crisis, recession and sovereign crisis periods and 3-4 basis points. during the post-crisis period). Again the conclusions of Dick-Nielsen et al (2012) based on the Danish sample to not differentiate substantially from ours, i.e. they do not find a special relationship between trade size and its influence on the change in price impact for this segment of the market either.

Based on our findings for the covered and government bond markets we reach to the conclusion that trade size does not have an immediate effect on change in price impact as Amihud (2002) suggests, i.e. a ten times larger trade does not necessarily have a ten times higher price impact than a small trade. Our results to a great extent overlap with the conclusions that Dick-Nielsen et al (2012) draw based on their tests of the performance of Danish covered and government bonds. Further, these findings were the main argument for our decision not to divide the price impact by quantity.

7. Conclusion

This paper relates through a thorough analysis liquidity of Swedish covered bonds to the liquidity of Swedish government bonds over the period 01.2008 – 02. 2014. Our results reveal some important trends that could be of interest for holder of both types of bonds and for policy makers.

First, our findings suggest that the liquidities of both markets are generally comparable during calm times, especially when looking at the short term market. However in periods of stress (especially the 2008 crisis) the liquidity of short term government bonds performs better than that of short term covered bonds, while for long term bonds the tendency is the opposite. This is a different result compared to Dick-Nielsen et al (2012)'s observation that in Denmark both short and long term covered bonds outperform government bonds during the crisis. Nevertheless, the Swedish short term covered bond market managed to remain relatively liquid during the crisis, due to the activities of the market-makers. However, it is important to remember that the intervention of the National Debt Office also contributed to maintaining reasonable levels of liquidity, which might not have being achieved otherwise. In this context Marklund (2014) warns that there may be a misleading trust of investors that such interventions will occur any time when necessary. This naturally is cannot be taken for granted, however it is something speculators could take advantage of. On the other hand, as the instrument was rather new in Sweden at that time (especially foreign) investors might have not really understood the difference with mortgage-backed securities, which probably caused their escape from covered bonds and increased appetite for government bonds during the crisis.

The second important finding is that short term bonds are more liquid than long term bonds in both in the covered and government debt markets, an observation noticed in the Danish context by Dick—Nielsen et al (2012) as well. This implies that time to maturity is a major factor for the liquidity of the markets. However, we should take into account that in the case of covered bonds to a certain extent it is possibly not as important for long term as for short term covered bonds to be liquid, since some of the major holders of long term bonds are insurance companies and pension funds. These investors have typically long term horizons and correspondingly keep their investments for long periods; therefore for them the security of their holdings is of greater importance than their liquidity. To a great extent this could also serve as an explanation for our next finding that long term covered bonds register better levels of liquidity than long term government bonds.

The forth main finding of our analysis is that in these markets trade size does not affect liquidity in the way Amihud (2002) predicts. Dick-Nielsen et al (2012) arrive at a similar conclusion based on their tests in the Danish markets. Although it is somewhat counterintuitive we, in fact, notice that in Sweden small trades with covered bonds have often a higher price impact than larger trades. This phenomenon could be explained with the different underlying dynamics of the different types of trading with covered bonds (inter-dealer and dealer-client). Dick-Nielsen et al (2012) explain the increase in price impact in the dealer-client market in Denmark and the corresponding decrease in the inter-dealer market with the larger trade sizes in the inter-dealer market (buyers have greater bargaining power there). Unfortunately, data on the counterparties that performed the transactions in Sweden was not disclosed to us and therefore we cannot provide more precise evidence from the Swedish market.

Our next finding is that liquidity risk for all markets increases during the crisis, with the only exception being short term government bonds where it remains constant. This observation backs the hypothesis that market participants were surprised by the scale of the crisis and did not know what price impact of trades to expect in such a period, especially in a young market, such as the one for covered bonds. In Denmark this effect was valid for all segments of both markets (Dick-Nielsen et al, 2012). Similarly to them, we believe that the argument of Brunnermeier and Pedersen (2009) for this development, that the increase of non-linear price moves caused by trades could have triggered tighter funding constraints for many investors, is reasonable. However, in contrast to Denmark, where the liquidity risk of especially long term covered bonds exceeds its early 2008 levels at the end of 2011, the liquidity risk of both markets in Sweden returned to its pre-crisis values by that time.

With regards to the classification of covered bonds for the LCR purposes the lobbying of some countries (especially Denmark) seems to have resulted in a new draft by the European Commission (The Covered Bond Report, 2014). Its terms would allow banks to use certain covered bonds with an overall cap of 70% (instead of 40%) with 7 % haircut in order to meet the LCR requirements. In other words some covered bonds would acquire level 1 status (some experts describe it as "level 1B" as there is an overall cap of 70% in contrast to government bonds). Due to the enormous importance of the covered bond in Denmark, the Danish authorities are very keen on ensuring that this proposal materializes. However, based on our analysis and its limitations we cannot reach to a one-sided conclusion whether Swedish covered bonds should be granted this status. As we have shown, Danish covered bonds liquidity yields better results than Swedish covered bonds liquidity when we compare them to their respective government bond markets. Since a potential collapse of the banking system represents a systematic risk for Sweden we believe that further research is needed in order to conclude whether Swedish covered bonds could be treated as level 1 (B) assets.

A precondition to a further analysis is the access to all the information in the MiFID data from the Authority of Financial Supervision (Finansinspektionen). By knowing the name, as well as the identification number of the counterparties involved in the transactions, the data cleaning process could be improved. This would yield even more precise results, i.e. the elimination of repurchases would be dramatically easier to detect. In addition to that, with these parameters it would have been possible to examine the liquidity differences within the inter-dealer and the deal-client markets (a potentially very interesting test due to the structure of the Swedish market with the dedicated market-makers). Furthermore, as previously discussed it is very hard to capture liquidity, because there is no universal concept and measures for that. Therefore upon the availability of relevant data we would recommend a larger study with more liquidity proxies in order to get deeper insight into the liquidity in this market.

We would also recommend further studies to attempt to investigate the parameters that affect the liquidity in these markets. This approach would facilitate the forecasting of future liquidity drops, which represent a serious threat for banks and the financial stability of Sweden as a whole.

8. Reference list

Alexander, G.J., Edwards, A.K. and Ferri, M.G. (2000*), "The Determinants of Trading Volume of High-Yield Corporate Bonds"*, Journal of Financial Markets 3 pp. 177-204

Amihud, Y. (2012), "*Illiquidity and stock returns: cross-section and time-series effects"*, Journal of Financial Markets 5, pp. 31-56

Archarya V., Pedersen, L. (2005), *"Asset pricing with liquidity risk"*. Journal of Financial Economics 77(2) pp. 375 -410

Baker, K. (1996), *"Trading Location and Liquidity: An Analysis of U.S. Dealer and Agency Markets for Common Stocks"*, Financial Markets, Institutions and Instruments, Vol.5, № 4

Bank for International Settlements (2013), "*Basel III: The Liquidity Coverage Ratio and liquidity risk monitoring tools*"

Barley. R., (2013*). "Euro-Zone Bonds Find Favor"*, Wall Street Journal. URL: Http://online.wsj.com/news/articles/SB10001424127887323854904578259942900715134?mg=reno64wsj&url=http%3A%2F%2Fonline.wsj.com%2Farticle%2FSB10001424127887323854904578259942900715134.html

Blume, M.B., Keirn, D.B. and Patel, S.A. (1991), "Returns and Volatility of Low Grade Bonds", The Journal of Finance, 46 pp. 49-74

Brown, M. (2009), *"Summary of Government Interventions in Financial Markets Sweden"*

Brunnermeier, M. and L. H. Pedersen (2009), "Asset pricing with liquidity risk" Review of Financial Studies 22

Buchholst, B., Gyntelberg, J., Sangill T. (2010), *"Liquidity of Danish Government and Covered Bonds – Before, during and after the Financial Crisis – Premilinary findings",* Denmark's National Bank Working Papers

Börse Frankfurt (2014), "Types of Bonds: Transparency in the Bond Jungle". URL: http://www.boersefrankfurt.de/en/basics+overview/bonds/types+of+bonds

Callesen, P. (2014), *A Central Banker's Perspective on European Regulatory Reform*, BIS Central Banker Speeches, Annual Conference on Regulatory Reform and Nordic Capital Markets, Copenhagen,

Chordia, T., Sahn-Wook, H., and Avanidhar, S. (2009), *"Theory-based illiquidity and asset pricing"*, Review of Financial Studies 22, 3629-3668.

Danske Markets (2011), "*The Guide to the Swedish Covered Bond Market"*

Danske Markets (2012), "*Danish Covered Bond Handbook. The covered bond handbook of mortgage banks in Denmark"*

Dick-Nielsen, J., Gyntelberg, J., Sangill, T. (2012), *"Liquidity in Government versus Covered Bond Markets"*, BIS Working Papers № 392, Monetary and Economic Department

Draghi, M. (2011), *DECISION OF THE EUROPEAN CENTRAL BANK of 3 November 2011 on the implementation of the second covered bond purchase programme,* THE GOVERNING COUNCIL OF THE EUROPEAN CENTRAL BANK

European Central Bank (2014), Long-term interest rate statistics for EU Member States. URL: http://www.ecb.europa.eu/stats/money/long/html/index.en.html

European Central Bank (2012), Press Release: Ending of covered bond purchase programme 2 (CBPP2). URL: http://www.ecb.europa.eu/press/pr/date/2012/html/pr121031_1.en.html

European Central Bank (Eurosystem) (2008), *"Covered Bonds in the EU Financial System"*

European Central Bank (Eurosystem) (2011), *"The Impact of Eurosystem's Covered Bond Purchase Programme on the Primary and Secondary Markets",* Occasional Paper Series, № 22

European Covered Board Council (2013), "*European covered bond fact book 2013"*

European Banking Authority (2013), "*Discussion Paper on Defining Liquid Assets in the LCR under the draft CRR"*, EBA/ DP/ 2013/ 01

Financial Times (2009), "*Banks ask for crisis funds for eastern Europe*". URL: http://www.ft.com/intl/cms/s/0/9830fa0c-e809-11dd-b2a5-0000779fd2ac.html#axzz32C3FTI8d

Gwilym, O.A., Trevino, L., Thomas, S. (2002), *"Bid-Ask Spreads and the Liquidity of International Bonds"*, The Journal of Fixed Income

Goyenko, R., Holden, C., Trzcinka, C. (2008), *"Do Measures of Liquidity Measure Liquidity?",* Journal of Financial Economics 92 pp. 153–181

Hong. G. and Warga, A. (2000), *"An Empirical Study of Bond Market Transactions"*, Financial Analysts Journal, Vol. 56, No. 2, pp. 32-46

Kamara, A. (1994), *"Liquidity, Taxes, and Short-Term Treasury Yields",* The Journal of Financial and Quantitative Analysis, Vol. 29, No. 3, pp.403-417

Keynes, J., M., (1930), *"A Treatise on Money"*, Vol. II (Macmillan, London).

Kylei, A. (November, 1985), “CONTINUOUS AUCTIONS AND INSIDER TRADING” Econometrica, Vol. 53, No. 6

Lampe, M., Stenström, O., (2008) *“Securitization and covered bonds in Sweden”*, Mannheimer Swartling, Global Securitisation and Structured Finance

Matlock, G., (2010), *"Peripheral euro zone government bond spreads widen"*, Reuters. URL: http://www.reuters.com/article/2010/02/16/markets-bonds-spreads-idUSLDE61F0W720100216

Martín R., Sevillano, J., González, L. (2013), *“Covered Bonds: The renaissance of an old acquaintance”,* Banco de España (Eurosistema) Estabilidad Financiera, №24, p.67-88

Marklund, L. (2014), "*Memorandum 7 – Consequences of an increased loan-to-value ratio for the funding of mortgages with covered bonds*", Sveriges Riksbank

Moshinsky, B. (2013), *“Covered Bonds Get Second-Class Status in EU Liquidity Review”, Bloomberg. URL:* http://www.bloomberg.com/news/2013-12-20/covered-bonds-given-second-class-status-in-eu-liquidity-review.html

Nykredit Markets (2007), *"Danish covered bonds”*

Nykredit Markets (2011), "*Nordic covered bonds – Sweden. A Handbook*”

Perraudin, W. (2014), “Covered Bonds vs. ABC Liquidity: A Comment on the EBA’s Proposed HQLA Definition”, Association for Financial Markets in Europe (AFME)

Sandström, M., Forsman, D., Stenkula von Rosen, J., Wettergren, J. (2013), “*The Swedish Covered Bond Market and its Links to Financial Stability*“, *Sveriges Riskbank Economic Review 2013:2*

SANFORD J. GROSSMAN and MERTON H. MILLER (1988), *“Liquidity and Market Structure“,* THE JOURNAL OF FINANCE * VOL. XLIII, NO. 3

Sarr, A., Lybek, T. (2002), *"Measuring Liquidity in Financial Markets"*, IMF Working Paper, WP/02/232

Statistics Sweden (2011)

Sarig, O. and Warga, A. (1989), *"Bond Price Data and Bond Market Liquidity"*, The Journal of Financial and Quantitative Analysis, Vol. 24, No. 3, pp.367-378

Schultz, P. (1988), "*Corporate Bond Trading Costs and Practices: A Peek Behind the Curtain"*, University of Notre Dame

Schwarcz, S. (2011), *"The Conundrum of Covered Bonds"*, Business Lawyer, Vol. 66, May 2011

Santoso, W., Harun, C., Wonida H (2010), *"Market Liquidity Risk as an Indicator of Financial Stability: The Case of Indonesia"*

Sveriges Riksbanken (2013), "Den svenska finansmarknaden"

Swedish Association of Covered Bonds Issuers (2014), *"Statistics on Covered Bonds"*

The Covered Bond Report (2014), *"Danes laud Commission draft with LCR Level 1B covered"*

Thomas, S. (2006), *"Resilience of Liquidity in Indian Securities Markets"* Economic and Political Weekly, Vol. 41, No. 32, pp. 3452-3454;

Xiaoxia, L., Tao, S. (2014), *"Why is the Amihud (2002) Illiquidity Measure Priced?"*

Wagstyl, S. (2009), "Banks ask for crisis funds for eastern Europe", Financial Times . URL: http://www.ft.com/intl/cms/s/0/9830fa0c-e809-11dd-b2a5-0000779fd2ac.html#axzz32BiX1zP9

Werner, R., Spangler, M. (2014), *"German Covered Bonds: Overview and Risk Analysis of Pfandbriefe*", IX, 82, ISBN: 978-3-319-02552-0 (p.1-74)

9. APPENDIX

A. Liquidity in sub periods (table 1)

Table 10: Regression output - liquidity in short term covered bonds (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
Intercept (Pre-crisis)	2,976	0,102	29,08	0,000	2,775	-	3,177
Crisis	2,433	0,185	13,16	0,000	2,071	-	2,795
Recession	2,995	0,131	22,82	0,000	2,738	-	3,252
Soverign crisis	0,653	0,111	5,9	0,000	0,436	-	0,87
Post-crisis	0,899	0,146	6,15	0,000	0,613	-	1,186
R2	0,0248						
Number of obs	32899						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 11: Regression output - liquidity in short term government bonds (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
Intercept (Pre-crisis)	3,227	0,048	66,840	0,000	3,133	-	3,322
Crisis	0,667	0,073	9,170	0,000	0,524	-	0,809
Recession	0,390	0,070	5,550	0,000	0,252	-	0,528
Soverign crisis	0,285	0,057	5,030	0,000	0,174	-	0,396
Post-crisis	-0,343	0,066	-5,200	0,000	-0,473	-	-0,214
R2	0,002						
Number of obs	108618						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 12: Regression output - liquidity in long term covered bonds (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
Intercept (Pre-crisis)	6,010	0,140	42,790	0,000	5,735	-	6,286
Crisis	4,667	0,218	21,450	0,000	4,240	-	5,093
Recession	3,179	0,163	19,500	0,000	2,859	-	3,498
Soverign crisis	0,961	0,149	6,440	0,000	0,668	-	1,253
Post-crisis	-0,382	0,158	-2,420	0,015	-0,691	-	-0,073
R2	0,022						
Number of obs	69075						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 13: Regression output - liquidity in long term government bonds (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
Intercept (Pre-crisis)	10,025	0,085	118,440	0,000	9,859	-	10,191
Crisis	3,870	0,153	25,250	0,000	3,569	-	4,170
Recession	1,421	0,106	13,360	0,000	1,213	-	1,630
Soverign crisis	**-0,179**	0,094	-1,900	0,057	-0,363	-	0,006
Post-crisis	-2,799	0,103	-27,230	0,000	-3,001	-	-2,598
R2							
Number of obs							

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

B. Liquidity in different trade sizes (table 2 – 5)

Table 14: Regression output - liquidity in short term covered bonds for trade size <25 % (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
Pre crisis (intercept)	5,633	0,267	21,080	0,000	5,110	-	6,157
Crisis	3,746	0,421	8,890	0,000	2,920		4,572
Recession	0,964	0,320	3,020	0,003	0,337	-	1,591
Sov crisis	-2,004	0,286	-7,010	0,000	-2,564	-	-1,443
Post crisis	-2,014	0,397	-5,070	0,000	-2,793	-	-1,235
R2	0,053						
Number of obs	8225						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 15: Regression output - liquidity in short term covered bonds for trade sizes 25-50 % (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	confidence interv		
Pre crisis (intercept)	2,219	0,178	12,450	0,000	1,869	-	2,568
Crisis	1,472	0,311	4,740	0,000	0,863		2,081
Recession	2,138	0,218	9,800	0,000	1,710	-	2,565
Sov crisis	0,659	0,190	3,460	0,001	0,286	-	1,032
Post crisis	1,198	0,232	5,170	0,000	0,743	-	1,652
R2	0,017						
Number of obs	8225						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 16: Regression output - liquidity in short term covered bonds for trade sizes 50-75 % (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
Pre crisis (intercept)	2,082	0,163	12,780	0,000	1,762	-	2,401
Crisis	1,005	0,328	3,060	0,002	0,361		1,649
Recession	4,061	0,228	17,780	0,000	3,614	-	4,509
Sov crisis	1,525	0,182	8,390	0,000	1,169	-	1,882
Post crisis	1,786	0,252	7,090	0,000	1,292	-	2,280
R2	0,039						
Number of obs	8225						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 17: Regression output - liquidity in short term covered bonds for trade sizes >75 % (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
Pre crisis (intercept)	2,585	0,206	12,560	0,000	2,182	-	2,989
Crisis	1,411	0,397	3,560	0,000	0,633		2,189
Recession	4,335	0,276	15,680	0,000	3,793	-	4,877
Sov crisis	1,765	0,222	7,970	0,000	1,331	-	2,199
Post crisis	2,010	0,290	6,930	0,000	1,441	-	2,578
R2	0,031						
Number of obs	8224						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 18: Regression output - liquidity in short term government bonds for trade sizes <25 % (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
Pre crisis (intercept)	4,276	0,135	31,770	0,000	4,012	-	4,539
Crisis	**-0,203**	0,174	-1,170	0,243	-0,543		0,138
Recession	0,416	0,185	2,250	0,024	0,054	-	0,779
Sov crisis	0,454	0,154	2,950	0,003	0,152	-	0,755
Post crisis	**-0,229**	0,179	-1,280	0,201	-0,579	-	0,122
R2	0,002						
Number of obs	27155						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 19: Regression output - liquidity in short term government bonds for trade sizes 25-50 % (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
Pre crisis (intercept)	2,558	0,090	28,440	0,000	2,382	-	2,735
Crisis	0,696	0,130	5,360	0,000	0,441		0,951
Recession	0,373	0,124	3,010	0,003	0,130	-	0,617
Sov crisis	0,512	0,103	4,960	0,000	0,310	-	0,715
Post crisis	**-0,308**	0,118	-2,600	0,009	-0,540	-	-0,075
R2	0,004						
Number of obs	27155						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 20: Regression output - liquidity in short term government bonds for trade sizes 50-75 % (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
Pre crisis (intercept)	2,999	0,097	31,070	0,000	2,809	-	3,188
Crisis	1,244	0,148	8,380	0,000	0,953		1,535
Recession	**0,176**	0,138	1,280	0,200	-0,093	-	0,446
Sov crisis	0,233	0,111	2,100	0,035	0,016	-	0,449
Post crisis	-0,331	0,127	-2,610	0,009	-0,579	-	-0,083
R2	0,005						
Number of obs	27155						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 21: Regression output - liquidity in short term government bonds for trade sizes >75 % (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
Pre crisis (intercept)	3,195	0,071	45,010	0,000	3,056	-	3,334
Crisis	0,829	0,138	6,000	0,000	0,558		1,100
Recession	0,515	0,116	4,440	0,000	0,288	-	0,743
Sov crisis	**-0,146**	0,090	-1,630	0,104	-0,321	-	0,030
Post crisis	-0,476	0,107	-4,450	0,000	-0,685	-	-0,266
R2	0,005						
Number of obs	27153						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 22: Regression output - liquidity in long term covered bonds for trade sizes < 25 % (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
Pre crisis (intercept)	11,929	0,420	28,390	0,000	11,105	-	12,752
Crisis	6,103	0,582	10,490	0,000	4,962		7,244
Recession	0,461	0,464	1,000	0,320	-0,447	-	1,370
Sov crisis	-3,699	0,437	-8,460	0,000	-4,555	-	-2,842
Post crisis	-5,985	0,461	-12,970	0,000	-6,890	-	-5,081
R2	0,062						
Number of obs	17269						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 23: Regression output - liquidity in long term covered bonds for trade sizes 25-50 % (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
Pre crisis (intercept)	5,150	0,202	25,500	0,000	4,754	-	5,546
Crisis	3,479	0,318	10,930	0,000	2,855		4,103
Recession	2,573	0,244	10,530	0,000	2,094	-	3,052
Sov crisis	1,056	0,220	4,800	0,000	0,625	-	1,488
Post crisis	**-0,187**	0,238	-0,780	0,432	-0,654	-	0,280
R2	0,020						
Number of obs	17269						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 24: Regression output - liquidity in long term covered bonds for trade sizes 50-75 % (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
Pre crisis (intercept)	4,565	0,238	19,220	0,000	4,100	-	5,031
Crisis	2,966	0,366	8,110	0,000	2,249		3,683
Recession	3,230	0,283	11,400	0,000	2,675	-	3,786
Sov crisis	2,181	0,255	8,550	0,000	1,681	-	2,680
Post crisis	0,895	0,270	3,320	0,001	0,366	-	1,424
R2	0,013						
Number of obs	17269						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 25: Regression output - liquidity in long term covered bonds for trade sizes > 75 % (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
Pre crisis (intercept)	4,475	0,288	15,520	0,000	3,910	-	5,040
Crisis	3,997	0,441	9,070	0,000	3,134		4,860
Recession	3,942	0,331	11,910	0,000	3,293	-	4,591
Sov crisis	2,099	0,302	6,950	0,000	1,507	-	2,691
Post crisis	1,598	0,312	5,120	0,000	0,986	-	2,210
R2	0,013						
Number of obs	17268						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 26: Regression output - liquidity in long term government bonds for trade sizes <25 % (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
Pre crisis (intercept)	12,549	0,244	51,510	0,000	12,071	-	13,026
Crisis	4,214	0,409	10,300	0,000	3,412		5,016
Recession	1,542	0,283	5,450	0,000	0,987	-	2,097
Sov crisis	1,018	0,260	3,910	0,000	0,507	-	1,528
Post crisis	-2,611	0,284	-9,200	0,000	-3,167	-	-2,055
R2	0,012						
Number of obs	55724						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 27: Regression output - liquidity in long term government bonds for trade sizes 25 - 50 % (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
Pre crisis (intercept)	10,464	0,187	55,980	0,000	10,098	-	10,831
Crisis	4,441	0,311	14,290	0,000	3,832		5,050
Recession	1,867	0,228	8,200	0,000	1,420	-	2,313
Sov crisis	**-0,367**	0,205	-1,790	0,074	-0,770	-	0,035
Post crisis	-1,690	0,224	-7,550	0,000	-2,129	-	-1,252
R2	0,013						
Number of obs	55724						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 28: Regression output - liquidity in long term government bonds for trade sizes 50-75 % (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
Pre crisis (intercept)	9,517	0,134	70,790	0,000	9,254	-	9,781
Crisis	2,818	0,251	11,240	0,000	2,327		3,310
Recession	**0,211**	0,179	1,180	0,239	-0,140	-	0,562
Sov crisis	-1,606	0,154	-10,450	0,000	-1,908	-	-1,305
Post crisis	-3,522	0,169	-20,780	0,000	-3,854	-	-3,190
R2	0,020						
Number of obs	55724						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 29: Regression output - liquidity in long term government bonds for trade sizes >75 % (basis points)							
Variable	**Parameter**	**Standard dev**	**T-stat**	**P-value**	**95 % confidence interv**		
Pre crisis (intercept)	8,798	0,122	72,200	0,000	8,559	-	9,037
Crisis	3,026	0,248	12,200	0,000	2,540		3,512
Recession	**0,106**	0,162	0,650	0,513	-0,212	-	0,424
Sov crisis	-1,571	0,138	-11,360	0,000	-1,842	-	-1,300
Post crisis	-3,982	0,149	-26,650	0,000	-4,275	-	-3,689
R2	0,029						
Number of obs	55723						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

C. Liquidity's relation to trade size in sub periods

Table 30: Regression output - Price impact in relation to trade size short term covered bonds pre crisis (basis points)							
Variable	**Parameter**	**Standard dev**	**T-stat**	**P-value**	**95 % confidence interv**		
<25% (intercept)	5,179	0,202	25,61	0,000	4,782	-	5,575
25-50%	-3,035	0,286	-10,61	0,000	-3,596	-	-2,474
50-75%	-3,183	0,286	-11,13	0,000	-3,744	-	-2,622
>75%	-2,594	0,286	-9,07	0,000	-3,155	-	-2,033
R2	0,0462						
Number of obs	3362						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 31: Regression output - Price impact in relation to trade size short term covered bonds crisis (basis points)							
Variable	**Parameter**	**Standard dev**	**T-stat**	**P-value**	**95 % confidence interv**		
<25% (intercept)	10,074	0,447	22,55	0,000	9,198	-	10,951
25-50%	-5,434	0,632	-8,6	0,000	-6,674	-	-4,195
50-75%	-6,964	0,632	-11,01	0,000	-8,204	-	-5,723
>75%	-6,265	0,632	-9,91	0,000	-7,504	-	-5,025
R2	0,0925						
Number of obs	1487						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 32: Regression output - Price impact in relation to trade size short term covered bonds recession (basis points)							
Variable	**Parameter**	**Standard dev**	**T-stat**	**P-value**	**95 % confidence interv**		
<25% (intercept)	7,110	0,224	31,74	0,000	6,671	-	7,549
25-50%	-2,794	0,317	-8,82	0,000	-3,415	-	-2,173
50-75%	-1,864	0,339	-5,49	0,000	-2,529	-	-1,198
>75%	**-0,265**	0,302	-0,88	0,380	-0,856	-	0,327
R2	0,0201						
Number of obs	5219						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 33: Regression output - Price impact in relation to trade size short term covered bonds sov crisis (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
<25% (intercept)	3,619	0,071	50,77	0,000	3,48	-	3,759
25-50%	-0,736	0,101	-7,3	0,000	-0,934	-	-0,539
50-75%	**-0,017**	0,101	-0,17	0,864	-0,215	-	0,18
>75%	0,794	0,101	7,87	0,000	0,596	-	0,991
R2	0,0116						
Number of obs	19603						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 34: Regression output - Price impact in relation to trade size short term covered bonds post crisis (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
<25% (intercept)	3,481	0,167	20,82	0	3,154	-	3,809
25-50%	**0,033**	0,237	0,14	0,888	-0,43	-	0,497
50-75%	**0,407**	0,237	1,72	0,085	-0,0569	-	0,871
>75%	1,135	0,237	4,8	0	0,671	-	1,599
R2	0,0092						
Number of obs	3228						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 35: Regression output - Price impact in relation to trade size short term government bonds pre crisis (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
<25% (intercept)	3,91	0,0992	39,45	0,000	3,717	-	4,106
25-50%	-1,18	0,1400	-8,41	0,000	-1,455	-	-0,905
50-75%	-0,971	0,1400	-6,92	0,000	-1,245	-	-0,696
>75%	-0,588	0,1400	-4,19	0,000	-0,862	-	-0,313
R2	0,0049						
Number of obs	16765						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 36: Regression output - Price impact in relation to trade size short term government bonds crisis (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
<25% (intercept)	3,80	0,103	37	0	3,595	-	3,997
25-50%	**-0,01**	0,145	-0,09	0,927	-0,298	-	0,271
50-75%	0,60	0,145	4,15	0	0,318	-	0,887
>75%	**-0,20**	0,145	-1,34	0,179	-0,479	-	0,0896
R2	0,0026						
Number of obs	13233						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 37: Regression output - Price impact in relation to trade size short term government bond recessions (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
<25% (intercept)	4,565	0,121	37,6	0,000	4,327	-	4,803
25-50%	**-0,479**	0,172	-2,79	0,005	-0,815	-	-0,142
50-75%	-1,491	0,172	-8,68	0,000	-1,827	-	-1,154
>75%	-1,819	0,172	-10,6	0,000	-2,156	-	-1,483
R2	0,0097						
Number of obs	14984						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 38: Regression output - Price impact in relation to trade size short term government bonds sov crisis (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv	
<25% (intercept)	2,84	0,06	47,6	0,000	2,719	2,953
25-50%	0,875	0,0846	10,33	0,000	0,709	1,041
50-75%	1,433	0,0839	17,08	0,000	1,269	1,598
>75%	0,388	0,0843	4,6	0,000	0,223	0,553
R2	0,0073					
Number of obs	44413					

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 39: Regression output - Price impact in relation to trade size short term government bonds post crisis (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv	
<25% (intercept)	3,215	0,0728	44,14	0	3,072	3,358
25-50%	-0,261	0,103	-2,53	0,011	-0,463	-0,0591
50-75%	-0,595	0,103	-5,78	0	-0,797	-0,393
>75%	-0,468	0,103	-4,54	0	-0,67	-0,266
R2						
Number of obs						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 40: Regression output - Price impact in relation to trade size long term covered bonds pre crisis (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
<25% (intercept)	9,805	0,299	32,810	0,000	9,219	-	10,391
25-50%	-4,704	0,423	-11,130	0,000	-5,532	-	-3,875
50-75%	-5,055	0,423	-11,960	0,000	-5,884	-	-4,226
>75%	-5,421	0,423	-12,820	0,000	-6,250	-	-4,592
R2	0,0487						
Number of obs	4260						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 41: Regression output - Price impact in relation to trade size long term covered bonds crisis (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
<25% (intercept)	18,234	0,538	33,870	0,000	17,178	-	19,289
25-50%	-9,293	0,762	-12,200	0,000	-10,787	-	-7,799
50-75%	-10,650	0,761	-13,990	0,000	-12,142	-	-9,157
>75%	-10,281	0,761	-13,510	0,000	-11,773	-	-8,789
R2	0,0805						
Number of obs	3044						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 42: Regression output - Price impact in relation to trade size long term covered bonds recession (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
<25% (intercept)	12,645	0,195	64,960	0,000	12,263	-	13,026
25-50%	-4,813	0,275	-17,490	0,000	-5,352	-	-4,273
50-75%	-4,690	0,275	-17,040	0,000	-5,229	-	-4,150
>75%	-4,319	0,275	-15,690	0,000	-4,859	-	-3,779
R2	0,0333						
Number of obs	12301						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 43: Regression output - Price impact in relation to trade size long term covered bonds sov crisis (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
<25% (intercept)	8,348	0,096	87,370	0,000	8,160	-	8,535
25-50%	-2,111	0,135	-15,620	0,000	-2,375	-	-1,846
50-75%	-1,621	0,135	-12,000	0,000	-1,886	-	-1,357
>75%	-1,774	0,135	-13,130	0,000	-2,039	-	-1,510
R2	0,0087						
Number of obs	33193						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 44: Regression output - Price impact in relation to trade size long term covered bonds post crisis (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
<25% (intercept)	5,821	0,098	59,680	0,000	5,630	-	6,012
25-50%	-0,773	0,138	-5,600	0,000	-1,043	-	-0,502
50-75%	**-0,237**	0,138	-1,720	0,085	-0,508	-	0,033
>75%	**0,240**	0,138	1,740	0,082	-0,031	-	0,510
R2	0,0036						
Number of obs	16277						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 45: Regression output - Price impact in relation to trade size long term government bonds pre crisis (basis points)

Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
<25% (intercept)	9,480	0,152	62,520	0,000	9,183	-	9,778
25-50%	**-0,234**	0,214	-1,090	0,276	-0,654	-	0,187
50-75%	1,002	0,214	4,670	0,000	0,581	-	1,422
>75%	1,410	0,214	6,580	0,000	0,990	-	1,831
R2	0,0035						
Number of obs	23251						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 46: Regression output - Price impact in relation to trade size long term government bonds crisis (basis points)							
Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
<25% (intercept)	16,787	0,315	53,300	0,000	16,170	-	17,405
25-50%	-2,251	0,450	-5,000	0,000	-3,132	-	-1,369
50-75%	-4,165	0,441	-9,440	0,000	-5,030	-	-3,300
>75%	-5,080	0,445	-11,400	0,000	-5,953	-	-4,207
R2	0,0148						
Number of obs	10205						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 47: Regression output - Price impact in relation to trade size long term government bonds recession (basis points)							
Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
<25% (intercept)	14,167	0,136	103,820	0,000	13,899	-	14,434
25-50%	-1,750	0,193	-9,070	0,000	-2,128	-	-1,372
50-75%	-4,023	0,193	-20,850	0,000	-4,401	-	-3,645
>75%	-5,110	0,193	-26,480	0,000	-5,488	-	-4,732
R2	0,0206						
Number of obs	40136						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 48: Regression output - Price impact in relation to trade size long term government bonds recession sov crisis (basis points)							
Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
<25% (intercept)	13,674	0,083	164,720	0,000	13,512	-	13,837
25-50%	-3,246	0,117	-27,650	0,000	-3,476	-	-3,016
50-75%	-5,701	0,117	-48,560	0,000	-5,932	-	-5,471
>75%	-6,365	0,117	-54,210	0,000	-6,595	-	-6,135
R2	0						
Number of obs	100386						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level

Table 49: Regression output - Price impact in relation to trade size long term government bonds post crisis (basis points)							
Variable	Parameter	Standard dev	T-stat	P-value	95 % confidence interv		
<25% (intercept)	9,908	0,096	102,920	0,000	9,719	-	10,096
25-50%	-1,530	0,136	-11,240	0,000	-1,796	-	-1,263
50-75%	-4,007	0,136	-29,430	0,000	-4,274	-	-3,740
>75%	-5,191	0,136	-38,130	0,000	-5,458	-	-4,925
R2	0,0353						
Number of obs	48917						

Source: Swedish Financial Supervisory Authority; own calculations
Note: numbers in bold = not significant on the 5 % level