The Swedish Money Market Risk Premium – Experiences from the Crisis

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This paper analyses the extent to which the Swedish money market risk premium has been affected by the current financial turmoil. We also examine the impact of shocks transmitted from the US and European markets in more detail. Our results indicate that the Swedish market has been significantly affected by shocks from the US market, but not from the European market. The findings also reveal that the main driver of the money market risk premium in the first part of the crisis was liquidity risk. However, during the latter part of the crisis, there has been a shift from liquidity risk to credit risk. This has specific policy implications for central banks.

1. Introduction

The international financial markets have become more open and more closely linked together over time. However, the internationalisation of the financial markets has had both positive and negative effects. On one hand, international financial markets facilitate improved risk sharing and diversification. On the other hand, when a financial crisis occurs, the contagion effects can be more severe. Although the current financial crisis started in the United States, it has become a global crisis. Thus, the situation for policymakers in Sweden today is very different from the situation in the 1990s, when Swedish banks were hit by a domestic financial crisis. In the current global environment, it is essential to understand how and to what extent Swedish financial markets are affected by the crisis, so that

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relevant and proper policy measures can be undertaken to mitigate the effects on the domestic banking system and the real economy.

To this end, this paper aims to investigate the degree to which the Swedish money market risk premium has been affected by developments in the European and US markets before and during the crisis. That is, we study the development of the Swedish short-term money market risk premium and one of its components, credit risk, with emphasis on the issues of systematic risk[2] (i.e. market risk or undiversifiable risk) and financial contagion. More specifically, we aim to answer the following questions: Has the level of systematic risk changed in the crisis period compared to the pre-crisis period? What factors drive the short-term money market risk premium and are there spillovers from the US and European markets?

In general, the risk premium is the extra return investors demand for bearing risk. The risk premium may vary over time as the investors' perception of the underlying risk and their attitude towards risk change. For example, in money markets, short term rates may reflect both liquidity and credit risk premiums. In this paper, the Swedish money market risk premium is decomposed into a credit risk part and a liquidity-driven part so as to facilitate investigation of the changes over time in the components. It is important to understand the composition of the money market premium together with the manner in which it was affected during the crisis, as the spread has an impact on the real economy through, for example, the variable-rate loans tied to it (mortgages etc).[3] The better our understanding of the risk premium, the easier it will be to implement the relevant policy measures in order to reduce the spread. For example, depending on whether the risk premium during the crisis consists mainly of credit or liquidity risk, policymakers can choose to focus on the level of capital in financial institutions, or to increase liquidity in the financial system. As the International Monetary Fund (IMF) (2009) discusses, being able to reduce the money market spread may have positive effects on other spreads, for example corporate spreads.

The rest of the paper is organised as follows. The following section describes the data. Section 3 studies the development of the short-term Swedish money market risk premium, before and during the crisis, relative to European and US risk premiums. It also investigates the transmission of shocks from the US and Euro markets to the Swedish market. Section 4 analyses data on credit risk, proxied by CDS (credit default swaps) spreads, during the pre-crisis and crisis periods. In Section 5, an indicative decomposition of the short-term money market risk premium into a credit risk part

[2] The systematic risk is the risk inherent to the entire market and, in this paper, is quantified by correlation.
[3] See Karlsson et al. (2009) for a discussion on the connection between interest rates and the real economy.

and liquidity risk part is performed. Finally, the last section presents our conclusions.

2. Data

Data on the short-term money market risk premiums is collected from Reuters EcoWin for the Swedish, US and Euro area markets. The spread between the three-month interbank rate and the expected future overnight rate is used to represent the risk premium in short-term money market rates. For Sweden, the Stibor rate is the interbank rate and the STINA interest rate swap[4] is utilised as a proxy for future overnight rates.[5] The corresponding variables for the Euro area are the 3-month BBA Libor rate and the EONIA swap, and for the US the 3-month BBA Libor rate and the overnight interest rate swap.

The data utilised in this paper covers the period from 2 January 2006 to 30 June 2009, yielding a total sample of 912 daily observations. Note that there are missing observations in the data – these have been replaced by linear interpolations. The total sample is divided into two separate periods, the pre-crisis period covering 2 January 2006 to 31 July 2007, and the crisis period from 1 August 2007 to 30 June 2009. In most graphs, however, the period January 2007 to June 2009 is displayed, as we find that the period from the beginning of 2007 provides sufficient information on the pre-crisis period.

For the credit risk measure, proxied by 5-year CDS spreads, data has been collected from Reuters EcoWin for the Euro area and from Bloomberg for the United States. The 5-year spreads are used, as these are the most liquid instruments. The variables collected for the Euro area and the United States are the iTraxx Financial Index and CDX index, respectively. The data on CDS spreads for the four largest Swedish banks (Svenska Handelsbanken, Nordea, SEB and Swedbank) has been collected from Handelsbanken Capital Markets. Data for the different Swedish banks is only available from 30 January 2006. An equally-weighted index of the spreads for the Swedish banks has been constructed as a measure of the credit risk in the Swedish market. In total, 858 daily observations have been used in the analysis of the credit risk data.

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[4] An overnight interest rate swap is a swap in which the floating leg is linked to a published index of daily overnight rates. The two parties agree to exchange at maturity, on an agreed notional amount, the difference between interest accrued on the agreed fixed rate and interest accrued through the geometric average of the floating index rate.

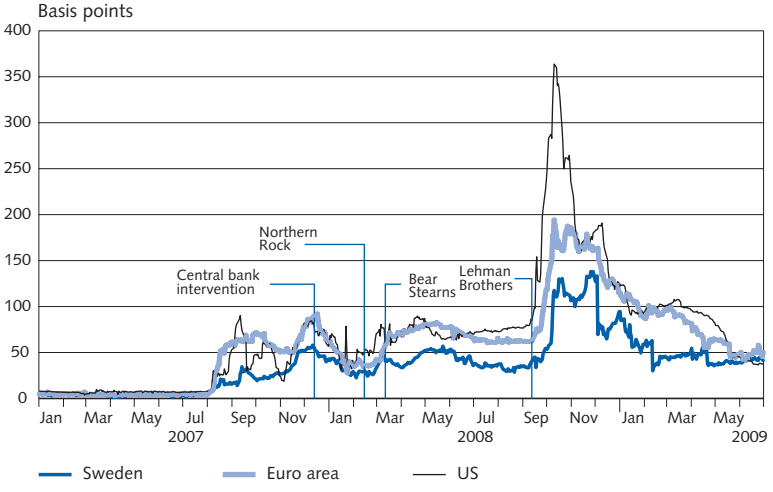
[5] STINA is used for the reason that there is no overnight interest rate available for the Swedish market. Because STINA is a so-called tomorrow/next interest rate, it will be slightly higher than a true overnight interest rate. We perform a robustness test, in which STINA is corrected by subtracting a moving average of the difference between the tomorrow/next interest rate and the repo rate. The choice of the interest rate does not affect the results.

3. The short-term money market risk premium

3.1 RECENT EVENTS

In this section, developments in the Swedish short-term money market are analysed and the risk premium is compared to the risk premiums in the Euro area and United States. Before the start of the financial turmoil in August 2007, the risk premiums were at stable and relatively low levels in all three markets (see Graph 1). For example, the short-term money market risk premium was around five basis points on average in Sweden and the Euro area and seven basis points in the United States in the period before the financial crisis, as shown in Panel A of Table 1. The volatility in the pre-crisis period was also low in all three markets. According to Heider et al. (2008), the low interest rate spread on the interbank market in Europe and the United States during the period before August 2007 indicates full participation of borrowers and lenders in the interbank market.

Figure 1. Short-Term Risk Premium
The graph shows the development of the spread between the 3-month interbank rate and O/N rate from January 2007 to June 2009 for Sweden, the euro area and the United States.
Basis points



In August 2007, the risk premiums in short-term money market rates increased significantly. This increase was brought about by concerns over losses associated with US subprime mortgage-related structured products. Although the subprime problems were US specific, the loans had been sold on outside the United States, resulting in the problems quickly spreading to other markets. Uncertainty about where losses would arise made banks and other financial institutions more cautious in lending to each other. This increased the liquidity risk and banks started to hoard

liquidity, which affected the functioning of interbank markets (Sveriges Riksbank (2008a)). At first, the risk premium peaked in December 2007 with over 100 basis points for the US and European markets. The risk premiums then declined somewhat after the liquidity injections by the Federal Reserve and other central banks. The risk premiums increased again in February 2008 after the takeover of Northern Rock and the subsequent collapse of Bear Sterns. Heider et al. (2008) conclude that the elevated spread was a sign of an adverse selection problem in the interbank market, whereby safe borrowers dropped out of the market and the interest rate rose to reflect the fact that only riskier borrowers remained.

However, the bankruptcy of Lehman Brothers in mid-September 2008 had the greatest impact on the risk premium in all three markets. According to Heider et al. (2008), after Lehman Brothers' collapse, the interbank markets in Europe and the United States broke down because of increased counterparty risk and, consequently, extensive liquidity hoarding by lenders. As shown in Panel A in Table 1, the US money market risk premium reached a maximum of 364 basis points during the crisis period. The corresponding figures for the Swedish and euro markets were 138 and 194 basis points, respectively. The Swedish spread underwent a similar development to premiums in the United States and Europe during the crisis period, but has stayed at a lower level. According to Sveriges Riksbank (2008a), the Swedish interbank market functioned relatively well during the first part of the crisis period, compared to interbank markets abroad, although it was tangibly affected after September 2008.

Since the collapse of Lehman Brothers, risk premiums have receded and are back at the same levels as prevailed prior to September 2008. However, compared to the pre-crisis period, they have remained elevated. According to the IMF (2009), liquidity hoarding and concerns about counterparty credit risk continued during spring 2009, and certain banks continued to deposit surplus liquidity with central banks.

3.2 SYSTEMATIC RISK

In general, systematic risk is defined as the portion of risk that cannot be eliminated by diversification across the markets.[6] Using correlation as an indicator for systematic risk, we can study whether Swedish markets are exposed to global market risk during a financial crisis.[7] For example, increased correlations between the money market risk premiums indicate higher systematic risk.

[6] Systematic risk is different from systemic risk which is the risk that the entire financial system will collapse.

[7] Significant increases in correlations between interest rates have been found in literature studying previous financial crises, see, for example, Baig and Goldfajn (1998).

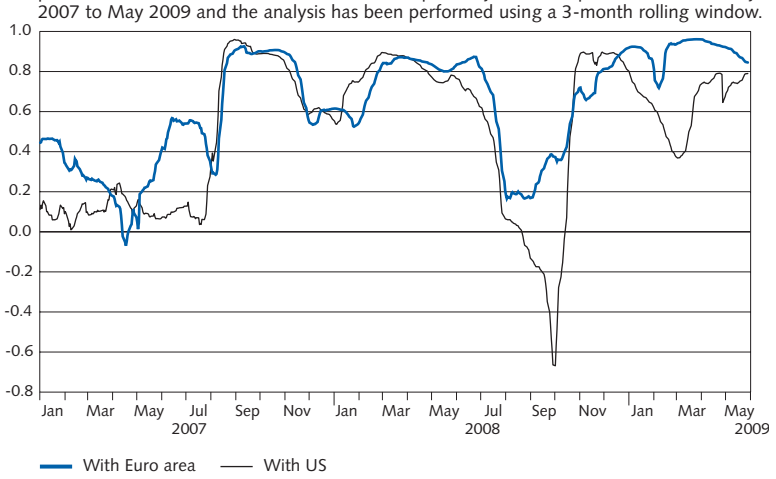
Table 1. Short-term risk premiums

Panel A displays the summary statistics for the short-term risk premiums in Sweden, the euro area and the United States in two periods. The first period is the pre-crisis period between January 2006 and the end of July 2007, while the second period lasts from August 2007 to the end of June 2009. Summary statistics are given in basis points. Statistically significant higher means and medians at the 1 % level in the crisis period (compared to the pre-crisis period) are marked with *. Panel B shows the simple correlations (Pearson) between the time series in the two periods. Statistically significant higher correlations at the 1 % level in the crisis period (compared to the pre-crisis period) are marked with *. Panel C contains the results from the principal component analysis of the short-term risk premiums of Sweden, the Euro area and the United States. The sample is divided into two periods, the pre-crisis and crisis periods, and the principal components are computed using ordinary correlations.

	Sweden	Euro area	US
Panel A: Summary statistics			
Pre-crisis period (Jan 06–Jul 07)			
Mean	4.8	5.1	6.9
Median	4.8	5.0	7.0
Std	1.4	1.1	1.4
Min	-0.5	2.5	0.5
Max	8.8	12.7	13.9
Crisis period (Aug 07–Jun 09)			
Mean	47.5*	77.9*	88.7*
Median	41.5*	68.1*	73.7*
Std	25.8	36.0	59.1
Min	4.9	5.5	6.9
Max	138.0	194.3	363.9
Panel B: Correlations			
Pre-crisis period (Jan 06–Jul 07)			
Sweden	1		
Euro area	0.160	1	
US	0.020	-0.019	1
Crisis period (Aug 07–Jun 09)			
Sweden	1		
Euro area	0.906*	1	
US	0.795*	0.878*	1
Panel C: Principal component analysis			
Pre-crisis period (Jan 06–Jul 07)			
Principal component	Proportion		
PC 1	0.3876		
PC 2	0.3348		
Loadings:	Sweden	Euro area	US
PC 1	0.7095	0.7051	0.0289
PC 2	0.0934	-0.1344	0.9865
Crisis period (Aug 07–Jun 09)			
Principal component	Proportion		
PC 1	0.9069		
PC 2	0.0689		
Loadings:	Sweden	Euro area	US
PC 1	0.5735	0.5914	0.5669
PC 2	-0.6496	-0.0935	0.7545

Using a 3-month rolling window, we have computed time-varying correlation as presented in Graph 2. In the pre-crisis period, the correlations between the markets were relatively low. This is also evident from paired correlation coefficients for the risk premiums displayed in Panel B in Table 1. During the crisis period, international risk premiums seemed to fluctuate in conjunction. For example, at that time, the average correlations between the Swedish money market risk premium and the risk premiums in the Euro area and the United States were 0.91 and 0.80, respectively. Interestingly, the correlations between markets declined rapidly in September 2008 when Lehman Brothers went bankrupt. The negative correlation with the US market could be a result of the Swedish risk premium slightly lagging the US risk premium during this period of extreme volatility in the money markets.[8]

Figure 2. Correlations 3-Month Rolling Window: Risk premiums
The graph displays the correlation between the Swedish risk premium and the risk premium in the euro area and United States respectively. The time period is from January 2007 to May 2009 and the analysis has been performed using a 3-month rolling window.



Although the correlation analysis indicates that markets tend to fluctuate in conjunction during crises, it says little about what drives these movements. Next, we want to understand whether movements in risk premiums across countries take place on the basis of the effect of common factors or region-specific factors. To identify these factors, we have adopted a statistical approach, namely principal components analysis (PCA), which is described more in detail in Box 1.

Applying PCA, we find that, in the pre-crisis period, there seem to be two independent components that explain the variation in the risk premiums

[8] Because of the time difference, some US events are incorporated in the Swedish risk premium on the following day.

Box 1: Principal Component Analysis (PCA)

In general, principal component analysis (PCA) is a way of identifying patterns in data, and of expressing this data in such a manner as to highlight similarities and differences. Principal component analysis involves a mathematical procedure that transforms a number of correlated variables into a number of uncorrelated variables called principal components. These independent components capture co-movements or variations in the series under study. The first principal component accounts for as much of the variability in the data as possible, and each succeeding component accounts for as much of the remaining variability as possible. If the series follows a common pattern, for example a general market trend, the first principal component should be able to explain most of the joint variation in the data. Several major assumptions are made in principal component analysis, such as linearity, independence and that large variances have important structures.

For more details on PCA see Campbell et al. 1997.

as shown in Panel C in Table 1. It is reasonable to assume that these two components represent regional factors, where the first component can be interpreted as a European factor and the second one as a US-specific factor.

Turning to the crisis period, there is only one common factor that captures about 91 per cent of the total variance variability of the data[9]. This component can be interpreted as systematic risk (or market risk) which captures changes in investors' risk appetite (and cost of capital). The fact that risk premiums were driven by a common factor during the crisis, indicating an increase in systematic risk, highlights the importance for policymakers of taking the anticipated effects of systematic risk into account.

3.3. SPILLOVERS BETWEEN MARKETS: VECTOR AUTOREGRESSIVE MODEL

Next, we want to study whether the increase in systematic risk is due to the transmission of US and Euro market tensions to the Swedish markets. In order to answer this question, we use a vector autoregressive (VAR) model for the short-term risk premiums. The VAR model allows us to capture the evolution of and interdependencies between time series, and to test the causal relationship between series[10], that is, whether a market has

[9] The factor loadings on the first principal component are positive and similar in term of magnitudes for all countries.

[10] The methodology is similar to the one used in Kahlid and Kawai (2003), who only find weak support of spillover effects between the Asian economies during the Asian crisis.

a direct effect on other markets. Results of causality tests are displayed in Table 2.[11] The test results indicate that, in the pre-crisis period, the three money market risk premiums were independent of each other. In the crisis period, only the US risk premium had a significant impact on the Swedish risk premium. That is, while we find that US market tensions affected the Swedish risk premium, we do not find that there were any spillovers from the European market. One possible explanation is that the US market affected the European and Swedish markets simultaneously. Thus, in this crisis, the focus of policy measures should have been on mitigating the contagion from the US market. Similar results were found by the European Central Bank (ECB) (2008), which determined that US market tensions affected the Euro area market, but not vice versa. However, the Bank of Japan (2008) found that both the US and European markets had an impact on the Japanese market during the recent financial turmoil.

Table 2. Granger Causality Tests

First, in order to perform a Granger causality test, an estimated VAR model is presented in this table. The model has 3 lags in the pre-crisis period and 2 lags in the crisis period. The lag length was determined using the Akaike information criterion. In the second step, the null hypothesis of no causality is tested. That is, the null hypothesis is that the independent variables, i.e. the Euro area and US short-term risk premiums, do not affect (or cause) the Swedish short term risk premium. The null is rejected if the p-value < 0.05.

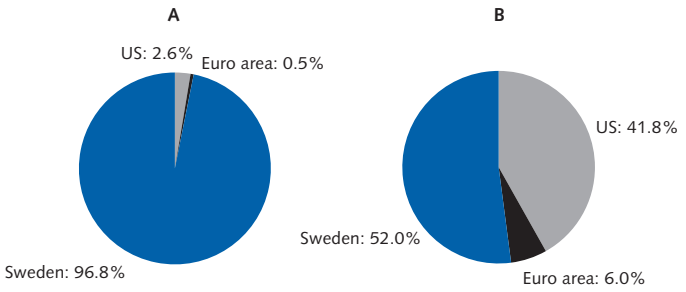
Hypothesis	Chi-sq	Prob.	Result
Pre-crisis period (Jan 06–Jul 07)			
US does *not* cause SWE	1.97	0.578	Not rejected
EURO does *not* cause SWE	2.13	0.547	Not rejected
Crisis period (Aug 2007–*Jun 2009*).			
US does *not* cause SWE	14.67	0.000	Rejected
EURO does *not* cause SWE	3.28	0.194	Not rejected

These results are supported by the variance decomposition analysis, which provides information on the relative importance of shocks on the Swedish spread over 20 trading days.[12] In the pre-crisis period, 97 per cent of the variance of the Swedish money market risk premium was attributable to Swedish shocks (see Graph 3). In the crisis period, this proportion dropped to 52 per cent. Instead, the impact from US market shocks increased from 3 per cent to 42 per cent. The impact from the Euro market remained small during the crisis.

[11] In the empirical analysis, the lag length in the model was determined using the different information criteria in the lag exclusion test, so that there is no significant serial correlation left in the residuals. The VAR(3), i.e. a model with 3 lags, was used for the pre-crisis period and VAR(2) was used for the crisis period.

[12] The variance decomposition is identified using the Cholesky decomposition, with the order being us, euro area and Sweden. The time period is the same as in ECB (2008).

Figure 3. Variance Decomposition Analysis
The two pie charts below present the variance decomposition of the Swedish risk premiums in the pre-crisis (A) and crisis (B) periods. The lengths of the periods are 20 days and the Cholesky ordering is US, euro area and Sweden.



3.4 US DOLLAR LIQUIDITY SHORTAGES IN INTERBANK MARKETS

The analysis so far has concluded that there have been spillover effects from the US market to the Swedish market. In this section, the examination is taken one step further and the US dollar liquidity shortages in interbank markets as a specific transmission channel are investigated. An understanding of which mechanisms cause financial contagion will help policymakers to be more precise in their policy measures.

During the crisis, many European banks experienced an increased need for US dollar liquidity. However, as providers of US dollar liquidity became more reluctant to lend to non-US financial institutions, these banks had to use currency swaps to access US dollars (ECB (2008)). To handle the shortage of US dollars, several central banks negotiated swap agreements with the US Federal Reserve to provide access to dollars in their domestic markets. According to the ECB (2008), during the second half of 2007, the risk premium in the Euro money market spreads increased due to increased tensions in the US dollar money market. Also, Baba et al. (2008) found a significant lead-lag relationship between the US dollar FX swap and the short-term risk premium for the Euro market. Their findings indicate that the increase in the cost of accessing US dollars for European banks raised the European money market risk premium.

The Swedish central bank announced a swap agreement with the US Federal Reserve in September 2008. The purpose of this was to address increased strains in US dollar short-term funding markets (Sveriges Riksbank (2008c)). The Swedish central bank then provided loans in dollars in the domestic market through auctions.[13] Most auctions executed until

[13] The first auction took place on 1 October 2008 and, by the end of June 2009, 13 auctions had been held, offering a total of USD 119 billion.

mid-May 2009 were fully subscribed, indicating a high interest for accessing US dollars through the central bank.

We aim to study whether the Swedish money market risk premium was correlated with the extra premium that non-US banks (relative to US banks) had to pay to access the US dollar market rate during the crisis.[14] We will interpret a positive and significant relationship as an indication that the increase in the cost of accessing US dollars for Swedish banks raised the Swedish money market risk premium. The spread between the FX US dollar implied swap rate and the US Certificate of Deposits (CD) is used to represent the extra premium that non-US banks had to pay to access the US dollar market rate. The US CD rate then represents the domestic interbank rate in the US.[15]

The paired observations are plotted in scatter-charts and a linear regression model is fitted to the data. Graphs 4a, b and c display the results. The crisis period is divided into three sub-periods to capture changes in the slope in different periods. The first period lasts until Lehman Brothers' collapse. Before 15 September 2008, there was no relationship between the Swedish money market spread and the FX US dollar spread (Graph 4a), as indicated by the linear regression model fitted to the data (R-square = 0.01).

However, in the period directly following Lehman Brothers' collapse until the end of 2008, there was a significant positive relationship between the FX US dollar swap spread and the Swedish short-term money market risk premium (Graph 4b). The slope coefficient is positive and statistically significant at the one per cent level (R-square = 0.31). Hence, the results indicate that, during the latter part of 2008, one possible transmission channel of money market tensions from the US market to the Swedish market was formed by the strains in the US dollar short-term funding markets.[16]

In the most recent period, the first half of 2009, the relationship with the US dollar funding markets again weakens (Graph 4c), indicating easier access to US dollars in the Swedish market. This is supported by the fact that the dollar auctions held by the Swedish central bank from mid-May 2009 were not fully subscribed.

[14] The analysis only considers the correlation between the two variables and, thus, not any causal effects.

[15] The US CD rate is chosen over the US Libor rate as the Libor rate is quoted by a majority of non-US financial institutions.

[16] The results are not affected if, instead of Stibor, the Swedish deposit rate is used to calculate the short-term risk premium.

Figure 4a, 4b and 4c. Correlation between the FX US dollar market and the Swedish money market during the crisis
Scatter-plots of the paired observations of the Stibor-OIS spread and the implied FX US dollar swap spread with a fitted linear regression model for the period 1 August 2007 to 15 September 2008 (Graph 4a), 16 September 2008 to 30 November 2008 (Graph 4b), and 1 December 2008 to 30 June 2009 (Graph 4c), respectively.

Figure 4a. Before Lehman Brothers

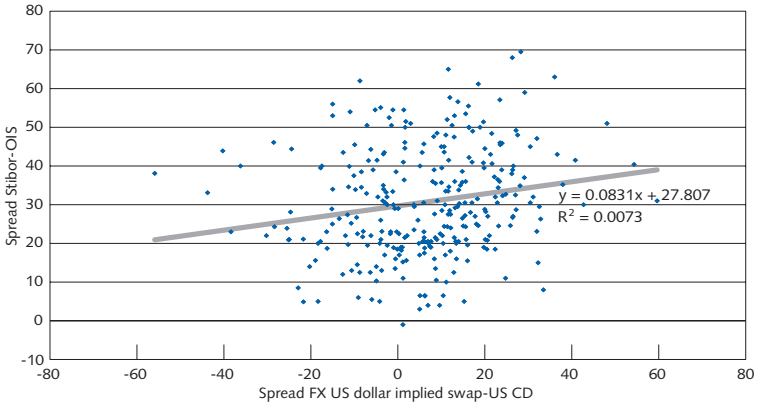


Figure 4b. Fall 2008 – After Lehman Brothers

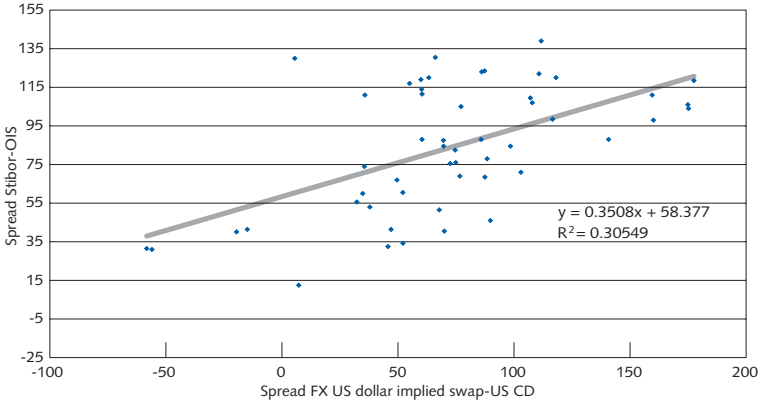
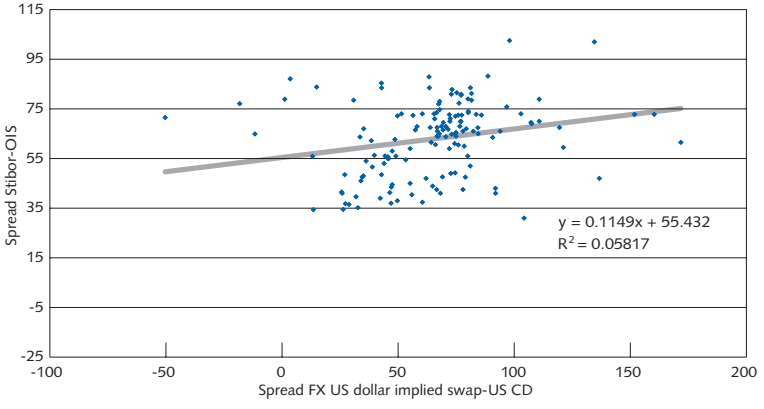


Figure 4c. Dec 2008-June 2009

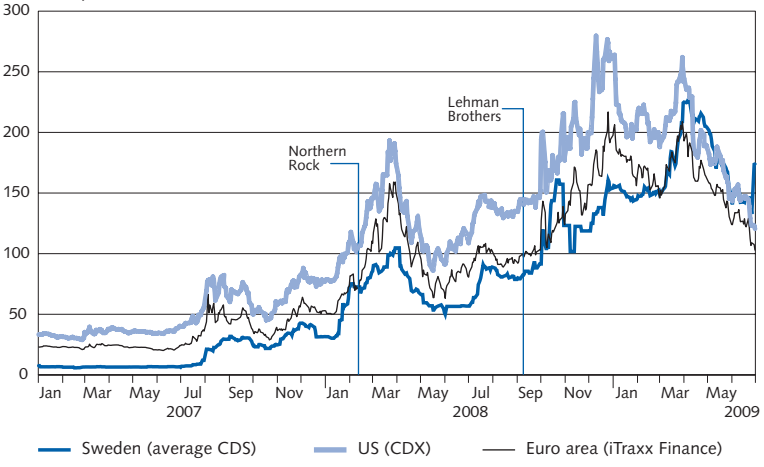


4. Credit risk

4.1 DEFINITIONS AND RECENT DEVELOPMENTS

A part of the short-term money market risk premium corresponds to credit risk, which in this paper is proxied by credit default swaps (CDS). CDS is a traded credit derivative product used as insurance against credit risk.[17] Graph 5 displays the development of the credit risk measure for the Swedish, US and European markets from January 2007 to June 2009.

Figure 5. International CDS spreads
The graph shows the development of the CDS spreads from January 2007 to June 2009 for Sweden, the euro area and the United States. For Sweden, an average of the CDSs of the four largest banks is used, for the Euro area, the iTraxx Finance index and, for the United States, the CDX index.
Basis points



The CDS spreads display the same pattern as the money market premiums. The levels were stable at around ten basis points in the Swedish market and around 30 basis points in the European and US markets before the financial turbulence started in July 2007 (see Panel A in Table 3). The CDS spread then doubled in Sweden and more than doubled in Europe and the United States. The Swedish CDS spread has remained at a lower level than the spreads in the other markets during most of the crisis period. It was only during the spring of 2009 that the Swedish CDS spread became higher than the euro area spread. This largely contradicts the findings of the IMF (2009), which suggest that, during the crisis, CDS spreads have widened

[17] This involves a bilateral contract whereby the buyer of protection pays a fixed premium to the seller of protection for a period of time and, if a certain pre-specified credit event occurs, the protection seller pays compensation to the protection buyer. One drawback of using this measure is that the CDS premium refers to a combination of the risk of default and the compensation demanded by investors for bearing this risk, rather than only the risk of default.

Table 3. CDS spreads

Panel A presents a summary of statistics for the CDS spreads in Sweden, the euro area and the United States in two periods. Panel B displays a summary of statistics for the CDS spreads for the four largest Swedish banks: Swedbank, SEB, Nordea and Svenska Handelsbanken (SHB). The first period is the pre-crisis period from January 2006 to the end of July 2007, while the second period is from August 2007 to the end of June 2009. Summary statistics are given in basis points. Statistically significant higher means and medians at the 1 % level in the crisis period (compared to the pre-crisis period) are marked with *.

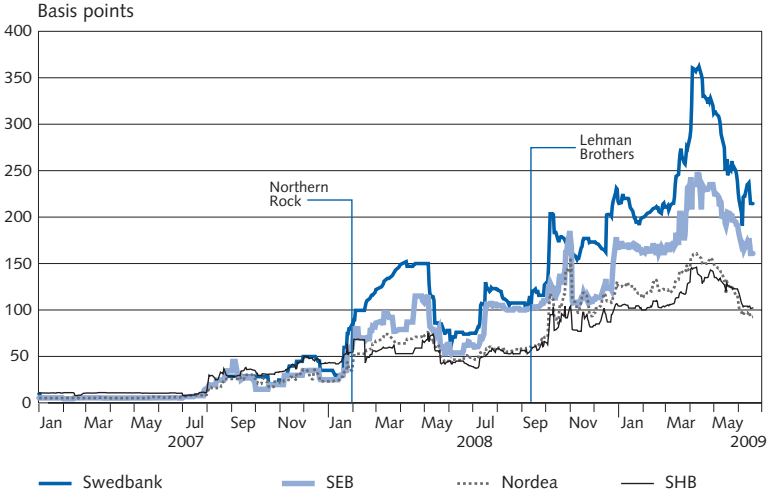
	Sweden	Euro area	US
Panel A: International CDS spreads			
Pre-crisis period (Jan 06–Jul 07)			
Mean	8.9	28.0	38.7
Median	9.5	27.4	37.9
Std	2.1	5.5	5.8
Min	5.8	20.2	28.9
Max	21.3	66.3	78.2
Crisis period (Aug 07–Jun 09)			
Mean	148.8*	146.7*	186.1*
Median	149.6*	152.1*	188.6*
Std	37.9	31.4	38.9
Min	78.8	92.0	120.5
Max	226.7	216.9	279.7

	Swedbank	SEB	Nordea	SHB
Panel B: Swedish CDS spreads				
Pre-crisis period (Jan 06–Jul 07)				
Medelvärde	8.6	8.0	7.2	11.4
Median	9.8	8.6	7.8	11.3
Standardavvikelse	2.8	2.6	1.8	2.1
Minimum	4.8	4.4	5.0	7.7
Maximum	19.5	19.5	17.1	29.9
Crisis period (Aug 07–Jun 09)				
Mean	214.7*	160.0*	112.7*	100.5*
Median	210.0*	165.0*	116.9*	103.4*
Std	65.4	41.2	26.7	23.4
Min	100.0	100.0	57.0	52.5
Max	362.0	248.3	161.1	146.0

more in smaller economies than in larger economies. The US market has had the highest average spread in the crisis period, 186 basis points. The credit measure for the euro area increased significantly in late February 2008. One contributing factor was formed by the events surrounding Northern Rock and its acquisition by the British government on 18 February 2008. The largest increase in the US CDS spread occurred on 15 September 2008, the same day that Lehman Brothers went bankrupt. The spread increased by 43 basis points compared to the previous trading day.

The CDS spreads for the four largest Swedish banks, presented in Graph 6, did not show much dispersion during the pre-crisis period.

Figure 6. CDS Spreads Swedish Banks
The graph displays the development of the CDS spreads from January 2007 to June 2009 for the four largest Swedish banks: Swedbank, SEB, Nordea and Svenska Handelsbanken (SHB).
Basis points



However, during the crisis period, the CDS spreads for Swedbank and SEB increased more than did those of the other two banks. This can be explained by the two banks' larger foreign exposures, especially in the Baltic region (see Sveriges Riksbank (2008b)).

4.2 SYSTEMATIC RISK

To illustrate the manner in which the correlations developed over time, they have been calculated using a 3-month rolling window.

Graph 7 shows the average correlation between the CDS spreads in the Swedish market. In August 2007, at the start of the crisis, the correlations between banks increased rapidly to 0.9, remaining elevated throughout the rest of the period. Thus, even though SHB and Swedbank may have very different risk exposures, their CDS spreads have tended to converge closely during the financial crisis.

The time-varying correlation between the Swedish credit risk and other markets exhibits a somewhat different pattern (see Graph 8). This correlation increased significantly in August 2007. However, the correlation with the US market decreased at the beginning of 2008, while it remained elevated with respect to the euro area. Unlike the correlation between the Swedish banks' CDS spreads, the correlation with foreign markets declined rapidly at the end of 2008, even becoming negative for a short period. It then increased again during spring 2009.

Figure 7. Correlations 3-Month Rolling Window: Swedish CDS spreads
The graph displays the average correlation over time between the four largest Swedish banks (Swedbank, SEB, Nordea and Svenska Handelsbanken). The time period is from January 2007 to June 2009 and the analysis has been performed using a 3-month rolling window.

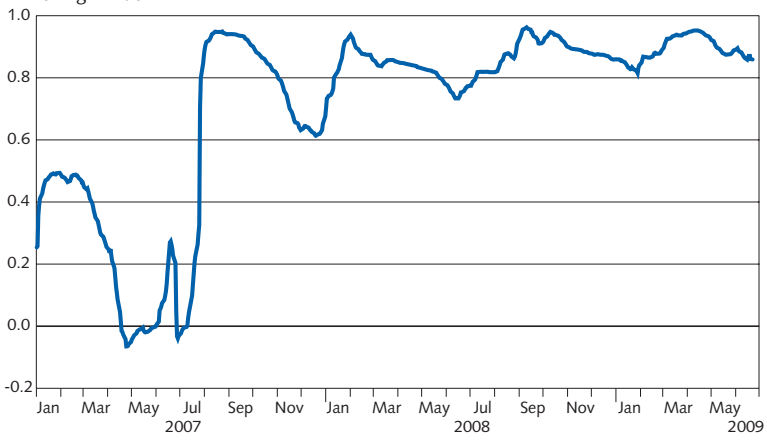
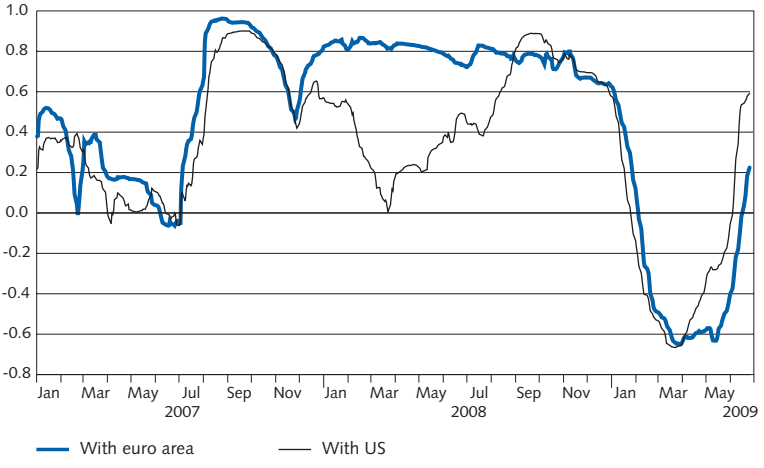


Figure 8. Correlations 3-Month Rolling Window: International CDS spreads
The graph displays the average correlations between the Swedish CDS spread and the CDS spread in the Euro area and United States, respectively. The time period is January 2007 to June 2009. For the Euro area, the iTraxx Finance index is used, for the United States, the CDX index and, for Sweden, the average CDS spread for the four largest Swedish banks.



5. To what extent does the short-term money market risk premium consist of credit risk?

This paper has so far analysed the developments of the short-term money market risk premium and one of its components, credit risk. In this section, we take this analysis a step further. Given the evidence from previous financial crises, which indicates a connection between financial instability and credit risk (see for example Herring (1999)), we wish to explore whether the part of the short-term risk premium attributed to credit risk

has increased. Hence, the money market risk premium will be separated into two parts: one part due to credit risk and one due to liquidity (both market liquidity and bank specific liquidity).

Understanding the composition of the money market premium and the manner in which it was affected during the crisis is important, given the effect the spread has on the economy through, for example, the variable-rate loans tied to it (one example being mortgages). The better the understanding of the premium and the factors affecting it during a financial crisis, the easier it will be to implement the correct and relevant policy measures to reduce the premium. This simple decomposition of the spread follows the methodology used by the Bank of England (2007) and is illustrated in Box 2.

Box 2: Decomposing the risk premium

The implied (risk-neutral) probability of default for the underlying security can be derived using a no-arbitrage relationship. The method is illustrated using a simple example:

Consider a 1-year CDS contract on a specific bank and assume the total CDS premium (p) is paid up front. Let the default probability be pd and the recovery rate be *rr*. The protection buyer pays the premium p and his expected payoff is $(1\text{-}rr)*pd$. When two parties enter a CDS transaction, the CDS premium is set so that the expected value of the swap transaction is zero, that is,

$$p = (1\text{-}rr)*pd$$

Hence, given a certain recovery rate, it is possible to get an expression for the probability of default.

This probability of default can be used to infer a credit spread (above the risk free rate) that must prevail such that a risk-neutral investor is indifferent as regards investing in a risk-free bond or a higher risk bank deposit.

5.1 METHODOLOGY

Under certain assumptions, the method maps a standard CDS price into a fair spread for obtaining funding in the interbank market. The residual of the Stibor-OIS spread net of the credit premium is the liquidity premium.

Money market risk premium – credit premium = liquidity premium

There are a number of assumptions and limitations with this methodology. Firstly, credit and liquidity premiums are unlikely to be entirely independent. Low liquidity and the consequently impaired ability of banks to obtain funding in the interbank market may affect the perceived likelihood of a bank

default. Secondly, it is assumed that investors are risk neutral. A risk neutral investor does not require any extra return for taking on risk. Hence, the investor only takes the expected return into account (and not the risk) when deciding on an investment.

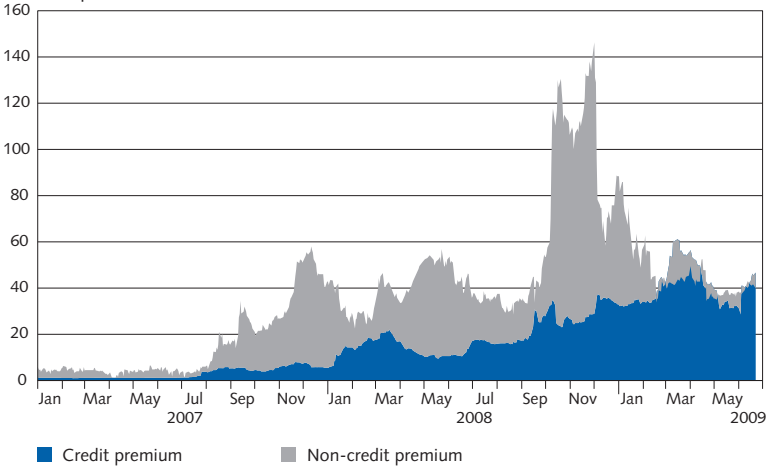
To represent the credit premium in the money market risk premium, we utilise the CDS prices presented in the previous section. In principle, CDS prices reflect the default probability of the bank in question, the loss given default and some compensation for uncertainty regarding these factors. To determine the credit premium, an assumption regarding the recovery rate of deposits in the event of default must be made. Liquidity effects in CDS markets are not taken into consideration. The Bank of England (2007) uses a recovery rate of 40 per cent, with the justification that this is the rate assumed by protection sellers in their CDS price calculations. The same recovery rate will thus be used here.

5.2 RESULTS OF DECOMPOSITION

Graph 9 displays the result of decomposing the risk premium in the Swedish market into a credit premium and a liquidity premium.

Graph 9 indicates that both the liquidity and the credit premiums were at relatively low and stable levels until August 2007. The credit premium then rose somewhat in August 2007, but the largest increase in the total risk premium came from the liquidity premium. The credit premium increased during the period from January to April 2008, while the liquidity premium increased heavily during the months of December 2007 and

Figure 9. Indicative Decomposition of the Risk Premium
The graph illustrates the indicative decomposition of the Swedish short-term risk premium into credit premium (blue area) and non-credit premium (grey area) during the period January 2007 to June 2009.
Basis points



June 2008. The liquidity premium dominated the large increase in total risk premium during the period directly before and directly following Lehman Brothers' bankruptcy in mid-September 2008. After Lehman Brothers' bankruptcy, the total risk premium immediately increased from about 20 basis points to 130 basis points, an increase of over 500 per cent. These results are in accordance with the analysis of Michaud and Upper (2008). Their results suggest that, during August and September 2007, credit factors only accounted for a lesser proportion of the spread.

However, at the beginning of 2009, the relationship between the two parts of the premium changed. During 2009, the credit risk premium rose at the same time as the liquidity premium rapidly decreased. As a result, the total premium consisted mainly of credit risk during the first half of 2009. This indicates that the crisis quickly developed from being a liquidity crisis to affecting the real economy and hence, increasing the credit risk.

The results highlight the importance of understanding the drivers of the crisis in order to be able to implement the correct policy measures. When the main driver of the risk premium is liquidity risk, policy measures should focus on increasing liquidity in the financial system. When the main driver is credit risk, policy measures should focus on increasing the capital buffer in banks and facilitating access to credit in the economy. The results also highlight the fact that the main driver of the risk premium can change during a crisis, thus emphasising the importance of the continuous analysis of crises by policymakers. Although the model and the analysis may be somewhat simplified, they clearly illustrate the general trends in risk factors and can, therefore, be used as support for policy decisions.

6. Concluding Remarks

This article considers the Swedish short-term money market risk premium during the period from January 2006 to the end of June 2009. Although the current financial crisis started in the United States, it has become a global crisis. Thus, as the conclusions of this paper demonstrate, systematic risk is a core element of the current financial crisis.

The conclusions indicate that the risk premiums have had a turbulent development from a starting point in July 2007. The most conspicuous event of the crisis so far took place in September 2008, when Lehman Brothers collapsed, causing a loss of confidence among investors. Even though Swedish banks have not had large exposures to the US sub-prime market, the Swedish premium has, to a large extent, been affected by developments in international financial markets. During the most turbulent periods, the correlation of the Swedish money market risk premium

with the US market and the euro area increased to over 0.9. It is of primary interest for Swedish policymakers to understand the extent to which Sweden is affected by systematic risk in a financial crisis, so that they can implement policies to limit the incidence and the impact of market risk. The fact that premiums which, under normal market conditions, were driven by different factors quickly became driven by a common factor when the crisis started also points to the importance, for policymakers, of taking the anticipated effects of systematic risk into account.

The analysis also investigates the spillover effects from the European and US markets. We conclude that the US risk premium has had a significant effect on the Swedish money market risk premium. One specific channel for the transmission of US money market tensions to the Swedish market was formed by the US dollar liquidity shortages in the interbank markets. One of the policy implications of this conclusion is the importance of facilitating access to funding in foreign currencies to domestic banks during a financial crisis.

The final analysis decomposes the risk premium into a credit risk premium and a liquidity risk premium. The results indicate that the risk premium during the first part of the crisis, involving the collapse of Lehman Brothers, was driven by liquidity risk. However, in 2009, the main driver instead became credit risk. The interpretation presented is that the crisis, which started as a purely financial crisis, spread to the real economy, involving an increase in credit risk. This has important policy implications. If the main driver of the risk premium is liquidity risk, policy measures should focus on increasing liquidity in the financial system. If the main driver is credit risk, policy measures should focus on increasing the capital buffer in banks and facilitating access to credit in the economy. The results also highlight the fact that the main driver of the risk premium can change during a crisis, thus emphasising the importance of the continuous analysis of crises by policymakers.

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