



Sveriges Riksbank Economic Review



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Dear readers,

In this issue of the Riksbank's journal you will find articles relating to both of our main tasks: monetary policy and financial stability.

- Gabriela Guibourg, Christian Nilsson and Ulf Söderström report from a seminar that the Riksbank arranged in early 2013 and give an account of several complex issues that were the subject of intense discussion. How is the trade-off between inflation and unemployment affected when inflation expectations are anchored around the inflation target? Do well-anchored inflation expectations help to limit a fall in inflation when unemployment increases? Is there a risk that well-anchored inflation expectations together with inflation outcomes below the target will help to increase unemployment? Can the ECB help to reduce unemployment in the crisis countries of the euro area by temporarily increasing inflation in the entire euro area?
- Maria Sandström, David Forsman, Johanna Stenkula von Rosen and Johanna Fager Wettergren describe the market for covered bonds and identify the potential risks this market may pose to financial stability. They describe why covered bonds have a high credit rating and their major importance to the funding of the Swedish banks. The risks are mainly due to the maturity mismatch between covered bonds, which have relatively short maturities, and the more long-term mortgages that they fund. This adds to refunding risks in connection with a financial crisis as market efficiency may be undermined.
- Elias Bengtsson, Ulf Holmberg and Kristian Jönsson describe new methods for measuring systemic risk in the financial system and what they say about developments at the major Swedish banks. The systemic importance of the four major banks increased ahead of the financial crisis, which led to increased risks when the full force of the crisis hit in 2008–2009 and when the European debt crisis intensified in 2011. Thereafter the measures indicate declining risks in the Swedish financial system. However, the ranking of how systemically-important the four major banks are is affected by which measure is used. It is therefore important to use several different measures when assessing risks in individual banks and the financial system as a whole

Read and enjoy!

Claes Berg, Cecilia Roos-Isaksson and Per Sonnerby

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Gabriela Guibourg, Christian Nilsson and Ulf Söderström

Inflation targeting's greatest merit is that it has anchored inflation expectations around the inflation target. According to mainstream economic theory, monetary policy can also counteract cyclical fluctuations in unemployment, but it cannot affect unemployment or any other real variables in the long term. However, the increase in unemployment in recent years has nevertheless given rise to a debate on the role monetary policy should play to counteract more long-term trends on the labour market. This article gives an account of the discussions on this and closely-related issues in a full-day seminar arranged by the Riksbank at the beginning of the year.

- The market for Swedish covered bonds and links to financial stability **22**

Maria Sandström, David Forsman, Johanna Stenkula von Rosen and Johanna Fager Wettergren

Covered bonds are characterised by an increased level of safety for the investor in the form of a claim on the issuer as well as on an underlying collateral pool. This article shows that covered bonds are one of the most important sources of funding for the Swedish banks, particularly for funding mortgages. The market for covered bonds is also important to the role of the major banks as market makers. In Sweden, the market for covered bonds is characterised by large issues of bonds, frequent smaller on-tap issues and market makers that set prices on the secondary and repo markets. One advantage of using covered bonds is that they help to reduce funding costs for the banks. As the Riksbank has previously pointed out, the banks' extensive funding through covered bonds is also associated with certain weaknesses. Renewed stress on the international capital markets and a fall in house prices in Sweden are factors that could impair the functioning of the market.

■ Identifying systemically-important banks in Sweden – what can quantitative indicators show us? **50**

Elias Bengtsson, Ulf Holmberg and Kristian Jönsson

The global financial crisis has led to an increased focus on identifying systemically-important financial institutions and on assessing to what extent they contribute to risks in the financial system. However, producing an identification method is complicated and associated with several difficult choices. This article provides some guidance on how to design methods for identifying systemically-important banks in Sweden. Both simple and advanced indicators are used. One conclusion is that the systemic importance of the four major Swedish banks varies considerably over time. It is also apparent that the different indicators can provide different results for the ranking of systemically-important banks, despite the fact that each indicator in itself provides a rather constant ranking over time. The different indicators of systemic importance should therefore be able to complement each other to a great degree. This suggests that several different indicators may be needed when assessing the risks in individual banks and the system as a whole.

Inflation, unemployment and monetary policy – new research findings

GABRIELA GUIBOURG, CHRISTIAN NILSSON AND ULF SÖDERSTRÖM*

The authors work in the Monetary Policy Department of the Riksbank.

On 15 February 2013 the Riksbank organised a full-day seminar on the theme "Inflation, unemployment and monetary policy". The seminar brought together academics and central bank economists from Sweden and abroad. The purpose was to discuss some new studies of the relationship between inflation and unemployment, and the role unemployment and employment should play in the monetary policy framework. This article summarises the papers presented and the discussions held at the seminar.

Introduction

It's now been 20 years since the inflation target was introduced in Sweden.¹ As a monetary policy regime, inflation targeting has worked well. Its greatest merit is that it has provided the Swedish economy with a nominal anchor – it has been successful in anchoring inflation expectations to the inflation target. Following the introduction of the inflation target, inflation in Sweden fell from the two-digit figures observed in the 1970s and 1980s to slight fluctuations close to the 2 per cent target (see Figure 1). In addition, contrary to what many feared, GDP growth did not turn out to be lower because of this; rather slightly higher (Figure 2). During this period, Sweden has also become an EU member, the fiscal policy framework has been strengthened, new rules and regulations have led to wage formation that functions better and product markets have been deregulated. Together with these reforms, inflation targeting has helped to create better fundamentals for growth, although it is difficult to determine the exact significance of the monetary policy conducted. Indeed, various studies about the development in countries with and without inflation targets have not led to any clear conclusions about the way in which the introduction of an inflation target affects growth. Yet, there nevertheless appears to be a consensus view that a transition to an inflation target does not affect growth negatively.²

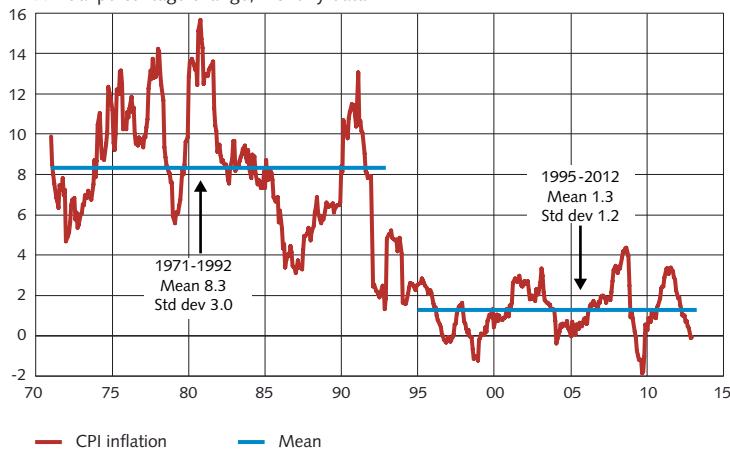
* We thank Claes Berg, Marianne Nessén and Lars E. O. Svensson for their comments on previous drafts.

1 The inflation target was announced in January 1993, but started to apply officially to the annual CPI increase as of 1995. See also the article "The development of inflation in a longer perspective" in Account of Monetary Policy 2012, Sveriges Riksbank.

2 See Ball (2010) and Svensson (2010).

Figure 1. CPI in Sweden

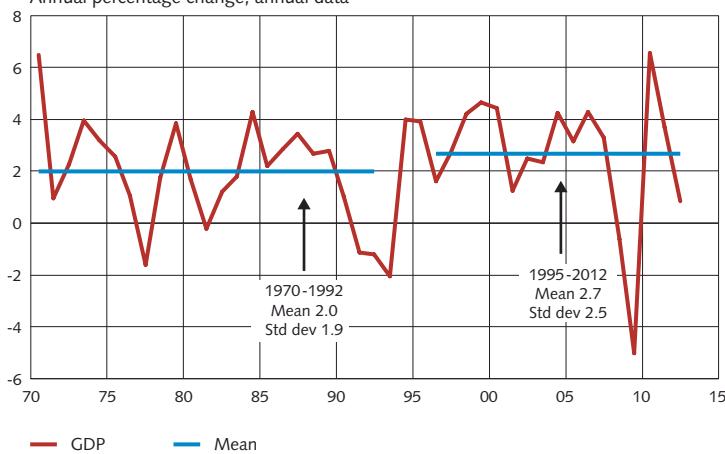
Annual percentage change, monthly data



Source: Statistics Sweden

Figure 2. GDP in Sweden

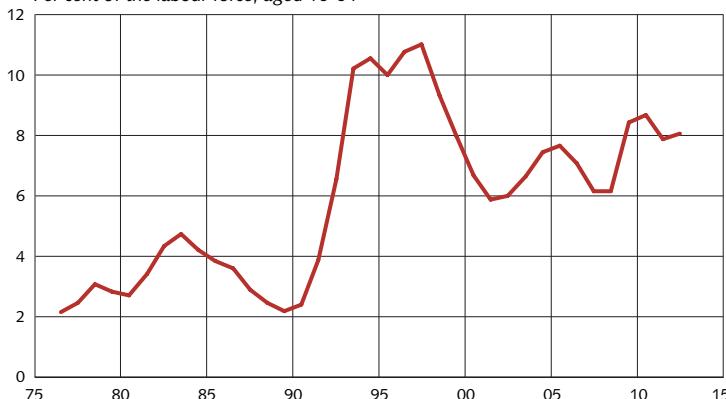
Annual percentage change, annual data



Source: Statistics Sweden

Developments on the Swedish labour market have, however, been much less favourable. Unemployment rose to over 10 per cent after the banking crisis at the outset of the 1990s, and although it decreased during the latter part of the 1990s, it never came back down to the pre-crisis levels (see Figure 3). And, after the latest global financial crisis, unemployment increased again in both Sweden and other countries.

Figure 3. Unemployment in Sweden
Per cent of the labour force, aged 16-64



Source: Statistics Sweden

In light of the deep global recession which followed in the wake of the financial crisis, it is not surprising that unemployment has risen. There are, however – at least in Sweden – clear signs that much of the rise in unemployment is structural in nature; that is, it has more to do with the functioning of the labour market than the state of the economy. For example, there are indications that matching between job seekers and vacant positions does not function as well as it did before, among other things because of changes in the composition of the working-age population. Unemployment is also higher for certain groups that are weakly linked to the labour market. In addition, geographic mobility has decreased and the average period in unemployment has increased. At the same time, company recruitment periods have lengthened, suggesting that it is now more difficult for companies to find the competence they seek.³

What can monetary policy do to counteract unemployment?

The prevailing view in economic theory is that monetary policy can counteract cyclical unemployment by influencing demand in the economy. In the long term, however, monetary policy cannot influence any real variables, and hence not unemployment either. A way to express this is to say that the Phillips curve (the relationship between inflation and unemployment) is vertical in the long term, so there is no long-term trade-off between unemployment and inflation. However, rising unemployment in recent years has nevertheless evoked a debate about the role monetary policy should play in counteracting more long-term labour market trends.⁴

3 See for instance the article "Has the functioning of the labour market changed?" in the Monetary Policy Report published in October 2012, Sveriges Riksbank.

4 This debate is also being conducted in other countries, such as in the USA, where unemployment has declined relatively slowly in the recovery of the past few years.

How does this debate tally with the customary view that monetary policy cannot influence unemployment in the long term? Is there nevertheless a long-term trade-off between inflation and unemployment? And, if so, what are the implications for monetary policy? In order to gather knowledge about what current research has to say about these and other closely related matters, the Riksbank arranged a full-day seminar on the theme “Inflation, unemployment and monetary policy” for academics and central bank economists from Sweden and abroad. During the seminar, the significance of various economic relationships and explanations were discussed which led to diverging conclusions about the role of monetary policy in reducing unemployment. Table 1 shows the papers presented at the seminar.

Table 1. Papers presented at the seminar

“Inflation Dynamics and the Great Recession: An Update”

Authors: Indra Astrayuda, Johns Hopkins University, Laurence Ball, Johns Hopkins University, och Sandeep Mazumder, Wake Forest University

Discussant: Henrik Jensen, University of Copenhagen

“The Case for Temporary Inflation in the Eurozone”

Authors: Stephanie Schmitt-Grohé, Columbia University, och Martín Uribe, Columbia University

Discussant: Nils Gottfries, Uppsala University

“Forecasting Inflation”

Authors: Jon Faust, Board of Governors of the Federal Reserve System, och Jonathan H. Wright, Johns Hopkins University

Discussant: Ragnar Nymoen, University of Oslo

“The Possible Unemployment Cost of Average Inflation Below a Credible Target”

Author: Lars E.O. Svensson, Sveriges Riksbank

Discussant: Lars Ljungqvist, Stockholm School of Economics and New York University

“Notes for a New Guide to Keynes (I): Wages, Aggregate Demand, and Employment”

Author: Jordi Galí, Centro de Recerca en Economia Internacional, Universitat Pompeu Fabra

Discussant: Per Krusell, Institute for International Economic Studies, Stockholms University

A matter discussed was how unemployment and inflation are affected by inflation expectations being well-anchored to the inflation target. The stable inflation expectations are a sign that inflation targeting has been successful. If monetary policy is credible and inflation expectations are well-anchored, the short-term trade-off between inflation and resource utilisation (unemployment, for example) will be more favourable. In other words, inflation will be more stable and less affected when resource utilisation fluctuates. This can be part of the reason why inflation in many countries has not fallen as expected when unemployment has risen, since wage claims, for example, are based on inflation expectations that are stable around the inflation target.

Stable inflation expectations can also lead to the emergence of a long-term trade-off between inflation and unemployment. If over a long period the actual average rate of inflation is below the inflation target while, for example, wage demands are based on

expectations of inflation being close to the target, real wages and hence unemployment might be higher, even in the long term. It is therefore particularly important that inflation does not fall below the inflation target if inflation expectations are well-anchored to the target.

Another matter that relates to the labour market is how rigidity in wage formation affects unemployment and inflation. If wages are sluggish and do not decline despite the economy being in a deep recession, unemployment will be unnecessarily high. Many countries in the euro area exemplify this, with unemployment having risen in recent years, but without any great extent of wage adjustment. A potential resort could then be, by means of more expansive monetary policy, to temporarily increase the rate of inflation in the entire euro area in order to reduce real wages and boost employment in these countries.

Wage rigidity can thus affect economic welfare through unnecessarily large fluctuations in employment over time. This rationale is based on Classical economic theory, which focuses on how wages affect companies' costs and hence production and employment. The Keynesian theory finds instead that employment is determined by aggregate demand, so wage levels are of no direct consequence to employment. The more contemporary New Keynesian theory combines insights from Classical and Keynesian theory. In such models, wage changes can affect employment and aggregate demand directly, but exactly how depends to a great extent on how monetary policy is designed. A result discussed at the seminar was that, according to New Keynesian models – unlike Classical models – it is not certain that welfare improves with more flexible wages.

Monetary policy works with a lag and must therefore be based on projections about inflation and other economic development variables. Good forecasts are thus key to well-balanced monetary policy. At the seminar, different inflation forecasting methods were therefore also discussed. Central banks use different models and methods to capture the current state of the economy and establish forecasts of economic development ahead. Structural economic models are based on economic theory and attempt to capture the functioning of the economy. Statistical models are instead less strictly related to economic theory and are used to identify usable statistical relationships between different variables. Also, judgements are used to interpret the development according to various surveys, and draw overall conclusions from the results of various models.

However, according to the evaluation of various forecasting methods described at the seminar, attempts to capture more complicated cyclical patterns do not generally lead to better inflation forecasts. More advanced models cannot improve a relatively simple forecast which starts with a good nowcast of inflation and then gradually glides towards the long-term mean value of the inflation rate. Yet, such methods and models can nevertheless contribute to improving the monetary policy decisions and communication of central banks. For instance, an inflation forecast that deviates from the inflation target in the medium term indicates a need to adapt monetary policy.

Well-anchored inflation expectations can help resolve the “deflation puzzle”

In connection with the financial crisis and “the great recession”, a phenomenon emerged in the USA (and several other countries) known as “the deflation puzzle”; inflation fell surprisingly little in relation to the sharp rise in unemployment during 2008-2010.

One way of illustrating this is to assume that inflation is determined by inflation expectations and the deviation of unemployment from trend according to a traditional Phillips curve:

$$\pi_t = \pi_t^e - \alpha(u_t - u_t^*) + e_t$$

where π_t^e is expected inflation, $(u_t - u_t^*)$ the unemployment gap and e_t a random term. Estimates of such a Phillips curve, with expected inflation being given by inflation in the previous period – that is $\pi_t^e = \pi_{t-1}$ – worked relatively well for explaining inflation in the USA until 2007. When unemployment rose sharply during the financial crisis, inflation in the USA ought, according to those estimates, have fallen sharply and turned into deflation. However, in reality inflation fell much less, irrespective of whether inflation is measured using CPI or CPI ex energy and food prices as a measure of underlying inflation.⁵

In a paper published in 2011, Ball and Mazumder suggest two empirical specifications of the Phillips curve that enable it to better explain the development of the actual inflation rate. Their specification involves the weighted median of CPI inflation across different sectors being used as a measure of underlying inflation, and the effect of unemployment on inflation, the parameter α , being allowed to vary over time.⁶ With this new specification, the modest drop in inflation during 2008-2010 could be predicted relatively well.

However, in their contributions to the Riksbank's seminar, Indra Astrayuda, Laurence Ball and Sandeep Mazumder noted that the recent development cannot be captured by this specification either.⁷ While the new specification predicts that inflation will continue to fall, the actual inflation rate bottomed out in mid-2010 and has since risen slightly. The model cannot explain this development, and a “deflation puzzle” has hence emerged again.

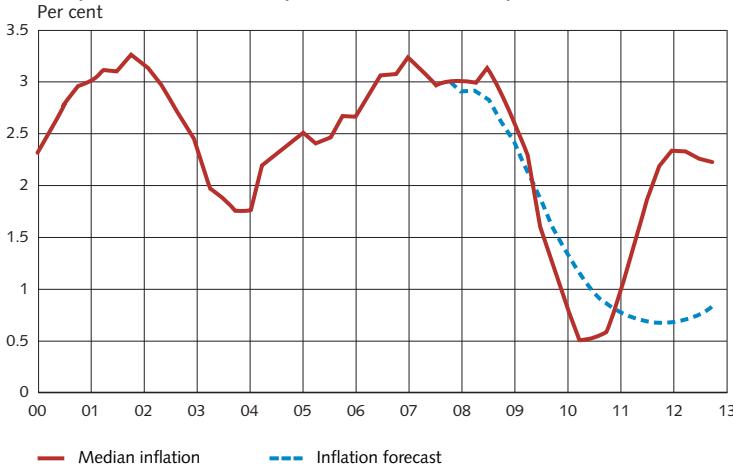
The authors are thus proceeding and attempting to find further explanations. One explanation could be that inflation expectations have gradually become better anchored to what is perceived to be the Federal Reserve's target for inflation. Estimates suggest that this is the case, but it only seems to be part of the reason (see Figure 4).

⁵ It has also been observed that inflation has been unexpectedly stable since 2008 in other countries too, see for example IMF (2013, chapter 3).

⁶ See Ball and Mazumder (2011). A reason for using the weighted median inflation across different sectors is to reduce the effects of changes in relative prices, and hence temporary supply shocks, between sectors. Ball and Mazumder (2011) believe that median inflation is a better measure of underlying inflation than the CPI ex energy and food prices, because it better eliminates the effects from the supply shocks that occurred during the studied period.

⁷ See Astrayuda, Ball and Mazumder (2013).

Figure 4. Dynamic forecasts of median inflation in the USA, 2008-2012, based on a Phillips curve with inflation expectations anchored at 2.5 per cent



Source: Astrayuda, Ball and Mazumder (2013, Figure 7)

Another reason could be that not all unemployment affects inflation. People who have been unemployed for relatively long periods may be more weakly linked to the labour market and be less attractive to employ. They may then have less of a restraining effect on wage formation. When unemployment is defined based on people who have been unemployed for less than 15 weeks, the explanatory degree increases in the Phillips curve estimate. This is because unemployment, according to this definition, is largely back at the pre-crisis level (and thus therefore no longer has a restraining effect on inflation).

The subsequent discussion focused a lot on how inflation expectations should be measured and modelled. In the empirical analysis, the authors assume that the expectations are backward-looking and are determined by an average of the inflation rate in previous years. However, exactly how the expectations are specified is of great consequence. If it is instead assumed that the expectations are forward-looking, the estimated slope of the Phillips curve is flatter and no longer statistically significant. Unemployment then has less of an effect on inflation, which helps explain the "deflation puzzle". Another possibility is to use different measures of inflation expectations (such as from surveys) for estimating the Phillips curve.

Some participants also found that the theory behind the relationship between inflation and unemployment is unclear. In contemporary New Keynesian theory, inflation is driven by the marginal costs of companies, which are largely determined by the wage trend. The link with unemployment is more complicated. In order to understand the development in inflation according to that theory, wage data could therefore be used to estimate the Phillips curve.

Do well-anchored inflation expectations and sub-target inflation bring about higher unemployment?

During the period 1997-2011, CPI inflation in Sweden was 1.4 per cent on average, and hence 0.6 percentage points below the inflation target.⁸ An important question is whether this has had any consequences in real terms. According to the mainstream of economic theory, there is a short-term trade-off between inflation and unemployment, such as in the Phillips curve above, but there is no such trade-off in the long term. In his contribution to the seminar, Lars E.O. Svensson notes, however, that inflation expectations have been very stable around the inflation target and have been on average close to 2 per cent despite actual inflation having fluctuated and having been lower than the inflation target on average.⁹ This can lead to a long-term relationship between inflation and unemployment. Svensson argues that inflation falling below the inflation target has therefore had real consequences in terms of unemployment being higher than necessary on average.¹⁰

If households and companies have rational expectations, inflation expectations over a long period of time should on average coincide with actual inflation. A potential explanation for inflation expectations being higher on average than actual inflation is based on the theory of "near-rational" expectations.¹¹ In this context, such expectations can be interpreted such that when the actual inflation does not deviate too much from the 2 per cent inflation target, many households and companies disregard this deviation and behave as though inflation were on target. For example, wage negotiations can be based on CPI inflation being 2 per cent ahead, despite inflation having been slightly lower than 2 per cent on average.

The consequence is real wages being higher than expected, and unemployment therefore being higher than its long-term sustainable level. The long-term Phillips curve is then no longer vertical (as in the case of rational expectations), but slopes downwards. In this case, there is thus a trade-off between inflation and unemployment, with unemployment being higher in the long run when inflation is lower.

Svensson estimates the Phillips curve for Sweden over the period from 1997 to 2011. According to the estimates, the long-term Phillips curve has a negative slope of around -0.75, see Figure 5.¹² Because actual CPI inflation has fallen below the target by 0.6 percentage points on average, this estimate means that unemployment was on average $0.6/0.75=0.8$ percentage points higher than it would have been had inflation been on target. However, there is a certain degree of uncertainty in this estimate. With a 95 per

⁸ The average pertains to the inflation series to which the Executive Board had access when the monetary policy decisions were made. The calculation method for CPI was changed in 2005. The average of the now official (revised) inflation rate is slightly lower. See Andersson, Palmqvist and Österholm (2012).

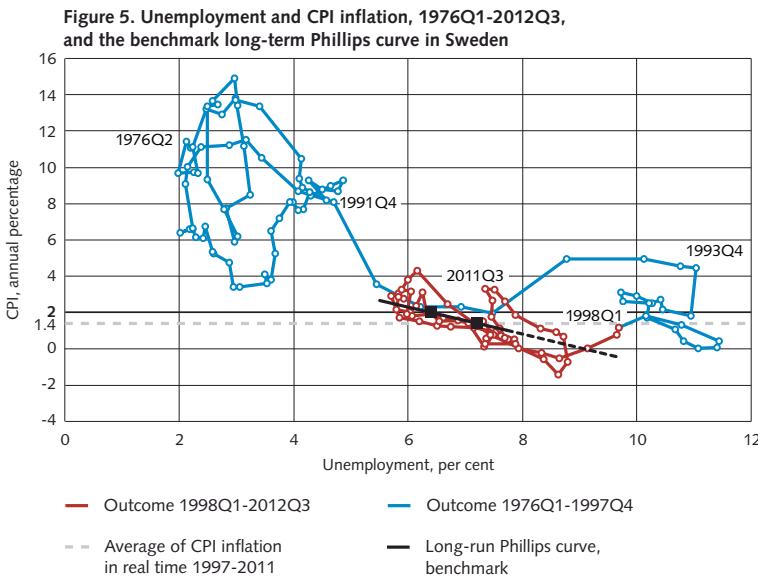
⁹ See also IMF (2013, chapter 3) for a discussion about how inflation expectations have stabilised around inflation targets in a number of OECD countries, and the implications of this for the relationship between unemployment and inflation and for monetary policy.

¹⁰ See Svensson (2013).

¹¹ See Akerlof, Dickens and Perry (2000).

¹² Svensson estimates the long-term Phillips curve in several ways, and selects a slope of -0.75 as a benchmark.

cent confidence interval, the cost in terms of higher unemployment could have been between 0.6 and 1.5 percentage points.¹³



Source: Svensson (2013, Figure 10)

In an international comparison, Svensson notes that in certain other countries with inflation targets, inflation has on average been very close to the target during the same period. In the UK, however, inflation exceeded the target by 1.4 percentage points on average during 2008-2011.

According to Svensson, the downward-sloping long-term Phillips curve should not, however, be used to reduce unemployment by means of the central bank secretly aiming at higher inflation. This would be incompatible with transparent monetary policy and participants in the economy would eventually realise this were the case, which would undermine the credibility of the inflation target. Svensson's conclusion regarding inflation targeting is that the central bank should ensure that the average inflation over a long period be kept close to the target. This could be achieved with a price level target, whereby monetary policy, instead of attempting to stabilise inflation year by year, endeavours to stabilise the price level around a rising trend, so that inflation is close to the target on average.

The subsequent discussion then primarily focused on how the regression results ought to be interpreted given the theoretical model. Some participants pointed out that the relationship in the Phillips curve will only be valid in the long term if it is assumed that inflation expectations are constant. However, this assumption is never explicitly tested in the paper. Others noted that different measures of inflation expectations behave differently

13 See also Söderström and Vredin (2013) for a discussion of Svensson's results.

over time. While measures from Prospera (used by Svensson in his paper) are stable around the inflation target, inflation expectations for the corporate sector as measured by the National Institute of Economic Research's survey are more variable over time, and lower than 2 per cent on average.¹⁴

In the discussion, it was also noted that a further implication of Svensson's results is that real wages have become higher than expected, which ought to have led to company profits being lower than expected. It would then be interesting to investigate whether support for this can be found.

Should wage rigidity in the euro area be counteracted by expansive monetary policy?

Two papers at the seminar discussed how wage formation rigidity affects the economy and unemployment in particular. In their contribution, Stephanie Schmitt-Grohé and Martín Uribe argue that a temporary increase in the inflation rate in the euro area could restore full employment in "peripheral" euro countries.¹⁵ Their analytical framework is a stylised model of a small, open economy with a fixed exchange rate, in which nominal wages are flexible when rising, but sluggish downwards.

Despite major increases in unemployment in a number of euro countries since 2008, nominal wage levels in these countries have not decreased to any great extent (hence a sort of equivalent to the "deflation puzzle" in the paper by Astrayuda, Ball and Mazumder).¹⁶ In the authors' model, the crisis is interpreted as an external shock which increases the real interest rate which the country must pay on its loans (the country is assumed to be a net borrower). The higher interest on loans leads to a decline in demand for nontradables.¹⁷ Because nominal wages are sluggish downwards, no adjustment occurs through wage formation; instead, employment in the nontradables sector falls.

Schmitt-Grohé and Uribe believe it is not probable that the peripheral euro countries will take any domestic political measures to reduce unemployment. As a solution, they propose instead that the European Central Bank (ECB) temporarily increases inflation in the entire euro area. Higher inflation would stimulate the nontradables sectors in the peripheral countries by means of a reduction in real wage increases and a rise in employment. According to the analysis, employment in the so-called core countries (which do not appear to have equivalent labour market problems) is not affected because nominal wages in these countries will rise in line with the price level. The price level will then increase more in the core countries than in the peripheral euro countries, which increases demand for the goods of the peripheral countries.

¹⁴ See Flodén (2012).

¹⁵ See Schmitt-Grohé and Uribe (2012).

¹⁶ The countries discussed in the paper are Cyprus, Greece, Ireland, Portugal and Spain.

¹⁷ Goods and services included in foreign trade are referred to as tradables, while goods and services that are not exposed to international competition in the same way are referred to as nontradables.

Schmitt-Grohé and Uribe calculate that a temporary increase in inflation to 4 per cent in the entire euro area in the next five years would suffice to restore full employment in the peripheral euro countries.

The discussion then focused partly on the theoretical framework in the paper, and partly on the empirical estimates. A common theory is based on overly high salaries in the tradables-producing sector leading to poorer competitiveness and hence reduced exports. The theoretical model used by the authors focuses instead on the effects in the nontradables-producing sector, but the effects on the tradables-producing sector ought to be at least equally important. It was then discussed whether the estimates in the paper exaggerate the problem. At the outset of the financial crisis, wages were around 20-30 per cent too high in certain countries, but since then wages have been adjusted somewhat and productivity has increased. The labour cost per produced unit has therefore fallen sharply in certain countries compared to, for instance, Germany. So, the problem has perhaps become less serious. Others pointed out that labour costs had fallen mainly because production and employment have decreased, which is a sign of weakness rather than a step in the right direction.

Wage rigidity can have positive effects on the economy

The contribution of Schmitt-Grohé and Uribe focused on a specific case in which wage rigidity leads to poorer economic developments. In his contribution to the seminar, Jordi Galí broadened the perspective and discussed the consequences of wage rigidity on efficiency and economic welfare. In Classical economic theory, equilibrium of real wages and employment is determined by labour supply and demand. Unemployment can only occur if there are restrictions that involve the prevailing real wage being over the equilibrium level. The natural way to reduce unemployment is by means of a downward adjustment in the real wage, for instance by means of the unemployed undercutting the prevailing wage. Then, demand for labour increases, and hence employment too. More flexible wages will then lead to more stable employment, a more efficient distribution of resources in the economy and better welfare.

John Maynard Keynes' fundamental criticism of the Classical theory was that the real wage appeared to determine employment without any real regard for the state of demand in the product market. The Keynesian theory turned the rationale around by regarding employment as a function of aggregate demand. The real wage was determined in turn by employment, and not vice versa.

Using the so-called New Keynesian theory, Jordi Galí analyses the discussion in Keynes "General Theory" about the role of wages in determining employment.¹⁸ The New Keynesian theory is based on insights from both Classical economic theory and Keynesian theory. A similarity between the New Keynesian model and "General Theory" is that wage adjustments do not play a direct role in determining employment. In the New Keynesian

¹⁸ See Galí (2012).

model, the effect of wages on employment is indirect only. This means that salaries affect inflation, while aggregate demand and employment are mainly affected by the central bank adjusting monetary policy. The extent to which better wage flexibility can stabilise employment is then highly dependent on how monetary policy reacts to inflation.

According to Keynes, variations in aggregate demand should result in countercyclical fluctuations in real wages. Because it is assumed that the real wage is set in relation to the marginal product of labour (how much production increases when one more person is appointed), and because the marginal product of labour is assumed to decrease when more workers are appointed, the real wage declines when demand increases and companies increase their production and appoint more workers. According to Keynes, lower real wages are thus connected to demand and production increasing. In reality, however, the real wage seems to move in a pro-cyclical manner, so the real wage increases when production rises. In a New Keynesian model, the real wage will also be pro-cyclical if prices are sufficiently rigid in relation to wages. In this case, the New Keynesian theory appears to fit in better with reality than the traditional Keynesian theory.

According to the Classical theory, increased productivity leads to increased labour demand, higher employment and higher real wages.¹⁹ Production increases both due to increasing employment and also due to higher productivity. According to this theory, productivity-enhancing shocks will thus give rise to a positive correlation between production and employment.

In Keynesian models, however, the effect of an exogenous productivity increase depends on the reaction of aggregate demand. If aggregate demand does not increase at all or not much, employment will decrease because the same production level can be achieved with fewer employees.

In New Keynesian models, the reaction patterns of monetary policy play, as noted above, a key role in the development of aggregate demand and hence employment. A common way of describing monetary policy is the so-called Taylor rule. This involves the policy rate being set with reference to how much inflation deviates from an inflation target, and how much resource utilisation deviates from a normal level. In a New Keynesian model with the policy rate determined by a Taylor rule, higher productivity can lead to increased production and a higher real wage with lower employment and lower inflation.²⁰ Galí believes that this description of the effects of shocks to productivity has significant empirical support.

In the debate about the functioning of the labour market, it is often claimed, with support from the Classical theory, that flexible wages reduce fluctuations in employment and enhance efficiency in the economy and hence welfare. According to New Keynesian models, however, the effects of a change in wages depend on how the change affects demand, and Galí demonstrates that welfare need not generally be higher when wages are

¹⁹ This is under the assumption that income effects on labour supply are not too great.

²⁰ This result is obtained in the simple model used by Galí, but is also valid in empirically estimated dynamic stochastic general equilibrium models with a richer structure.

more flexible.²¹ When the central bank follows a Taylor rule that reacts relatively little to the deviation of inflation from the target, the opposite can apply for reasonable parameter values. Galí therefore believes that it cannot be taken for granted that increased wage flexibility is always desirable, or that wage cuts are efficient in combating unemployment.

In the subsequent discussion, it was ascertained that a lesson was that even the simple New Keynesian model can have surprising implications and be complicated to understand. However, certain participants expressed doubts about the model as such. For example, the model includes shocks to demand which diverge greatly from what Keynes had in mind. Also, the model does not have any explicit role for unemployment: employment can be inefficiently low if real wages are too high, but why this is the case is not explicitly modelled. Also, it is assumed that everybody is perfectly insured against unemployment, so the consumption level of an individual is not affected by him or her becoming unemployed. It is therefore difficult to take the welfare analysis seriously in such a model. It would be desirable to base the model to a greater extent on different microeconomic relationships, for instance with different types of households, workers and companies. This could provide a more convincing analysis of the labour market and the role of monetary policy for unemployment.

The recipe for a good inflation forecast: Start with a solid assessment of the current situation and draw a smooth line to the long-term level

According to the New Keynesian analysis, good forecasts are key to well-balanced monetary policy, and monetary policy is more effective when it is well understood by the general public. Central banks have also started to attach greater importance to policy transparency, and forecasts for inflation and other key variables are being published by an increasing number. In inflation targeting regimes, the accuracy and credibility of inflation forecasts are thus of great importance. But which forecasting methods give good inflation forecasts?

Jon Faust and Jonathan H. Wright use real-time databases to evaluate inflation forecasts in the USA.²² They compare the forecasts from a large number of models with judgemental forecasts published by the Federal Reserve, and with two surveys conducted among forecasters in the private sector. The forecast models evaluated include naive forecasts (which use the latest outcome as the forecast), time series models, models based on various Phillips curves, dynamic stochastic general equilibrium (DSGE) models and forecasting methods that use large quantities of information and combine different forecast models. The forecasting ability of the models is evaluated over different horizons, from nowcasts (for the current quarter) up to eight quarters.

²¹ In the New Keynesian model used by Galí, the loss of welfare of the representative household is approximated by a loss function that depends on the variance in employment, price inflation and wage inflation.

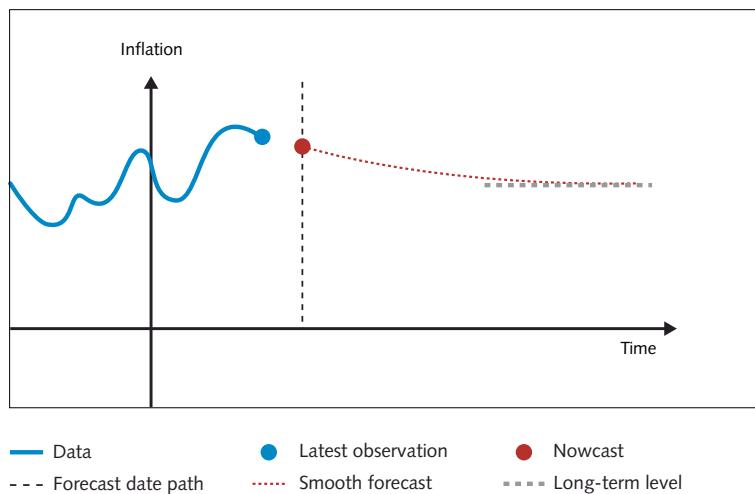
²² See Faust and Wright (2012).

The results show that a good nowcast is crucial to establishing good forecasts in the long term too. And, judgemental forecasts are much more successful than pure model-based forecasts.

Good forecasting methods must also take account of a slowly fluctuating inflation trend to capture the fact that the normal state can vary over time. The forecasting methods that fared best use models that measure inflation as a deviation from trend (the inflation gap), and use information from long-term inflation expectations.

Faust and Wright draw the conclusion that attempts to capture complicated cyclical patterns do not generally lead to better inflation forecasts. More advanced models which use more information cannot significantly improve a simple forecast which starts with a good nowcast of inflation and then gradually glides towards the trend value for inflation (see Figure 6).

Figure 6. Recipe for a good inflation forecast



Source: Faust's presentation at the seminar

According to this study, models which attempt to capture cyclical dynamics thus do not contribute to central banks doing better forecasts. Yet, according to Faust, such models can nevertheless help improve policy decisions if they deliver relevant alternative scenarios which describe how the inflation forecast reacts to monetary policy.

In the subsequent discussion, it was pointed out that structural breaks in the economy are important but very hard to forecast. A structural break can lead to enduring forecasting errors, and the model that best adjusts to such breaks will be the most efficient in forecasting. A naive forecast which predicts that inflation will be the same in the future as it is today may contain major forecasting errors on average, but be very efficient in capturing structural changes. Other participants stressed that although the paper was of great interest, it is unclear how usable the results are for central banks with inflation targets. The

long-term level of inflation is then given by the inflation target, and the task of the central bank is to get inflation to reach the target at a reasonable pace. It is then important to perform conditional forecasts, that is forecasts established under various monetary policy assumptions, in order to then determine suitable monetary policy. Faust found, however, that central banks also need unconditional forecasts, and that even for conditional forecasts, the use of smooth forecasting paths is more efficient.

Concluding discussion

The seminar was rounded off with a general discussion about some different questions of importance to monetary policy. Is there a long-term trade-off between inflation and unemployment? What role should employment and unemployment play in monetary policy? Should they be used as targets for monetary policy alongside the inflation target, or just as indicators of inflationary pressures? If monetary policy is to have an explicit target for employment or unemployment, what importance should be attributed to this target compared with the inflation target?

Some participants pointed out that there is probably a long-term relationship between inflation and unemployment, which conflicts with traditional economic theory. One reason could be that expectations are not entirely rational and are hence on average inaccurate even over longer periods of time. Another reason could be the presence of persistence effects (sometimes referred to as "hysteresis") in unemployment, whereby short-lasting fluctuations in unemployment can have long-lasting effects. If there is a long-term relationship, it will be important for monetary policy to focus on unemployment and employment to a greater extent than merely to the degree they can be used as indicators of future inflation.

Other participants believed that there is no satisfactory model of unemployment, which makes it hard to determine the degree of significance unemployment should bear in devising monetary policy. Also, it would be of use to have better models for studying how central banks' credibility is affected by having targets that are broader than pure inflation targets. Overly ambitious monetary policy may involve risks. Monetary policy with too many targets risks being ambiguous, which could lead to higher unemployment over time.

The papers presented at the seminar and the discussions conducted show that labour market issues are important to both inflation and monetary policy. However, the relationship between inflation, unemployment and monetary policy is complex and can vary over time. These matters will therefore remain high on the agenda in the monetary policy discussion ahead.

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The Swedish covered bond market and links to financial stability

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The covered bond market is large in Sweden, and such bonds is one of the primary funding sources of Swedish banks. The covered bond market is thus of great significance to the Swedish financial system.

This article consists of two parts. The first part describes what characterises a covered bond, how the Swedish market is structured and the financial infrastructure surrounding trade in covered bonds. Covered bonds are characterised by increased safety for the investor by a claim both on the issuer and on an underlying cover pool. In Sweden, this cover pool mainly consists of Swedish mortgages. The Swedish covered bond market features large bond issuances, frequent small on-tap issues and market makers who quote prices on the secondary and repo markets.

The second part discusses links between the banks' use of covered bonds and financial stability. We demonstrate how the covered bond market is important to the major Swedish banks in terms of their funding and in their role of market makers. The banks are hence negatively affected when the market comes under stress, which occurred in connection with the global financial crisis that started in 2007.

The use of covered bonds has the advantage of contributing to lower funding costs for the banks. As previously described by the Riksbank, the banks' extensive funding through covered bonds is however associated with certain weaknesses. Since the covered bonds finance mortgages with considerably longer maturities, a risk arises that the bank cannot roll-over its mortgage funding. This liquidity risk is even greater for the banking system as a whole, among other things due to that banks own each other's covered bonds. The government deposit guarantee scheme and expectations about authority actions can also contribute to market participants failing to sufficiently take into account the risks associated with covered bonds. Renewed stress on international capital markets and reduced confidence in Swedish covered bonds, for example due to a drop in domestic house prices are factors that could lead to a deterioration in the functioning of the market.

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Swedish covered bonds

In this article, Swedish covered bonds refers to covered bonds that have been issued in accordance with the Swedish legislation regarding covered bonds. Swedish banks also issue covered bonds in other countries under the legislation of such countries¹. Issues under the laws of other countries are normally secured by assets in those countries. It also occurs that foreign credit institutions issue covered bonds in Swedish kronor under non-Swedish legislation.² This study is, however, limited to bond issues by Swedish issuers under Swedish law.

WHAT IS A COVERED BOND?

Covered bonds work like ordinary bonds in many respects. They have a fixed maturity and the notional amount is repaid at maturity. However, covered bonds have a number of distinctive characteristics compared with other types of bonds.

Firstly, covered bonds are regulated by law while traditional bank bonds are only regulated by contracts between issuer and investor. Each country has its own covered bond legislation, so the bonds differ from country to country. There are, however, standard-setting regulations at EU level.³

Secondly, a covered bond holder has a claim both on the issuer and on an underlying cover pool. This means that the investor has priority with respect to a specific pool of assets in the event of the bankruptcy of the issuing institution. The legislation regulates, for instance, which assets may be included in the cover pool and how it may be compiled. With traditional bank bonds, the holder usually only has a claim on the issuer.

Thirdly, the cover pool linked to the covered bond is dynamic. This means that assets which are not up to scratch must be removed from the cover pool. If needed, new assets must be added.

Fourthly, the assets in the cover pool and the credit risk of the assets remain on the issuer's balance sheet. The issuer is thereby affected by the credit quality of the underlying assets throughout the entire life of the assets, which gives a greater incentive to perform a sound credit risk assessment.

For bonds secured by assets, which come about through securitisation, the investor also has a claim on a specific pool of assets. Such bonds are called MBS (mortgage-backed securities) when they are secured by mortgages, and ABS (asset-backed securities) when they are secured by other assets.

¹ The issued amount is at SEK 270 billion according to SNL.

² The issued amount is at SEK 27 billion according to Dealogic.

³ The standard-setting regulations are the UCITS directive and the capital requirement directive CRD IV. The interest group for European issuers, the European Covered Bond Council (ECBC), has also prepared a standard regarding which securities can constitute covered bonds.

Unlike a covered bond, the assets that constitute underlying collateral can be detached from the issuer's balance sheet when MBS are issued.⁴ The investor thus no longer has a claim on the issuer, but only on the underlying collateral. The credit risk is then transferred to the investor when the latter acquires the bond. For MBS where the assets are detached from the issuer's balance sheet, incentives to perform a sound credit risk assessment are not as strong as for covered bonds.

Unlike for a covered bond, the cover pool for MBS is often static. So, the cover pool assets are not necessarily replaced if the asset quality deteriorates.

The fact that covered bonds provide a claim both on the issuing institution and the underlying cover pool reduces the investors' risk of losses compared to if the investors only had a claim on the issuer. Hence, the investors do not require as high a return on covered bonds as on traditional bank bonds. Investors' risk of losses in the event of the issuer's bankruptcy is also determined by the quality of the assets in the cover pool. Because the assets remain on the issuer's balance sheet, the latter has reason to place assets with high credit-quality in the cover pool. On the whole, this contributes to the bank's ability as a rule to obtain funding at a lower cost through covered bonds compared with other types of bonds.

Swedish covered bond legislation

In the 1990s and 2000s, an increasing number of European countries implemented separate legislation regarding covered bonds. In order to avoid a competitive disadvantage for the Swedish banks, Swedish covered bond legislation was introduced in 2004.⁵

Since the introduction of the legislation, banks and credit market firms have had the possibility of applying to Finansinspektionen for authorisation to issue covered bonds under the law. A condition for the authorisation was that all so-called mortgage bonds be converted to covered bonds. Between 2006 and 2008, Swedish banks converted their mortgage bonds to covered bonds.

The law defines which of the bank's assets may be included in the cover pool, and regulates the loan-to-value ratio of the loans included. The assets permitted are mainly credits for homes, agricultural properties and commercial properties located in the European Economic Area (EEA). Loans for commercial properties may, however, only make up 10 per cent of the collateral value. Credits to the public sector, such as municipalities, are also permitted. Also, up to 20 per cent of the cover pool value may consist of other liquid assets such as cash, government securities and covered bonds issued by other institutions. These are called substitute collateral.⁶ In practice, the underlying collateral mainly consists

4 The bank sell the assets to a special bond-issuing company.

5 Covered Bonds (Issuance) Act (2003:1223). The legislation was preceded by discussions that spanned several years. It can be noted that the Riksbank was initially negative to separate covered bond legislation.

6 If there are special grounds, Finansinspektionen can authorise allowing substitute collateral to constitute up to 30 per cent of the cover pool.

of Swedish housing loans. The quality of the banks' cover pool is thus strongly linked to the ability of households to repay their mortgages.

The requirements set by Swedish law on loan-to-value ratio for the credits in the cover pool are not as strict as in Germany, but more strict than in many other countries.⁷ For housing loans, the highest permitted loan-to-value ratio is 75 per cent of the market value. For agricultural properties it is 70 per cent, and 60 per cent for commercial properties. If the loan-to-value ratio of a certain credit exceeds the highest permitted loan-to-value ratio for the cover pool, the issuer may include the share of the loan which is below the highest permitted loan-to-value ratio in the cover pool. The same applies should the market value of the properties that constitute underlying collateral for the loans decline.

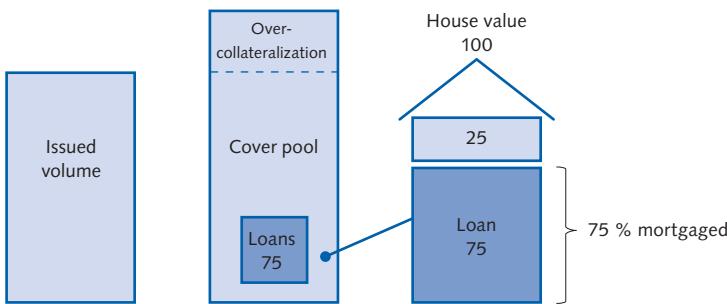
The law also states that the notional value of the collateral must, on an ongoing basis, at least equal the notional value of the outstanding covered bonds for each issuer. The issuer must therefore keep a register of the underlying collateral and the issued covered bonds and related derivative contracts.

Finansinspektionen is responsible for ensuring compliance with the Swedish Covered Bonds Act. To assist it, Finansinspektionen has independent inspectors who mainly monitor the issuer's register of underlying collateral. The collateral that exceed the required amount is called overcollateralization. Figure 1 shows the cover pool principle.

Finally, the Act regulates what happens in the event of an issuer entering bankruptcy and no longer being able to meet its obligations towards its creditors. In this event, the assets that constitute the underlying cover pool must be kept apart from the other assets of the bankruptcy estate. A person who has invested in covered bonds is entitled to payment out of these assets. If the cover pool assets do not suffice, investors in covered bonds have the same entitlement to payment out of the rest of the bankruptcy estate as the issuer's other creditors.⁸

⁷ According to the European Covered Bond Council, the LTV requirement for housing loans in Germany is 60 per cent, in Denmark 75 or 80 per cent, in the UK 80 per cent and in France 80 per cent. In Spain, there is an implicit LTV requirement of 80 per cent.

⁸ In 2010 the Act was amended to enable the party managing the issuer's bankruptcy estate to enter agreements on behalf of the underlying cover pool. This meant that the manager could, for instance, raise financing and enter derivative contracts to manage the underlying collateral and hence be able to sell the collateral in an orderly manner more easily.

Figure 1. Cover pool illustration

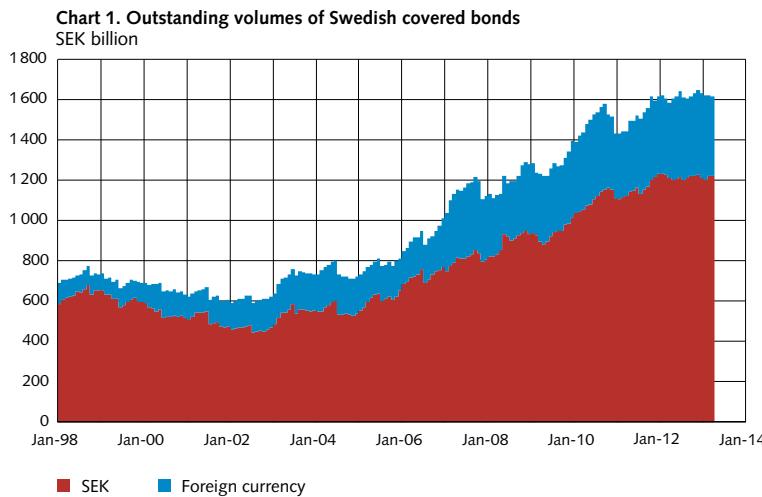
THE SWEDISH COVERED BOND MARKET⁹

Sweden has a long tradition of mortgage funding through mortgage institutions which have issued so-called mortgage bonds since the early 1900s. These bonds were formally not secured but could largely be equated to bonds collateralized by mortgages, the reason being that, in practice, investors would be entitled to the mortgages on the institution's balance sheet in the event of the issuer's bankruptcy. The covered bond market originates from what used to be the mortgage bond market.

The Swedish covered bond market has grown sharply in the 2000s, mainly due to the increased mortgage lending of banks (see Chart 1). The total outstanding volume of Swedish covered bonds currently amounts to SEK 1,940 billion, which also equals just over half of Swedish GDP. It is thus bigger than the Swedish government securities market, which amounts to around SEK 1,190 billion.

For covered bonds backed by mortgages, the Swedish market is the fourth largest globally after Spain, Denmark and Germany. The Swedish market is also the fifth largest globally in terms of covered bonds backed by all asset types. The majority of Swedish covered bonds is issued in Swedish kronor (75 per cent) while the remaining bonds are mainly issued in euro (18 per cent).

⁹ Parts of this section are based on interviews with market participants.



Note. Before 2006 the data refers to mortgage bonds. Bonds issued by SEB are not included after 2007 since the mortgage institution was merged with the mother company.

Sources: Financial markets data and Statistics Sweden

The market structure

There are currently seven banks and credit institutions¹⁰ on the Swedish market which issue covered bonds to fund their operations (read more in the section about issuers). On the market in Swedish kronor, the majority of bonds are traded in large issuances that comply with a certain standard. These bonds are called benchmark bonds and usually have maturities of between one and six years.¹¹

For these bonds, new issues can be carried out under existing issuances, known as *on-tap issues*. The secondary market is maintained by *market makers*. The system of market makers and on-tap issues is relatively uncommon compared to markets in other countries.

Market makers¹² play a key role on the Swedish market. They consist of a special function in the capital markets departments of banks, with the task of maintaining liquidity on the secondary market, that is, in trade between different investors. Market makers also sell bonds on the primary market, that is, when issuers issue bonds to investors.

The business model of the market makers largely involves making money on the spread between the bid and offer price of bonds. Through an agreement with the issuer, they have undertaken to continually quote bid and offer prices on the secondary market for benchmark bonds.¹³ Indicative prices are possible to follow on electronic information

¹⁰ Swedbank hypotek, Stadshypotek (Handelsbanken), Nordea hypotek, SEB, Swedish Covered Bond Company (SCBC) a subsidiary of SBAB, Landshypotek and Länsförsäkringar. In 2013, Skandiabanken has also been granted authorisation to issue bonds.

¹¹ In this article, benchmark bond on the Swedish market refers to a bond traded through market makers.

¹² On the market for Swedish covered bonds issued in Swedish kronor, there are currently six market makers – the four major Swedish banks, Danske Bank and Nykredit.

¹³ Not all market makers necessarily have agreements with all issuers.

systems and, upon request, the market makers provide the prices applicable to an actual transaction.

The undertaking implies that everybody who invests in a covered bond have the possibility of selling their holdings to the market makers if needed. In this way, liquidity is maintained on the market. In order not to be left with large holdings, the market makers can sell the bonds on. They can also fund the holding through, for instance, a repo, that is, by exchanging the bonds for Swedish kronor for a predetermined period, then exchanging them back again.

Issues on the primary market

When a credit institution intends to issue a new bond, the institution approaches one or more of its resellers, who are given the task of preparing terms and conditions ahead of a bond sale. The resellers are also usually market makers on the Swedish bond market. The amount a bank needs to issue is determined by the funding requirement. The issuer keeps in regular contact with the market maker in order to get a sense of demand and to time the issue well.

Usually, issuers repurchase a large share of the bonds around nine to twelve months before they mature. Investors are then offered the possibility of exchanging the maturing bond for one with a longer maturity at current yield. A reason for doing it like this is that the issuer wants to reduce the risk of inability to refinance the maturing bond.

Covered bonds in Swedish kronor that are not benchmark bonds are also issued. This occurs, for instance, when investors want a type of bond other than what is already available on the market, for instance with a longer maturity. Usually, such bond types are never traded on the secondary market. However, the issuer can offer to repurchase the bond as maturity approaches.

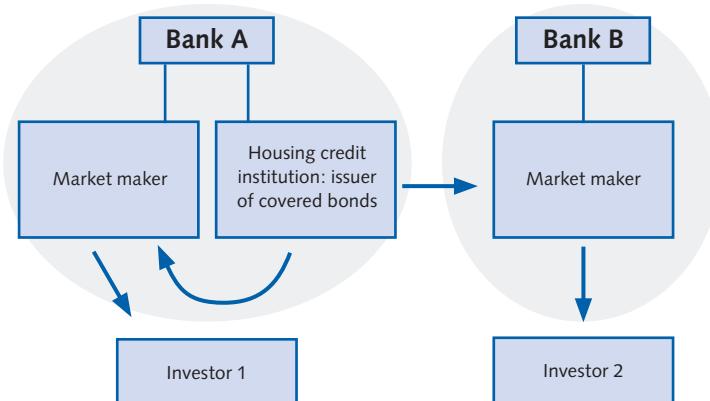
On-tap issues

After the initial issuance, further amounts can be issued under the same bond issuance; these are known as on-tap issues. New bonds are thus issued in the framework of the same agreement, on the same terms. The only new feature is the price (yield) which is adapted to the prevailing market situation.

When demand is deemed good, the issuer can decide to carry out an on-tap issue. This is carried out in accordance with the base agreement previously signed between the issuer and the market maker and, thanks to standardised documentation, the procedure can take place within a day. If on-tap issues occur on the initiative of the issuer, the latter can offer all market makers the opportunity of selling the bond on to investors. The market makers then in turn contact investors with information about the volume being sold and at what price. Issues can also occur on the initiative of investors, who approach the market maker and request a certain volume in a specific issuance. The issuer can then carry out a private placement for the investor through a market maker.

Through the Swedish system, in which small on-tap issues are carried out on a daily or weekly basis, the issuer can constantly adjust covered bond supply to market demand. This also helps to maintain trade. Figure 2 illustrates the flows in an issue.

Figure 2. Issues and the division of roles – an overview



Swedish covered bonds in currencies other than Swedish kronor

The Swedish banks obtain funding in foreign currency in order to diversify the risk in their funding, and because they need foreign currency. It has also been profitable at times. One quarter of Swedish covered bonds are issued in currencies other than Swedish kronor. This equates to SEK 495 billion, two thirds of which consist of bonds issued in euro.

Swedish covered bonds issued in euro are as a rule issued under Euro Medium Term Note (EMTN) programmes under UK law, which constitutes a standard for large parts of financial markets in Europe.¹⁴ The rules about the bond's structure and supervision follow the Swedish Covered Bonds Act, however. So, investors in Swedish covered bonds issued in foreign currency have the same rights to the underlying cover pool as investors in bonds issued in Swedish kronor.

On the market for covered bonds issued in euro, frequent, small on-tap issues are uncommon. Instead, the entire amount is borrowed upon issuance, which in individual cases can be supplemented with on-tap issues. The standard amount for an issue on the euro market has been EUR 1 billion, but the trend is headed towards lower issue volumes, although a minimum of EUR 500 million for the bond to be classed as a benchmark bond.¹⁵

On markets in other currencies there are also resellers who are responsible for bond sales on the primary market. However, as a rule their obligations are not as far-reaching as those of the Swedish market makers in terms of providing prices on the secondary market.

¹⁴ Using a EMTN programme is a common issue structure among European banks and firms. It involves the issuer issuing a base prospectus which complies with UK legislation as a rule. Under this base prospectus, different types of bonds can be continually issued as needed, often in different currencies.

¹⁵ Small volumes are called private placements.

However, a number of Swedish and international banks, without agreements with issuers, quote bid and offer prices for Swedish covered bonds on the secondary market.

Compared to the Swedish market, the possibility of investing in bonds with a short investment horizon is more limited on the euro market. According to information from banks which trade in Swedish euro bonds, the majority of investors who are active on this market intend to keep the bonds until maturity.

Maturity of Swedish covered bonds

Issuing a mortgage is usually a long-term commitment from the bank, which could justify long-term funding. The maturity of the covered bonds of Swedish banks is, however, much shorter than that of many mortgages that have a maturity of 40 years. The average maturity of the outstanding stock of Swedish covered bonds was at the end of 2012 almost three years, while the average maturity of newly issued bonds was 4.5 years.¹⁶ It is shorter than in many other European countries. Around 40 per cent of the benchmark bonds issued on the euro market in 2010 had maturities of over seven years¹⁷. Long bonds are particularly common in Denmark and Germany.

Many market participants describe how tradition and experience are important to market functioning. The fact that there is a tradition of a liquid market for covered bonds with maturities of between one and six years can thus have a certain bearing on bond maturity. If investors buy bonds with longer maturities, they may require a premium as compensation for the lack of liquidity.

LINKS BETWEEN SUBMARKETS

In order to understand the dynamics of the covered bond market, it is important to be familiar with the links between different submarkets. There are important links not only between the primary and secondary market, but also with other submarkets such as the repo and foreign exchange market.

The primary and secondary covered bond markets

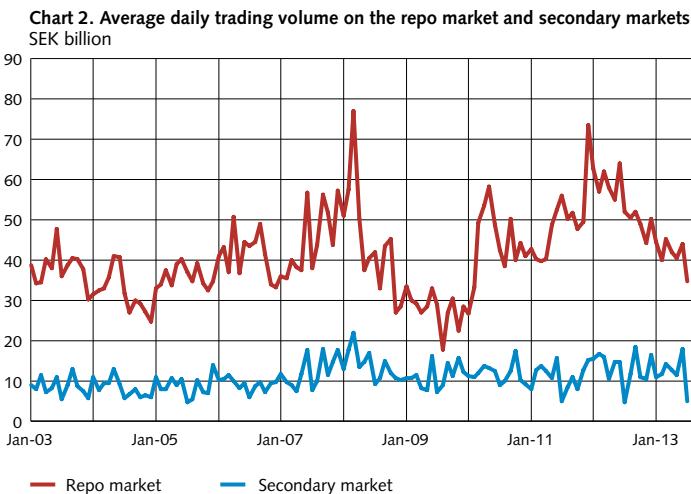
The primary and secondary covered bond markets are closely interlinked. When a bank is to issue a covered bond, investors compare it with the pricing on the secondary market, because this offers an alternative investment. Yields on the secondary market therefore form the basis of yields in issues. The possibility of issuing on the primary market is therefore negatively affected during periods of heavy selling pressure on the secondary market, because yields then rise.

In 2012, the daily trading volume of covered bonds averaged at SEK 13 billion on the secondary market. Hence, around 0.7 per cent of the total volume of covered bonds is

16 According to the Association of Swedish Covered Bond Issuers.

17 According to the European Covered Bond Council.

traded each day. Trading volumes have been relatively stable over time and have increased in line with the growing volume of outstanding covered bonds (see Chart 2).



Source: The Riksbank

Link to the repo market

A repo transaction in covered bonds involves the bond holder selling the bond to a counterparty in exchange for liquid funds. At the same time, the parties agree that the seller will buy back the bond at a later date. Repo instruments largely work like a secured loan over the term of the repo.

Certain covered bond investors want to liquidate their bonds by pledging them on the repo market. In such a transaction, the counterparty is usually the capital markets department of banks – the market makers in other words. The most common duration in a repo-transaction is a week.

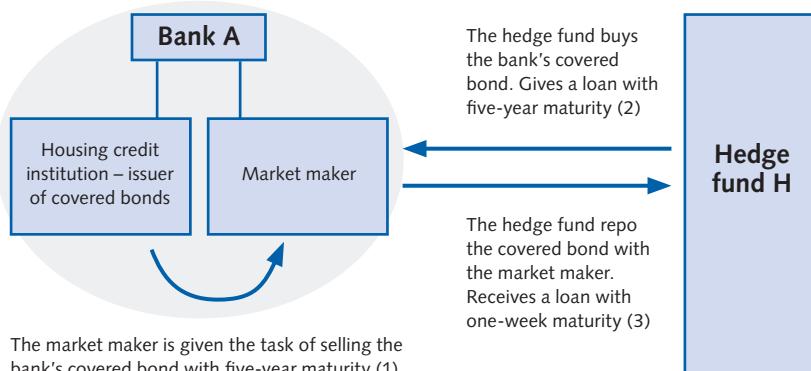
The market maker may in turn choose to finance its stock of covered bonds on the repo market. The opposite applies should a market maker encounter greater demand for covered bonds than what it has in stock. In this case, the bond can also be acquired on the repo market. If the market maker cannot find the covered bond on the repo market, it can approach the issuer. According to the market maker agreement, the issuer must offer repos to the market maker as needed.

According to market participants, in recent years there have been more investors wishing to fund their covered bond holdings through repos, than investors wishing to obtain covered bonds in exchange for kronor over the repo market. Market makers can thus rarely fund their total holdings on the repo market. Consequently, market makers must fund their stock of covered bonds in a different way. This occurs most commonly through internal loans from other parts of the bank, for instance from deposits or short-term funding.

The trading volume on the repo market for covered bonds in 2012 was SEK 54 billion a day on average – much higher than on the secondary market. Hence, around 3 per cent of the outstanding volume of covered bonds is traded on the repo market each day. The trading volume fell sharply after the financial crisis of 2008, but has since recovered (see Chart 2).

Some covered bond holders, hedge funds for example, want to fund their holdings of covered bonds on the repo market for quite some time. Both a bank which issues covered bonds and an investor may have an interest in the bank, in its role as market maker, funding the investor's covered bond holding. Figure 3 gives a simplified picture of such a transaction. A bank issues a covered bond through its mortgage institution which the bank's own market maker department has the task of selling (1). The bond has a five-year maturity. The market maker sells the bond to a hedge fund and thus raises funds with a five-year maturity (2). However, the hedge fund wishes to fund the bond through a one-week repo. The market maker then issues a loan with a one-week maturity to the hedge fund in exchange for the covered bond (3). This transaction does not decrease the liquidity risk of the bank because the bank first borrows money from the hedge fund, which it then lends back. Compared to the starting point, the bank can, however, extend the average maturity of its funding. The fact that the bank offers the investor the possibility of funding its covered bond holding through the market maker can also increase demand for the bank's bonds. The hedge fund may, on the other hand, earn money on the spread between the higher yield on the five-year bond and the lower yield on the one-week repo.¹⁸ In certain cases the market maker can roll-over the repo contract with the hedge fund over a long period of time.

Figure 3. A hedge fund funds its covered bond holding through a repo



¹⁸ The hedge fund can also manage the interest rate risk through fixed income derivatives.

Link to the foreign exchange market

Some of the Swedish covered bonds issued in foreign currency fund assets in Swedish kronor, such as mortgages. This funding in foreign currency is exchanged for kronor with another counterparty through what is known as a currency swap. The counterparties thus exchange currency with each other and have an agreement to exchange it back at a later date. The counterparty is often a foreign bank, but the swap can also be made internally with a different part of the same bank. Because Swedish banks have a need to exchange parts of their funding in foreign currency for Swedish kronor, they rely on a smoothly functioning currency swap market.¹⁹

Links to the futures market

The major Swedish banks are also market makers in futures contracts with covered bonds as the underlying asset. However, this only applies to some of the Swedish issuers' bonds. There are standardised contracts, with the underlying bonds either having a two-year or five-year maturity, which facilitates trade.²⁰ In 2012 trade on the futures market averaged just above SEK 7 billion daily.

MARKET PARTICIPANTS

This section describes the market participants operating on Swedish covered bond markets, that is, issuers, investors and interest groups. Market makers and resellers also have an important function but they are addressed in the market structure section.

Issuers

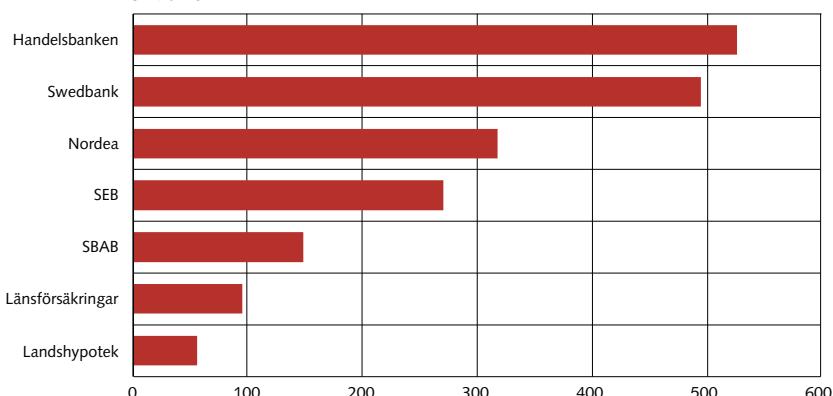
There are eight banks and their mortgage institutions which have been granted authorisation from Finansinspektionen to issue covered bonds under Swedish legislation. Currently, seven of these banks have issued covered bonds.²¹ Handelsbanken accounts for the largest market share (28 per cent) followed by Swedbank (26 per cent). Then come Nordea (17 per cent) and SEB (14 per cent). SEB is the only bank to have its mortgage operation incorporated into the bank, while other banks have separate mortgage institutions.

¹⁹ See Eklund, Johanna, Milton, Jonas and Rydén, Anders (2012), Swedish banks' use of the currency swap market to convert funding in foreign currencies to Swedish kronor. *Sveriges Riksbank Economic Review* 2, 2012.

²⁰ Futures contracts fall due on the next IMM date, that is the maturity is three months at most.

²¹ Swedbank hypotek, Stadshypotek (Handelsbanken), Nordea hypotek, SEB, SCBC (SBAB), Landshypotek, Länsförsäkringar hypotek and Skandiabanken. Skandiabanken has not yet issued any covered bonds.

Chart 3. Outstanding covered bonds by issuer, June 2013
SEK billion



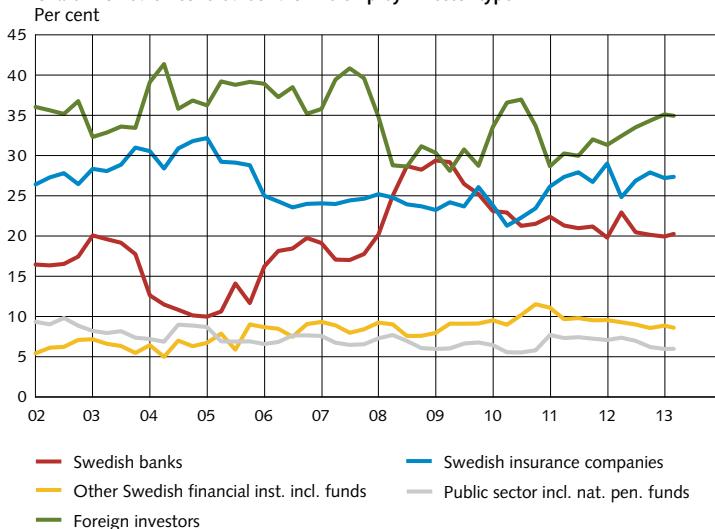
Sources: Public information from each bank

Investors

The primary owners of Swedish covered bonds are insurance companies, banks and bond funds including pension funds – that is, traditional participants in the fixed income market. They often have a long investment horizon. Among Swedish investors, the insurance companies are largest (28 per cent) followed by the Swedish banks themselves (around 21 per cent) (see Chart 4). The bank own the bonds through, for instance, their role of market makers and for their liquidity buffers. Other Swedish financial institutions including funds, own almost 10 per cent.

Around 35 per cent of the covered bonds issued by Swedish credit institutions are owned by foreign investors, which includes bonds issued in foreign currency. While there are no official statistics about the various categories of foreign owners, judging from equivalent statistics about covered bonds issued in euro, asset managers are the biggest investors, followed by insurance companies and banks.

Chart 4. Swedish covered bond ownership by investor type



Note. Covered Bonds issued by SEB are excluded since 2007.

Source: Statistics Sweden

On the Swedish covered bond market, there are investors with shorter investment horizons, which enter and exit covered bond positions more frequently. Investors with a short investment horizon are also important to the functioning of the market. They contribute to frequent trade in bonds, which can enhance market liquidity. Because many of these investors are active on the repo market, the functioning of the repo market can be said to be important to the functioning of the market in general. The presence of participants with a short-term outlook is also associated with risks (see the section on the financial crisis).

Credit rating agencies

As is the case for other securities, a high credit quality for the covered bonds contributes to a low funding cost. The opinions of credit rating agencies therefore have a bearing on the covered bond market. All Swedish issuers allow their covered bonds to undergo credit ratings by at least one of the credit rating institutions Moody's and Standard and Poor's (see Table 1).

All Swedish issuers have always had the highest possible credit rating, for their covered bonds²². Credit rating methods differ between the institutions, but as a rule there is a relationship between the sovereign's credit rating, the issuer's credit rating and the maximum credit rating that the covered bonds can attain. If the issuer's credit rating is too low, the highest possible credit rating cannot be achieved for the covered bond, regardless of the value of the underlying cover pool. It is mainly because a heightened risk of the

22 AAA according to Standard and Poor's scale, Aaa according to Moody's scale.

issuer's bankruptcy also increases the probability of delays in payment on the covered bonds. Another common requirement for a credit rating company to issue the highest possible credit rating is that the value of the underlying collateral exceeds the value of the outstanding bonds by around 5-15 per cent.

Table 1. Credit ratings of Swedish issuers

BANKS	MOODY'S			STANDARD AND POOR'S		
	Long-term rating	Short-term rating	Covered bonds	Long-term rating	Short-term rating	Covered bonds
Landshypotek				A	A-1	AAA
Länsförsäkringar	A3	Prime-2	Aaa	A	A-1	AAA
Nordea	Aa3	Prime-1	Aaa	AA-	A-1+	AAA
Handelsbanken	Aa3	Prime-1	Aaa	AA-	A-1+	AAA
SBAB	A2	Prime-1	Aaa	A	A-1	AAA
SEB	A1	Prime-1	Aaa	A+	A-1	
Skandiabanken	A3	Prime-2				
Swedbank	A1	Prime-1	Aaa	A+	A-1	AAA

Sources: Moody's, Standard and Poor's and the Riksbank

Supervisory authority

A number of international agreements and Swedish laws regarding credit institutions and investors affect the Swedish covered bond market. Finansinspektionen is chiefly responsible for ensuring compliance with these regulations.

Finansinspektionen also grants authorisations to issue covered bonds, and ensures compliance with the Swedish Covered Bonds Act. Finansinspektionen has also supplemented the Covered Bonds Act with more detailed regulations and general guidelines.²³ To assist it in its work to ensure compliance with the law, Finansinspektionen has *independent inspectors* who are appointed by Finansinspektionen but who receive financial remuneration from the issuer.

The fundamental issue of supervision is about the value of the cover pool at least equalling the value of the issued bonds. Therefore, supervision revolves around monitoring the loan-to-value ratio of the underlying loans and valuation of the assets, mainly real estate, which constitute collateral for the underlying loans. According to Finansinspektionen's regulations, issuers must, on an ongoing basis, monitor the price trend of real estate in the regions where loans are granted. If there is a severe deterioration in market conditions, the original valuation must be reviewed. A change in the regulations which came into effect in 2013 involved a clarification of the possibility of issuers to register value increases in the underlying collateral. If they utilise this possibility, they must also register value decreases to the same extent. Also, the issuer must perform regular stress tests to explore how declining values in underlying collateral and interest rate and currency fluctuations affect loan-to-value ratios and the value of the cover pool.

23 FFFS 2013:1, Finansinspektionen's Regulations and General Guidelines Governing Covered Bonds.

The issuer must keep a register of issued covered bonds and the underlying collateral. The register is monitored by the independent inspector. At least once a year, the inspector takes a sample of loans from the cover pool to find out if they are accurate in terms of, for instance, valuation and loan-to-value ratio. The findings of the review are reported to Finansinspektionen in an annual report. Through the regulations which came into effect in 2013, the guidelines for the independent review have been clarified.

Interest groups

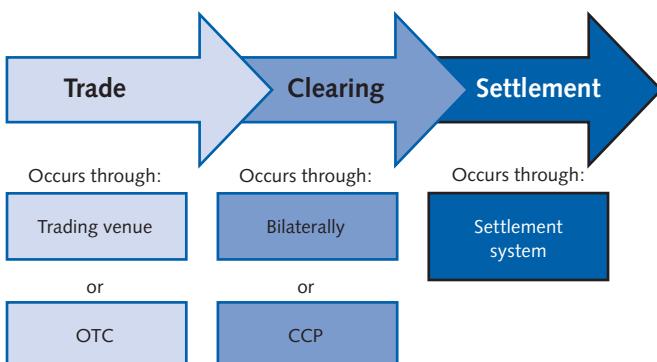
There are two Swedish interest groups related to the Swedish covered bond market. These are *Penningmarknadsrådet* (*the money market council*) and the *Association of Swedish Covered Bond issuers* (ASCB). The former is a work group under the Swedish Securities Dealers' Association. The council consists of the members of the Swedish Securities Dealers' Association which are market makers for Swedish government securities, which overlaps with the market makers for covered bonds. In the council, matters regarding the market's functioning, both in the short term and in more structural terms, are discussed. During the financial crisis in the autumn of 2008, active decisions were taken about, for instance, the size of trading lots and the spread between the bid and offer price on the interbank market (see the section about the financial crisis below).

The ASCB is the interest group of Swedish issuers. The objective of the association is to market Swedish covered bonds and convey the interests of issuers in relation to legislators and authorities. The association also represents Swedish issuers at international investor conferences and in the international umbrella organisation European Covered Bond Council (ECBC), which represents the national interest associations. The Swedish Bankers' Association provides the association's secretariat. All Swedish issuers are currently affiliated with the ASCB.

INFRASTRUCTURE SURROUNDING TRADE IN COVERED BONDS

A transaction in securities, for example covered bonds, is carried out in three steps (see Figure 4). The first step is trade, involving the buyer and seller finding each other and agreeing on a price. The next step is the compilation of transfer instructions – known as clearing. Once the transfer instructions are done, settling the transaction remains, involving the buyer and seller exchanging cash and securities.

Figure 4. The three steps of a securities transaction



Trade

Trade in securities can take place either through an organised market place or OTC (over the counter). The most common type of organised market place is a stock exchange.

When trade is conducted on organised market places, it occurs on a market place which, through its regulations, makes the market available to everybody. Everybody can also access prices and information about quoted securities. Trade on organised market places thus involves some transparency, and the market is equally accessible to all participants. There is also a greater possibility of warding off market abuse.

When trade is conducted OTC, there are no regulations governing the trade. This makes it easier to trade non-standardised contracts and tailored contracts. However, in OTC trade, only the parties included in the transaction know that the transaction is taking place, and at what price. Transparency into the OTC market is hence lower than for securities traded on an organised market place.

Swedish covered bonds can be traded both on an organised market place and OTC. A large amount of covered bonds that are classed as benchmark bonds are registered with NASDAQ OMX (the Stockholm stock exchange), enabling trade on the stock exchange to take place.²⁴ This applies to both the purchase and sale of bonds on the spot market and on the futures market.²⁵ Repo contracts with covered bonds as collateral may, however, not be entered over the stock exchange.

However, there is no trade on the stock exchange in covered bonds in Sweden. Rather, they are traded OTC through market makers both on the spot market and the futures market. Trade does not take place through a regulated market place because these are currently mainly devised for trading in equities. The covered bond market consists of a handful of participants which conduct relatively few but large transactions. Because trade

²⁴ NASDAQ OMX is a regulated market place in Stockholm. The contracts quoted on the stock exchange are as follows: SCBC (SBAB), Stadshypotek, SEB, Swedbank hypotek, Nordea hypotek, Länsförsäkringar.

²⁵ On the spot market, payment and delivery take place immediately, while on the futures market payment and delivery take place at a later, predetermined point in time.

does not occur continually, it can be difficult to match buyers and sellers at the same time, which occurs on a stock exchange, known as order-driven trade.

However, it can be said that trade in covered bonds is organised through the market maker system. Indicative bid and offer prices are shown on-screen, that is through electronic information systems provided by NASDAQ OMX, Bloomberg or Reuters. Most trade takes place over the phone. The fact that NASDAQ OMX publishes prices and trading volume statistics for quoted bonds also contributes to greater transparency on the market.

Clearing

Clearing involves the compilation of financial transaction instructions. In the compilation, it is verified that the parties agree on price, transaction date and so on. It is important that the counterparties in a transaction share the same perception of the terms of the transaction in order for settlement to go smoothly. The clearing of securities can take place either through a clearing organisation or bilaterally.

An increasingly common type of clearing organisation acting on the financial markets are central counterparties (CCP). A CCP is considered to contribute to more secure management of counterparty risk by stepping in as buyer for all sellers, and seller for all buyers, in securities transactions, and requesting collateral for the transactions. Both the buying and selling counterparty thus have the central counterparty as counterparty. Because CCPs come under authorities' supervision and monitoring, they are considered to be safe counterparties.

When clearing occurs bilaterally, there are only two counterparties involved and the compilations of the two counterparties occur simultaneously. In these cases, clearing can either occur verbally or through a written contract.

In Sweden, there is currently no possibility of CCP clearing of transactions in covered bonds on the spot market. However, both futures contracts with covered bonds as the underlying asset and repo contracts in covered bonds can be CCP-cleared on NASDAQ OMX.²⁶ The number of CCP-cleared futures contracts on NASDAQ OMX varies over time, but is on a rising trend. However, there is currently no CCP clearing of repo contracts in covered bonds.

However, the bilateral clearing of covered bonds is relatively standardised according to contracts developed by the ISDA²⁷ with the aim of making OTC trade secure and more efficient.

The main reason for market participants deciding not to opt for CCP clearing is that it incurs costs. Partly, the CCP charges for assuming the market participants' counterparty risks, through collecting collateral for instance, and partly CCP clearing requires system

²⁶ For many years, NASDAQ OMX has had a company in the group (in Sweden) which acts as CCP on Nordic markets and primarily clears derivatives, but also certain other financial instruments such as repo contracts and bonds.

²⁷ ISDA – International Swaps and Derivatives Association. The ISDA works to make the OTC market for derivatives and swaps secure and efficient.

support which also incurs costs. If counterparties find that the cost of alleviating the counterparty risk through CCP clearing exceeds the cost of managing the counterparty risk by themselves, they choose not to clear a transaction through CCP. This happens in particular if the counterparties have a smoothly functioning collateral management system between them.

On the derivatives market, counterparty risks are as a rule much bigger and harder to manage compared with the spot market. This is because the risk exposure extends over a longer period of time, often up to several months or years. New international regulations will place heightened demands on the CCP clearing of derivative contracts.²⁸ The European Market and Securities Authority (ESMA) defines which instruments are to be cleared through CCP. Whether derivatives associated with Swedish covered bonds will become subject to compulsory CCP clearing depends on whether the instruments will be included on ESMA's list.

Settlement

When trade and clearing of a financial instrument are complete, settlement remains. Settlement is the transfer itself of a registered security from the seller and payment from the buyer. Settlement is carried out through a settlement system. There is only one such system in Sweden – Euroclear Sweden, through which covered bond contracts are also settled.

When settlement is made through Euroclear Sweden, the security is transferred at the same time as payment. This simultaneousness is known as delivery versus payment. It involves the settlement risk disappearing, because the one side of the transaction is not conducted if the other is not carried out at the same time.

Links to financial stability

This section begins with a description of how the covered bond market is important for the major Swedish banks. We also show how the banks can be negatively affected when the market comes under stress, which occurred in connection with the global financial crisis that started in 2007. In addition, the Riksbank's views on a number of benefits and weaknesses for the financial system from the banks' use of covered bonds are summarised. Finally, factors that could bring about a deterioration in functionality on the market for Swedish covered bonds are discussed.

²⁸ See Eklund, Johanna, Sandström, Maria and Stenkula von Rosen, Johanna (2012), The derivative market is facing major changes, *Economic commentaries* no. 6, 2012, Sveriges Riksbank.

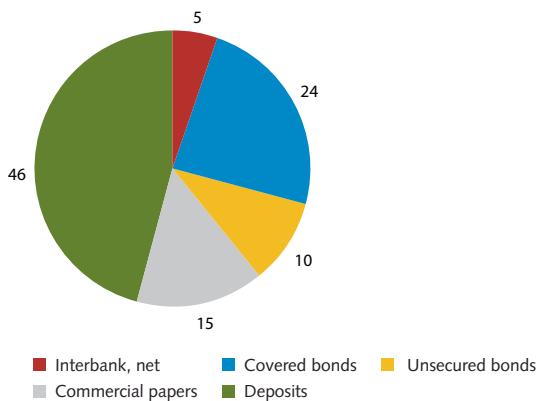
MAJOR SWEDISH BANKS ARE EXPOSED TO THE COVERED BOND MARKET

The major Swedish banks are exposed to the covered bond market in many ways. Besides the banks relying on the market for their funding, the market's function also affects their liquidity buffers, which largely comprise covered bonds. Also, they are exposed to the market in their role of market makers.

Covered bonds account for a large part of the banks' funding

The market funding of the major Swedish banks accounts for around half of their total funding, which is a relatively high proportion in an international perspective. Half of market funding comprises borrowing through covered bonds. This means that around one quarter of the banks' total funding is raised through covered bonds (see Chart 5).

Chart 5. The funding of the major banks at December 2012
Per cent

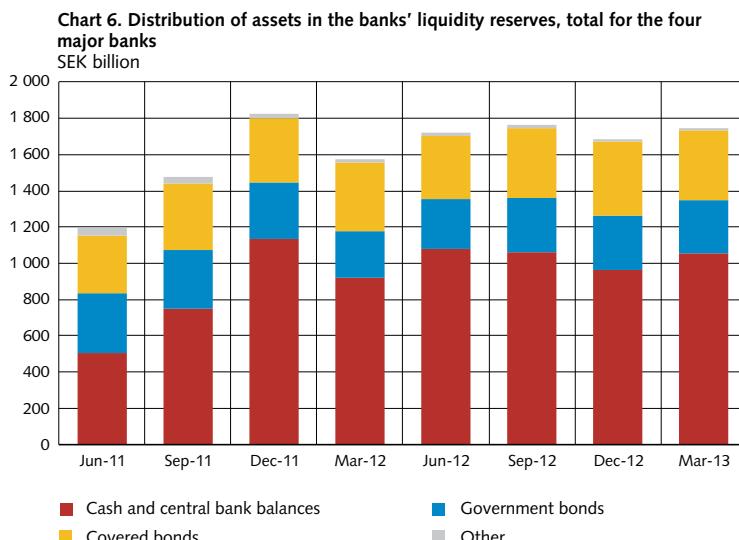


Sources: The banks' earnings reports and the Riksbank

Covered bonds constitute a significant part of the liquidity buffers of the banks

In addition to banks using covered bonds for their funding to a great extent, the market's function also affects their liquidity buffers. A substantial part of these buffers is made up of covered bonds (see Chart 6), and in order to convert these into liquidity, a functioning market is required. If bonds cannot be sold or exchanged²⁹ for cash or other securities on private markets, a large part of the banks' buffers would be illiquid in practice. In March 2013 covered bonds accounted for just over 20 per cent of the large banks' liquidity buffers, almost SEK 400 billion in total. That includes both covered bonds in Swedish kronor and in foreign currency. If balances with central banks are disregarded, which can be reduced when extraordinary measures are phased out, covered bonds amount to 60 per cent of the liquidity buffers.

29 Through a repo transaction.



Note. Liquidity buffers according to the definition of the Swedish Bankers' Association.

Sources: The banks' earnings reports and the Riksbank

The market makers sustain trade

The major Swedish banks are also affected by the covered bond market in their role of market makers. The banks' undertakings as market makers can lead to problems in a situation of many investors wishing to sell off their covered bonds at the same time, because the latter tend to end up in the market makers' own stock. In a situation of market stress with investors wishing to sell off the covered bonds of Swedish banks, the markets for all other market funding, including short-term funding, would probably be affected too. The banks would hence find it difficult to fund their growing stock of covered bonds. This occurred, for example, in connection with the collapse of Lehman Brothers in 2008 (see below).

THE SWEDISH COVERED BOND MARKET AND THE FINANCIAL CRISIS

The banks' major dependence on the covered bond market means they are hit hard when shocks occur on the market. The following describes the course of events and the actions of authorities and banks in connection with the acute financial crisis of 2008.³⁰

³⁰ The Riksbank has, in other contexts, described the general course of events in connection with the financial crisis. See, for example, Molin, Johan (2010), How has the Riksbank managed the financial crisis? *Economic Review* 2010:1, Sveriges Riksbank. See also Elmér, Heidi, Guibourg, Gabriela, Kjellberg, David, and Nessén, Marianne (2012), The Riksbank's monetary policy measures during the financial crisis – evaluation and lessons learnt *Economic Review* 2012:3, Sveriges Riksbank.

Course of events

The build-up of unease on international financial markets from 2007 had an impact on the Swedish covered bond market. During the second half of 2007, foreign investors reduced their holdings of Swedish covered bonds by almost one third, from SEK 450 billion to SEK 330 billion (see Chart 4). The market makers describe how the investors who withdrew typically had a short-term investment strategy, including structured investment vehicles (SIV), conduits and hedge funds.³¹

After Lehman Brothers collapsed in September 2008, the situation became more strained. At the same time, uncertainty increased about Swedish banks' exposure in the Baltics. Investors sought safe and liquid assets such as government securities, and sold what was perceived to be risky, which at the time also included Swedish covered bonds. The market fell subject to heavy selling pressure, mainly driven by foreign investors, but also Swedish ones. Thanks to the Swedish market maker system, it was nevertheless possible to sustain a certain level of trade. Here, investors had a possibility to exit assets – a possibility that was substantially lacking elsewhere. In their capacity of market makers, the Swedish banks bought the bonds, but because of the high level of uncertainty on the market, there were few buyers. The market makers' covered bond stock grew quickly and reached the limits for how much risk the internal regulations permitted. At the same time, markets for short-term funding were strained, so the banks had difficulty in funding their major holdings. All market makers tried to rid themselves of covered bonds by selling to their counterparties on the interbank market, which turned into an unsustainable situation. Unease on the secondary market also made it harder for banks to make issues on the primary market.

Both authorities and market participants understood the severity of the situation, which led to a series of measures within the course of a few weeks. In consultation with the Riksbank, the National Debt Office resolved to pump large amounts of treasury bills into the market.³² The money raised by the National Debt Office through its issues was placed in loans to banks with covered bonds as collateral.³³ This measure provided the banks with the possibility of exchanging their covered bond surplus for the government securities that their counterparties were demanding. The Riksbank extended the banks' possibility of providing covered bonds issued by affiliated institutions as collateral for credit from the Riksbank. The limit was first raised from 25 per cent to 75 per cent of the banks total amount of collateral and was eventually lifted entirely. The banks thus had greater possibilities of obtaining funding through loans from the Riksbank. At most, the Riksbank's lending to Swedish banks amounted to SEK 375 billion in November 2009.

³¹ SIVs and conduits are units controlled by banks that are not included on the bank's balance sheet, which invested in securities with expected low credit risk and which funded this through issuing short securities.

³² In total, bills amounting to just over SEK 200 billion were issued, and the outstanding stock amounted to SEK 120 billion at most. See Swedish National Debt Office (2010). Basis for evaluation of central government debt management 2008 and 2009.

³³ The loans had the same term as the treasury bills issued.

The banks agreed that the guidelines for interbank trading had to be changed to stabilise the situation. Trading lots were reduced, and the spread between bid and offer prices was widened in order to sustain trade.³⁴ On the whole, the series of comprehensive measures helped resolve the problems on the market.

After the financial crisis

After the crisis, the structure of and participant behaviour on the market partially changed. Until the acute financial crisis in the autumn of 2008, Swedish covered bonds were also traded between market makers (interbank), but since the crisis there has been very limited activity on the interbank market. The investor base has also changed to a certain extent. There is a consensus among market participants that the share of speculative investors, in particular foreign ones, has fallen.

Although the formal undertakings of the market makers are the same as they were before the crisis, the market makers describe how, on the back of heightened risk awareness, they have a lower propensity than before to accumulate large covered bond holdings. This could involve investors no longer being guaranteed the ability to trade large volumes on each occasion, in which case liquidity would deteriorate. The bid and offer price spread is also said to still be wider than before the crisis. According to market participants, issuers, investors and market makers share the view that the functioning of the market must be adapted to prevailing circumstances.

ADVANTAGES OF COVERED BONDS FOR THE FINANCIAL SYSTEM

Part one above describes how covered bonds have a series of positive qualities compared with other bond types. It is primarily a matter of advantages for investors, which ultimately facilitates funding for banks. However, these features are, to a certain extent, also positive for the financial system at large.

- Covered bonds involve lower risks for investors in relation to traditional bank bonds. This is mainly because covered bonds provide investors with access to a specific cover pool in the event of the issuer's bankruptcy. Covered bonds are also regulated by law and monitored by supervisory authorities.
- Assets in the cover pool remain on the issuer's balance sheet, unlike in securitisation when the assets can be removed. Therefore, the issuance of covered bonds creates strong incentives for performing a sound credit risk assessment of the underlying assets in relation to issuing MBS.

³⁴ The decision involved the smallest trading lot amounting to SEK 10 million (previously SEK 50 million for short maturities and SEK 100 million for long) and being traded with a greater spread between the bid and offer price.

- Because covered bonds can be considered relatively safe, investors have a lower required rate of return than for other bond types. This helps enable Swedish banks and mortgage institutions to obtain funding on relatively favourable terms, which in turn results in lower rates for mortgage customers.
- Also, covered bonds are treated favourably in the international regulations governing certain investors, such as funds and banks. This means that investors, including the banks themselves, can hold relatively large amounts of covered bonds, which adds to higher demand for them.
- Swedish covered bonds are relatively standardised. Partly, they comply with the standard set by legislation and regulations, and partly, because of the benchmark bond system, there is a limited amount of high-volume bonds traded on the market. The standardisation helps to reduce the resources required by investors to obtain information about the covered bonds. It can be of particular value for foreign investors with limited familiarity with Sweden. Hence, it can be said that the entry barrier for investors to the market is lowered, and trade is facilitated.
- The system of on-tap issues and market makers also helps sustain trade and hence liquidity on the market. It makes it easier for investors to buy and sell bonds and hence for the banks financing. Sound liquidity also provides market participants with a more up-to-date picture of pricing on the market. A clear picture of pricing makes it easier for an issuer to time issues well. It is also an advantage for investors in the valuation of holdings.

WEAKNESSES LINKED TO THE BANKS' USE OF COVERED BONDS

The banks' major reliance on covered bonds is associated with certain weaknesses. There is also a risk of market participants failing to sufficiently take into account these weaknesses due to expectations about government guarantees for the market.

Liquidity risk in funding long-term assets

The maturity of Swedish covered bonds is much shorter than many mortgages which, according to contracts, extend up to 40 years. The bank must therefore renew its funding for mortgages several times over the term of the mortgage. In practice, this occurs continually. A liquidity risk hence emerges; that is, a risk of the bank not managing to renew its mortgage funding. Irrespective of the form of funding it chooses, a bank takes a liquidity risk when it converts short-term funding to more long-term lending. The importance of this liquidity risk depends on how stable the financing is.

Swedish banks' funding through covered bonds has a maturity of almost three years. It can in that respect be seen as stable in relation to e.g. deposits which do not usually have

a time limit.³⁵ For an individual bank, the maturity of a mortgage is often shorter than what the contracts indicate due to, for example, households changing banks. However, although funding through covered bonds can be seen as stable funding for an individual bank, it may constitute less stable funding looking at the banking system as a whole. This is partly due to that when a household changes banks, the mortgage remains within the banking system and has to be refinanced. It is also due to the banks' undertaking as market makers and to the fact that banks' own each other's covered bonds (see below). The banks' undertaking as market makers can involve funding in practice not being as long-term as the maturity implies. This is because, if a lot of investors wish to sell the covered bonds of the banks at the same time, the bonds risk returning to the banking system through the market makers. Then, the banks must find new funding for these stocks of covered bonds.

The banks own each other's covered bonds

Already today, the banks own around one-fifth of Swedish covered bonds. They hence hold their own and each other's covered bonds, largely as a liquidity buffer. Liquidity buffers are intended to be used in a situation of the banks needing liquid funds. However, should a general confidence crisis in the Swedish banking system emerge, several banks would be in need of liquid funds at the same time. If several banks then sold their covered bond holdings to obtain liquid funds, this would, at the same time, render their own possibility of obtaining funding through covered bonds more difficult.

Encumbering the underlying collateral

When the underlying assets in the cover pool are reserved for investors in covered bonds, investors which have purchased the bank's unsecured securities, and private customers with accounts held at the bank, would have fewer assets for their recourse in the event of the bank's bankruptcy. This is particularly the case if the market value of the underlying assets is much higher than the value of the issued bonds. In order to gain compensation for this risk, investors in the bank's unsecured securities and private customers ought to demand higher compensation from the bank. If the share of encumbered assets is too high, there is a risk of investors no longer wishing to purchase the unsecured bonds of banks because they are considered far too risky. There are, however, several reasons for why investors in the bank do not demand higher compensation for the heightened risk when the share of encumbered collateral increases.³⁶ One reason is the government deposit guarantee scheme, whereby the government guarantees the deposits of private customers to a certain amount in the event of the bank's bankruptcy. Hence, private customers with modest savings have no reason to demand higher interest rates when the secured funding of banks increases. Instead, through the deposit guarantee scheme, the government assumes the risk

³⁵ Historically, however, deposits have proven to be a stable form of funding, thanks in part to the government deposit guarantee scheme.

³⁶ For a further discussion about asset encumbrance, see Juks, Reimo (2012), Asset encumbrance and its relevance for financial stability, *Sveriges Riksbank Economic Review* 2012, no. 3.

from depositors without the banks' fee for the deposit guarantee depending on the share of encumbered assets. The deposit guarantee scheme can thus help to reduce the total funding cost of banks by curbing the cost of deposits when secured funding increases.

Expectations about authority actions

Besides the deposit guarantee scheme, the expectations of market participants about government guarantees could entail them failing to sufficiently take into account the risks associated with covered bonds.³⁷ On several occasions, Swedish authorities have acted to remedy the problems arising on the covered bond market. This occurred partly during the banking crisis of the 1990s, and partly in connection with the stress that erupted on the market when Lehman Brothers collapsed and in connection with the problems experienced by Swedish banks in the Baltics. The previous actions of authorities could thus give rise to expectations about them acting again in the event of renewed market stress. Such expectations probably mean that market participants perceive covered bonds to be associated with lower risks than what would otherwise have been the case. In this case, the pricing of funding through covered bonds may be too low in relation to the actual risks. This could in turn lead to both issuers and investors taking excessive risk. For instance, the banks could price lending to customers at a lower level than what would be optimal from an economic point of view, which could lead to excessive credit expansion.

RISKS TO MARKET FUNCTIONALITY

Stress on the covered bond market could once again hit the Swedish banks. Two potential risks to the functioning of the market are renewed stress on international capital markets and unease about a domestic drop in house prices. If these were to occur at the same time, it would probably have a negative effect on the Swedish covered bond market.³⁸

Stress on international capital markets

Stress on international capital markets risk once more having an impact on the Swedish market. In a situation of great unease on financial markets, the propensity of market participants to lend money to each other decreases, and a preference for owning safe government securities may emerge. In such a situation, investors' possibilities of or appetite for owning Swedish covered bonds may decline, and selling pressure may arise. This would lead to Swedish banks finding difficulty in obtaining funding through covered bonds on the primary market. At the same time they risk, in their role of market makers, increasing their covered bond holdings. However, unease on international capital markets does not

37 For a further discussion about implicit government guarantees, see *Appropriate capital ratio in major Swedish banks*, 2011, Sveriges Riksbank.

38 For a current risk assessment, see *Financial Stability Report* 2013, no. 1, Sveriges Riksbank

necessarily spill over onto the Swedish banks' possibility of obtaining funding through covered bonds, as indicated by the unease of recent years surrounding the debt crisis in the euro area.

Risks of negative consequences in the event of a decline in house prices in Sweden

An aspect specific to the Swedish market is the risk of a substantial drop in house prices. The Riksbank has previously analysed the impact on covered bonds in such a scenario.³⁹ The conclusion was that the banks have sound possibilities of managing matching requirements for the cover pool in a situation of declining house prices and rising loan-to-value ratios. But the more the loan-to-value ratios on the underlying collateral increases, the harder it will be for banks to meet matching requirements in the event of a decline in house prices. Even if the bank can cope with the matching requirement, a substantial decline in house prices would probably have a negative effect on the banks' cost of and access to funding. The emergence of unease about a decline in house prices could suffice for investor confidence in covered bonds to diminish. Reduced investor confidence in turn affect the banks' possibilities of obtaining funding through covered bonds negatively.

Conclusion

We have seen that the Swedish covered bond market is large, and that Swedish banks depend heavily on this market. Shocks on the covered bond market may thus constitute a risk to financial stability. In this event, not only the banks but also other investors and the banks' customers would be affected. For instance, the banks' mortgage lending and mortgage rates are closely linked to their funding through covered bonds.

The Riksbank and other Swedish authorities are working to prevent shocks to the Swedish covered bond market. In its stability work, the Riksbank monitors the banks' issuance of covered bonds, trade on the secondary market and the investor base. We also monitor the trend in household indebtedness and house prices, because these are of consequence to the banks' possibilities of obtaining funding through covered bonds. The work also involves oversight to ensure that government regulations and the market structure do not give rise to incentives for excessive risk-taking among market participants.

In order to strengthen the financial system, authorities have come to a series of international agreements that may affect the market for Swedish covered bonds. These include the new liquidity and capital adequacy regulations for banks under Basel III and reforms in OTC derivatives trading through EMIR. At the same time, initiatives are under way to harmonise the structure of covered bonds between European countries. The Swedish authorities have also expressed the need for future regulations to contribute to maintaining a robust covered bond market.⁴⁰

39 See *The Riksbank's commission of inquiry into risks on the Swedish housing market*, 2011, Sveriges Riksbank.

40 See The Ministry of Finance, Finansinspektionen and the Riksbank (2013), Swedish Authorities' Response to the Green Paper on Long-term Financing of the European Economy (Dnr: 2013-493-AFS Sveriges Riksbank).

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Identifying systemically important banks in Sweden – what do quantitative indicators tell us?

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Identifying systemic institutions has developed into a key policy priority in the wake of the global financial crisis. The Basel Committee on Banking Supervision has developed global standards on systemically important banks (SIBs), and the implementation of those standards in Europe requires national authorities to identify banks that are systemically important on a domestic level based on quantitative and qualitative analysis. However, developing such a methodology is a difficult task that involves several difficult choices. One such choice concerns whether, which and how quantitative indicators can be used to identify SIBs.

This paper seeks to offer some guidance on designing a methodology for identifying SIBs in a Swedish setting. Based on a quantitative approach, the paper investigates to what extent are various indicators of systemic importance complementing or substituting each other; the extent to which various simple and advanced indicators produce consistent indications of systemic importance; and whether opting for simple indicators in designing a methodology for identifying SIBs would suffice; or whether such a choice lead to a disregard of vital aspects of systemic importance.

We find that the four largest Swedish banks' systemic importance increased before the financial crisis and that systemic risk increased sharply during the crisis in 2008-2009. We also find that systemic importance remained elevated during the sovereign debt crisis while falling as tension eased in 2012. Thus, the findings show that banks' systemic importance based on the indicators varies substantially over time. However, the various indicators yield rather different results on the ranking of systemically important banks and seem to be complementary to a large extent. The policy implication is to simultaneously consider a multitude of indicators when seeking to identify and differentiate between systemically important banks. Regulatory authorities thus face a daunting task in balancing the trade-offs between simplicity, transparency and predictability on the one hand, and a more advanced approach that may better capture systemic risk, but with complexity and opaqueness as a side-effect, on the other hand.

JEL classification: G20; G28; J1

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Identifying systemically important banks in Sweden – What do quantitative indicators tell us?

IDENTIFYING SYSTEMICALLY IMPORTANT BANKS – A KEY OBJECTIVE

Identifying systemic institutions has developed into a key priority in the wake of the global financial crisis. This since the failure of a systemically important institution may disrupt both the financial system and economic activity. The disruptions to financial stability that became evident when seemingly non-systemic institutions failed was a stark reminder of the need for an *ex ante* view of which financial institutions may be or become systemic under certain circumstances. Likewise, the bail outs of institutions designated as systemic have led to large public expenses, socialized losses and arguably distorted market discipline for a considerable time to come.

In 2011, G20 mandated the global standard setter on banking regulation – the Basel Committee of Banking Supervision (BCBS) – to develop a framework to guide national authorities to address the policy problems associated with systemically important banks.¹ The following year, BCBS issued a range of principles for dealing with domestic systemically important banks (D-SIBs).² According to these principles, national authorities should establish a methodology for identifying systemic banks in a domestic context, and undertake regular assessments of the degree to which they are systemically important (principles 1 and 6).³ In a European context, the implementation of the global standard into community law (the so-called CRD IV Directive) requires national authorities to identify banks that are systemically important on a domestic level based on quantitative and qualitative analysis.⁴

In Sweden, authorities have not formally designated any financial institution as systemically important to date. Nor have they announced any formalized methodology of identifying systemic institutions. However, in various policy statements and in the regulatory debate, the four largest Swedish banking groups are often implicitly or explicitly regarded as systemically important.⁵ When the Ministry of Finance, the Riksbank and the supervisory authority announced their intention to make the four largest banking holding companies subject to higher capital requirements than other banks, the authorities pointed to four circumstances that motivate stricter rules: A large banking sector in comparison with the domestic economy; significant cross-border operations that make resolution

¹ See G20 (2011).

² For the full set of principles, see BCBS (2012).

³ BCBS's framework for D-SIBs is considerably less prescriptive than its framework for global systemically important banks. National authorities seeking compliance with BCBS standards are thus given more flexibility in designing a framework for identifying D-SIBs.

⁴ Capital Requirements Directive IV Art. 124 a-c. It is also noteworthy that certain European countries—such as Switzerland, the UK and Denmark—already have implemented such methodologies.

⁵ See, for instance, the various statements issued by the Ministry of Finance, the supervisory authority and the Riksbank when the higher capital adequacy requirements for the four major Swedish banking groups were announced (Finansinspektionen 2011; Sveriges Riksbank 2011a; 2011b etc.). In these announcements, it is explicitly recognized that the higher capital adequacy does include the supplement for systemic importance developed by the Basel Committee and the Financial Stability Board.

cumbersome; a highly concentrated banking system where the financial services provided by an individual bank cannot be easily substituted; and extensive reliance on short term funding, particularly in foreign currencies. Taken together, the authorities argued that these circumstances imply significant social costs in the case of one or more of the large Swedish banks run into difficulties.⁶ In other words, these circumstances contribute to financial institutions' systemic importance.

CAN QUANTITATIVE INDICATORS OFFER GUIDANCE?

Adopting such a purely judgment-based methodology to identify systemically important banks (SIBs) may be attractive in that it offers the authority responsible for finance stability a large degree of flexibility to designate any banks as systemically important. It also reduced the risk of relying on indicators that fail to capture the complex concept of systemic risk. However, in the absence of quantitative indicators, the methodology may be prone to criticism of being subjective, arbitrary and unpredictable.

These shortcomings could to some extent be circumvented. Constructing simple indicators of systemic importance on the basis of the four above circumstances (i.e. a large banking sector, significant cross-border operations, a highly concentrated banking system and extensive reliance on short term funding) is a relatively straightforward task. The indicators would use accounting data to serve as proxies for systemic risk, such as the size of banks or concentration in important markets (e.g. lending or deposit taking). Such simple indicators are attractive in that they are intuitive, relatively easy to implement in practical regulatory policy, and easily explained to legislative bodies and the public.⁷ It however raises the question whether such a methodology would encompass sufficient indicators to capture the multifaceted and complex concept of systemic importance – simple accounting-based indicators are intrinsically backward-looking and perhaps provide a deceptive and too simplistic view of the extent to which banks contributes to systemic risk.⁸

One option would be to complement the methodology with some indicators that seek to identify SIBs by using an approach that is more forward looking in that they are based on market data, and more clearly related to economic theory. Such advanced indicators of systemic importance are attracting considerable interest from both the academic community and from policy makers. In principle, these advanced indicators measure systemic risk by relying on elaborate statistical techniques and econometric calculations typically using valuations from financial markets. Thus, these techniques are designed to harvest the markets perception of the financial institutions' systemic importance. While these approaches produce indicators that may be more forward looking and founded in economic theory, they are also fraught with a number of weaknesses that make them

⁶ See for instance Sveriges Riksbank (2011b) for a discussion.

⁷ For these reasons or others, a number of policy bodies and regulatory authorities have advocated or deployed simpler indicators as a basis for identifying systemically important financial institutions (c.f. IMF, FSB and BIS (2009); Swiss Commission of Experts (2010); Committee on Systemically Important Financial Institutions in Denmark (2013) etc.).

⁸ For a discussion on the weaknesses of simple indicators, see Bisiás et al. (2012).

problematic and/or cumbersome from a policy perspective. Most notably, valuations on financial markets may not be available for all financial institutions. Also, measures of systemic importance derived from valuations on financial markets may be distorted by e.g. explicit and implicit state guarantees. If market actors anticipate future bail outs of systemically important banks, this will be reflected in the pricing of those banks' assets (e.g. stock prices) and debt which in turn will affect the market based measures of systemic importance.

Depending on the set-up of the methodology to identify (and regulate) SIBs, market participants may be provided incentives to influence indicators through market manipulation.⁹ Taken together, systemic importance is a multifaceted concept that in fact may be hard to estimate using quantitative approaches.

DESIGNING A METHODOLOGY FOR IDENTIFYING SIBS INVOLVE TRADE-OFFS

Policy makers thus face a difficult choice in designing a methodology for identifying SIBs. In essence, policy makers should strive for a methodology that encompasses sufficient indicators to capture the multifaceted and complex concept of systemic importance, while at the same time retaining simplicity. This raises important questions regarding the indicators of systemic importance:

- To what extent are various indicators of systemic importance complementing or substituting each other?
- To what extent do the various simple and advanced indicators produce consistent indications of systemic importance? Are those indicators stable over time and under changing conditions?
- Would opting for simple indicators in designing a methodology for identifying SIBs suffice? Or does such a choice lead to a risk of disregard of vital aspects of systemic importance?

This paper seeks to offer some guidance on designing a methodology for identifying SIBs in a Swedish setting. Following an overview of the rapidly evolving literature on advanced indicators of systemic importance (section 2), the paper accounts for the methodological approach, including the choice of indicators and the data used to calculate them (section 3). This is followed by empirically investigating the explanatory power of the simple indicators on the advanced indicators in a Swedish setting (section 4). The paper concludes by discussing the policy implications of the results (section 5).

The findings are that banks' systemic importance, based on the indicators, are highly correlated and tends to vary substantially over time. In addition, the various indicators yield different results on the ranking of systemically important banks, even though each indicator provides a rather constant ranking over time. Thus, the various indicators of systemic importance seem to be complementary to a large extent. The policy implication is

⁹ For a comprehensive discussion on the pros and cons of market based indicators, see IMF, BIS and FSB (2009).

to simultaneously consider a multitude of indicators when seeking to identify and possibly differentiate between systemically important banks. These policy implications could be considered in the future implementation of BCBS's D-SIB standards and the CRD IV in Sweden.¹⁰

Identifying systemically important banks and measuring systemic risk

The concept of systemically important banks is well founded in the academic literature on financial stability. Yet, following a number of bank failures with wide-ranging repercussions on the financial system and a number of bank rescues (some of which still plague public finances in many countries) during the global financial crisis, interest in the topic has soared. And the body of research devoted to measuring systemic importance and identifying systemically important banks has expanded rapidly.

While it is widely recognized that systemic importance derives from systemic risk, agreement on how to measure systemic risk is still remote.¹¹ After all, systemic risk is a multifaceted phenomenon that may arise from different sources and spread through various channels.¹² Consequently, a disparate range of measures have been proposed by the academia. To provide an overview of the research field, we adopt the common way of distinguishing between methods that measures the vulnerability of separate banks and measures that estimates the vulnerability of the financial system to measure systemic risk (cf. Drehmann and Tarashev 2011).

METHODS THAT ASSESS THE VULNERABILITY OF INDIVIDUAL BANKS

One possibility is to measure the vulnerability of particular financial institutions to system-wide distress. This means that the impact of a systemic shock on individual banks is calculated. Examples include the Marginal Expected Shortfall (MES) of Acharya et al. (2010), which measures a financial institution's expected loss when the market falls below some predefined threshold over a given time horizon. Another example is the Systemic Risk Measures (SRISK) of Brownless and Engle (2011) and Engle, Jondeau and Rockinger (2012). SRISK-measures estimates the expected capital shortfall of a financial institution, conditional on a crisis occurring.

Adrian and Brunnermeier (2011) proposes a conditional Value-at-Risk¹³ (VaR) approach (ΔCoVaR), that can be used to calculate the VaR of banks under the condition that the financial system is under stress ($\Delta\text{CoVaR-Bank}$). Segoviano and Goodhart (2009) introduce

¹⁰ For instance, the European Capital Requirements Directive (CRD IV) articles 124a provides guidance but also offers leeway to national authorities in identifying SIBs and making them subject to additional capital requirements.

¹¹ In fact, a universally accepted definition of systemic risk is also missing (c.f. Bisiás et al. 2012).

¹² For a discussion, see Bisiás et al. 2012.

¹³ The Value-at-Risk (VaR) is a threshold value expressing the minimum loss for a given time period with some small probability. Thus, a 5 per cent VaR of 100 million SEK for a period of five days expresses that there is a 5 per cent probability that losses will exceed 100 million SEK during a period of five days.

a measure that captures dependencies among banks' probabilities of default through linear and non-linear dependencies between banks in the banking system as a whole. A final example is Brunnermeier, Gorton and Krishnamurthy (2011), who unlike the above methods include the liquidity position of banks to assess impact on system-wide net liquidity in systemic risk. Taken together, these methods are useful for understanding the vulnerability of a particular financial institution to systemic shocks, but they do not capture how distress in that institution impacts on the system.

METHODS FOR ASSESSING THE VULNERABILITY OF THE FINANCIAL SYSTEM

Besides the methods described above, there exist methods that capture how important a particular financial institution is for the system as a whole. Conceptually, such methods calculate the impact on the financial system contingent on a particular financial institution in distress. For example, Acharya, Engle and Richardson's (2012) capital shortfall approach measures the maximum monetary loss of the system that can be expected to occur with some small probability, conditional on a particular financial institution being in a distressed state. Billio et al (2012) proposes a Granger causality test to examine whether the development of a bank's stock price may be useful in forecasting developments in another bank's share price. The existence of such a causality could be a sign that there is a connection between banks that can cause contagion. The more contagion a bank can cause, the more important the bank is.

There are also other approaches that look into how individual institutions contribute to system-wide stress through network effects (c.f. Upper 2011; Allen Babus 2009; Chan-Lau et al. 2009; Billio et al. 2010) or various forms of interconnectedness and joint probabilities of default (Segoviano and Goodhart 2009; Gieseke and Kim 2009; Fender and McGuire 2010; Lucas et al. 2013). The systemic contingent claim analysis of Gray and Jobst (2010, 2011) extends the traditional risk-adjusted balance sheet model to determine the magnitude of systemic risk as well as the contribution of individual institutions to systemic (solvency) risk. Jobst (2012) describes a method that measures systemic risk by modeling system wide liquidity. The CoVaR-measure of Adrian and Brunnermeier (2011) can also be used in order to measure the VaR of the financial system, conditional on a particular bank being in distress (Δ CoVaR-System). In addition, tools derived from multivariate extreme value theory can also be adopted into measures financial institutions' contribution to systemic risk (see Hartmann et al. 2006)

While the various approaches are complementary in measuring systemic risk, it is also noteworthy that several approaches can be calculated to encompass systemic risk both through the vulnerability of individual banks and the system as a whole (c.f. Segoviano and Goodhart 2009; Adrian and Brunnermeier 2011).

In the following section, we account for how a selection of the above indicators, and a number of other more simple indicators, were calculated for a number of Swedish banks. Thereafter, in Section 4, we empirically investigate the questions set out in the introductory section.

Methodology and data

To analyze whether there are any useful proxies for systemic importance, we calculate and compare a number of indicators for the four largest Swedish banks (Svenska Handelsbanken, Nordea, SEB and Swedbank). We adopt a terminology where we distinguish between simple and advanced indicators. Simple indicators are based on recent policy statements by regulatory authorities and the Riksbank, and cover a number of structural characteristics of the Swedish banks and financial markets (see Section 1). The advanced indicators stem from academic research (discussed in Section 2) and are based on more sophisticated statistical techniques, designed to summarize financial institutions systemic risk in a single measure.

Below, we discuss the rationale for our choice of indicators and how they relate to the concept of systemic risk (technical details on how they are calculated are provided in Annex A). Thereafter, we describe the econometrics used to determine whether and which of the simple indicators that can be considered useful proxies for systemic importance measured by the advanced indicators. Finally, we outline the data sources used and data characteristics.

SIMPLE INDICATORS

To identify a range of simple indicators, we draw upon a number of circumstances in the Swedish banking sector that Swedish authorities repeatedly have highlighted in discussions on systemic banks and the vulnerability of the Swedish banking system.¹⁴ Below, we list these factors and the corresponding simple indicators developed to capture the risks the factors give rise to (for a more detailed description of the simple indicators, see Table 2 below). It is important to note that the relationship between simple indicators and systemic importance varies; indicators that relate to a large banking sector, significant cross-border operations and the concentration of the banking system signals increasing systemic importance. However, the indicators on reliance on short term funding are formulated so that they should have a negative relation to the measures of systemic importance that consider the vulnerability of individual banks. In other words, a bank should be less vulnerable to system-wide distress if it relies on domestic deposits or other stable sources of funding, or if it has larger liquidity reserves.

¹⁴ See, for instance, Sveriges Riksbank (2011); Finansinspektionen (2011) and Ministry of Finance (2008).

Table 1. Selection of simple indicators based on circumstances in the Swedish banking sector

BANKING SECTOR CIRCUMSTANCES	SIMPLE INDICATORS
A large banking sector in comparison with the domestic economy	Total assets
Significant cross-border operations that make resolution cumbersome	Total assets
A highly concentrated banking system where the financial services provided by an individual bank cannot be easily substituted	Domestic deposit taking Domestic lending* Market share – government bonds Market share – mortgage bonds Market share – futures and forwards Market share – foreign exchange
Extensive reliance on short term funding, particularly in foreign currencies	Domestic deposit taking/equity (negative) Stressed liquidity reserve (negative)** Structural liquidity (negative)***

* We proxy domestic lending with company level lending to attain comparable time series.

** The Riksbank's measure of a bank's stressed liquidity reserve is used as a proxy for the Liquidity Coverage Ratio.

*** The Riksbank's measure of a bank's structural liquidity is used as a proxy for the Net Stable Funding Ratio.

It is noteworthy that the identified simple indicators correspond closely to those suggested by the conceptual framework developed by BCBS (2012) to identify D-SIBs.¹⁵ Annex B outlines the developments in the simple indicators for the sample banks for the period 2005–2012.

ADVANCED INDICATORS

From the numerous advanced approaches to measure systemic importance of banks outlined in Section 2, we have used the following measures: the Marginal Expected Shortfall (MES) of Acharya et al. (2010), the Systemic Risk Measure (SRISK) of Brownless and Engle (2011) and Acharya, Engle and Richardson (2012), the Delta Conditional Value-at-Risk (Δ CoVaR) of Adrian and Brunnermeier (2011) and the Granger causality measure proposed by Billio (et al. 2012). The choice of these measures is based on their high impact on the academic and policy debate. Also they can all be estimated using public data. While all except the Granger causality measure are theoretically related (see Benoit et al. 2012 for a detailed discussion), these indicators measure somewhat different aspects of systemic risk.

As mentioned in Section 2, the *MES-measure* corresponds to a financial institution's expected loss when the market falls below some predefined threshold over a given time horizon.¹⁶ The underlying notion is that the institutions with the highest MES contribute the most to market declines. As such, banks with the highest MES are the greatest drivers of systemic risk. In the subsequent analysis, we calculate three different versions of the MES. The first version – MES 1 – defines the threshold (i.e. the distressed

¹⁵ According to BCBS's standard on D-SIBs, national authorities are recommended to take the following measures into consideration when identifying domestically systemic banks: (a) Size; (b) Interconnectedness; (c) Substitutability/financial institution infrastructure (including considerations related to the concentrated nature of the banking sector); and (d) Complexity (including the additional complexities from cross-border activity) (BCBS 2012).

¹⁶ For a more detailed description of the MES measure, see Annex A.

region) as a 2 percent market decline during one trading day. This holds true also in the second version – MES 2 – but this version uses the banks' beta to alleviate the results from stochastic movements. MES 3 is an alternative measure that acknowledges the clustering of volatility in market returns and seeks to adjust for the fact that volatility in banks' capital levels tend to be correlated and clustered under certain periods.¹⁷

The SRISK-measure estimates the expected capital shortfall of a financial institution, conditional on a crisis occurring.¹⁸ In the SRISK measure, the intuition is that the financial institution with the largest capital shortfall will contribute the most to a crisis. Therefore it should be considered as the most systemically important. Just as for MES, we calculate three versions of SRISK. In the first version, SRISK 1, a crisis is defined as a situation where the market declines by at least forty per cent over a six-month period.¹⁹ The SRISK 2 uses the banks' beta to alleviate the results from stochastic movements, just like its MES counterpart. This also applies to the SRISK 3, which acknowledges the clustering of volatility in market returns and adjusts for the fact that volatility in banks' capital levels tend to be correlated and clustered under certain periods.²⁰

In the subsequent analysis, as was discussed, the third measure $\Delta\text{CoVaR-System}$ measures the contribution of a financial institution to systemic risk. It is calculated from the Conditional Value-at-Risk (CoVaR) which is analogous with the conventional Value-at-Risk (VaR). CoVaR-System measures the maximum monetary loss of the system that can be expected to occur with some small probability, conditional on a particular financial institution being in a distressed state. $\Delta\text{CoVaR-System}$ is simply the difference between the systems CoVaR when the financial institution is in its distressed state and when it is not.²¹

The CoVaR-System measure can be modified in order to measure the Value-at-Risk of financial institution, conditional on the system being in its distressed state (c.f. Adrian and Brunnermeier 2011). We denote this measure as $\Delta\text{CoVaR-Bank}$ and use it as a complement to the indicators discussed above.

The Granger causality test proposed by Billio et al. (2012) tests for pairwise causality between all the banks in a banking system, modeling the change in a bank's share price as a function of past changes in the bank's share price and past changes in another bank's share price. Granger causality is said to exist if previous changes to the other bank's share price is statistically significant in the model.²² In this paper, all pairwise combinations of banks are examined in this way.

17 See Brownless and Engle (2012).

18 For a more detailed description of the SRISK measure, see Annex A.

19 The definition of a crisis is based on the insights of Acharya et al. (2010).

20 See Brownless and Engle (2012).

21 For a more detailed description of the ΔCoVaR measure, see Annex A.

22 For a more detailed description of the Granger causality measure, see Annex A.

THE SELECTION OF INDICATORS

On reflection, it is notable that the indicators selected for the subsequent analysis adopt a somewhat differing concept of systemic risk. As discussed in Section 2, measures of systemic risk can be distinguished in terms of whether they estimate the impact on the financial system should a particular financial entity fail, or whether they seek to measure the sensitivity of any particular financial entity to stress in the financial system.

The simple indicators that relate to size and market shares in deposit taking, lending and market shares in markets for certain important financial instruments represent the former category. The simple indicators on the funding profile of the banks (domestic deposit taking /equity; stressed liquidity reserve (negative); structural liquidity (negative)), on the other hand, rather relate to the sensitivity of the bank in question to financial system stress. Likewise, whereas ΔCoVaR -System, SRISK and Granger causality measures the impact of an individual bank failure on the financial system, MES and ΔCoVaR -Bank indicates the sensitivity of individual institutions to financial system stress. In this respect, the selected indicators complement each other and enable a fuller picture of how different indicators of systemic stress relate to each other in the Swedish setting.

DATA DESCRIPTION

To analyze the relationship between the simple and advanced indicators, we define the system as the Swedish financial market. The simple indicators are calculated on a quarterly basis and cover the period 2005Q2-2012Q3.²³ The advanced indicators are estimated using daily market data covering the period April 6 1999 to November 21 2012. For these indicators, the stock market index OMXS30 is used as a proxy for developments in the Swedish financial system. We relate the advanced indicators of systemic risk to the simple indicators by calculating moving averages over 30 trading days, while using the last trading day per quarter as our measurement point.

Table 2 below provides an overview of the simple and advanced indicators, their definition in terms of how they are calculated and their data sources.

Descriptive statistics for the daily return series used to calculate the advanced indicators is provided in Table 3 below. It shows that the four largest Swedish banks' returns are more volatile than the index. Also, their returns exhibit considerable kurtosis while the skewness varies between banks. Thus, we choose to use the empirical distributions when calculating the advanced indicators and since the banks' minimum daily returns range between -20 and -10 per cent, it is possible that the use of the empirical distributions in order to calculate the ΔCoVaR -indicators will result in slightly different distress levels.

²³ For the stressed liquidity reserve and for the banks structural liquidity, we use comparable pairs of data covering the period 2005Q4-2012Q2. For missing observations, we interpolated between quarters to achieve a balanced data panel.

Table 2. Overview of the simple indicators and the advanced indicators

SIMPLE INDICATORS	DEFINITION	DATA SOURCE
Total assets	Total group level balance sheet assets in relation to GDP	Statistics Sweden
Domestic deposit taking	Market share of Swedish retail, non-financial corporations and public sector deposit taking	Statistics Sweden
Lending	Share of total company level lending to retail, non-financial corporations and public sector entities	The Riksbank
Market share – government bonds	Market share in Swedish government bond market total turnover	The Riksbank/Selma
Market share – mortgage bonds	Market share in mortgage bond market total turnover	The Riksbank/Selma
Market share – futures and forwards	Market share in futures and forwards total turnover	The Riksbank/Selma
Market share – foreign exchange	Market share in Swedish foreign exchange market total turnover	The Riksbank/Selma
Domestic deposit taking/equity	Swedish retail, non-financial corporations and public sector deposit taking as a percentage of bank equity	The Riksbank/Statistics Sweden
Stressed liquidity reserve	Liquidity reserves in relation to a stressed cash outflow (for details see Sveriges Riksbank 2010)	Liquidatum/The Riksbank
Structural liquidity	Stability of funding in relation to maturity of assets (for details see Sveriges Riksbank 2010)	Liquidatum/The Riksbank
ADVANCED INDICATORS	DEFINITION	DATA SOURCE
MES	The expected shortfall of a bank given that the system moves into distress	The Riksbank/Bloomberg
SRISK	The amount of capital a bank is expected to need given a financial crisis	The Riksbank/Bloomberg
ΔCoVaR-System	The bank's contribution to the systems VaR given that the bank becomes distressed	The Riksbank/Bloomberg
ΔCoVaR-Bank	The system's contribution to the bank's VaR given that the system becomes distressed	The Riksbank/Bloomberg
Granger causality	The effect on bank's share price as a function of past changes in the bank's share price and past changes in another bank's share price	The Riksbank/Bloomberg

Table 3. Descriptive statistics of the daily return series used to calculate the advanced indicators

	MEAN	STD.DEV	MIN	MAX	SKEWNESS	KURTOSIS
OMXS30	0.0002	0.0164	-0.0817	0.1037	0.1918	3.0342
Handelsbanken	0.0006	0.0194	-0.1018	0.1421	0.5174	5.3174
Nordea	0.0005	0.0228	-0.1149	0.1609	0.5549	5.0396
SEB	0.0005	0.0267	-0.2000	0.2613	0.5500	9.6145
Swedbank	0.0005	0.0248	-0.1856	0.1894	0.1955	7.8460

Note. Based on daily market data covering the period April 6 1999 to November 21 2012.

In the following section, we account for the results of the analysis. We begin by outlining developments in the advanced indicators in 2005-2012. Thereafter, relations between the simple and advanced indicators are described and discussed.

Systemic importance of Swedish banks

DEVELOPMENTS IN SYSTEMIC IMPORTANCE OF SWEDISH BANKS

The rankings and developments in the advanced indicators between 2005 and 2012 for the sample of large Swedish banks are depicted in Figure 1 and Figure 2 below.²⁴ The following observations are notable:

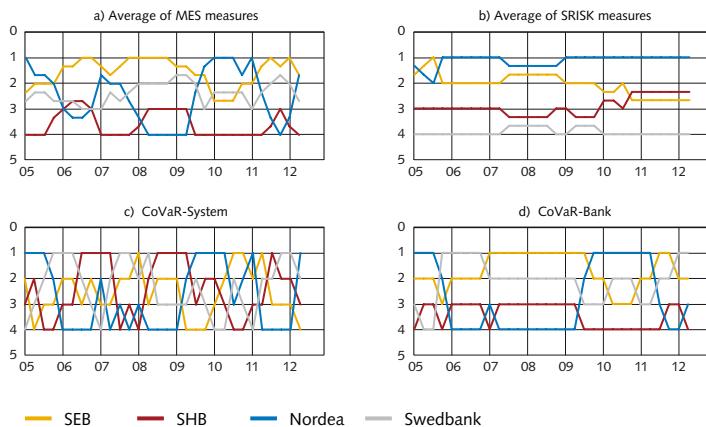
- The systemic importance of banks according to the advanced indicators varies considerably over time. It is notable that all advanced indicators but SRISK indicated that systemic risk increased in 2006 as the crisis approached. All indicators increase sharply as the crisis became fully fledged in 2008–2009. They increased again in 2011 as the Sovereign debt crisis took hold, and subsequently fell as tension eased in 2012. The increase in systemic risk during periods of market stress stems partly from our choice of estimation which effectively allows the banks' market risk to vary over time.²⁵ Thus, if the market perceives a bank more risky during time of distress, this will be reflected in the advanced indicators of systemic importance.
- The degree to which systemic importance differs between the individual banks is also noteworthy. The MES, Δ CoVaR-Bank and Δ CoVaR-System indicates that the systemic importance of the four banks is rather similar over the period. However, based on the SRISK indicators, Nordea becomes far more systemically important than its peers from 2008 and onwards. This deviation from the other banks' systemic importance may be attributed the rapid growth in Nordea's liabilities relative the other Swedish banks during the same time period.
- The advanced indicators tend to rank the banks in the sample rather differently. For example the SRISK-indicator ranks Nordea as far more systemically important than its peers, especially from 2008 and onwards. According to the MES and Δ CoVaR-Bank indicators, SEB is the most systemically important bank for the time period. However, according to the Δ CoVaR-System indicator, SEB frequently ranks as the least systemically important bank in the sample, even though the level of the difference between the banks is small. Handelsbanken ranks low according to all indicators but the Δ CoVaR-System. This could be interpreted as the bank being rather insensitive to systemic shocks, while the system tends to be dependent on the viability of the bank. In other words Handelsbanken tends to alleviate adverse market developments better than its Swedish peers, possibly due to the bank's decentralized decision making structure (see Holmberg et al. 2012).
- While the ranking of banks varies across the advanced indicators, each provides a rather constant ranking over time. MES, SRISK and Δ CoVaR-Bank maintains a stable ranking of the banks over time (with a limited number of exceptions). The ranking

²⁴ See Figure B1 in Annex B for an outline of developments in the simple indicators for the sample banks 2005–2012.

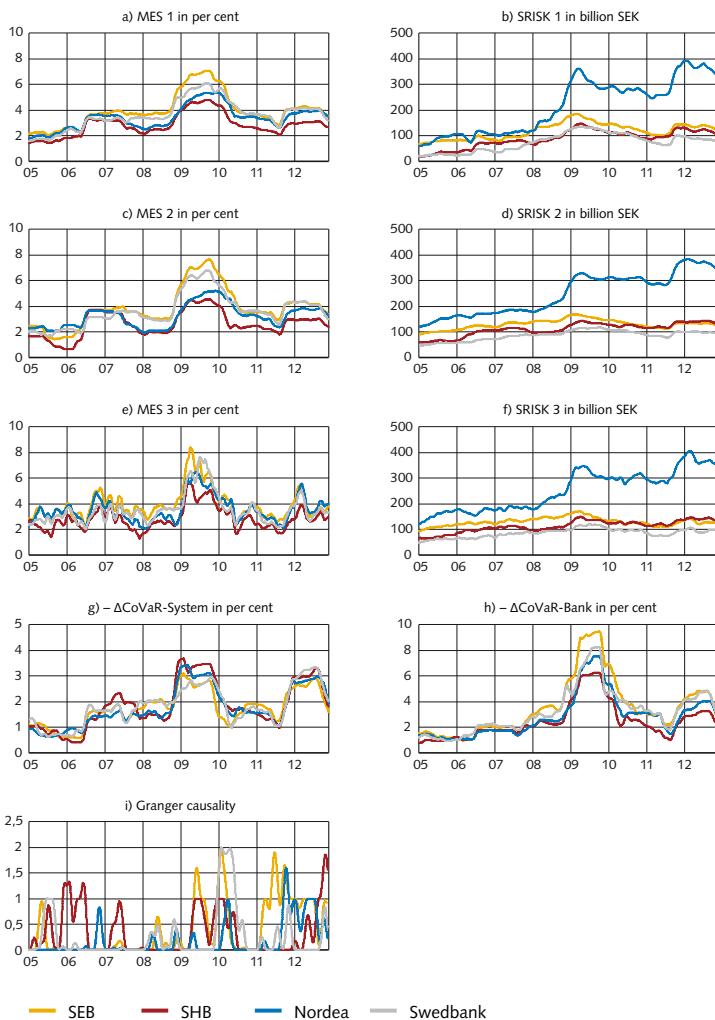
²⁵ See Annex A for details of the estimation techniques.

according to Δ CoVaR-System, on the other hand, varies considerably between 2005 and 2012. This is probably attributable to the small difference between banks in the estimated value of the Δ CoVaR-System indicator such that the rankings are within the error margins. The exception is the Granger measure. According to this indicator, each of the four banks is the most systemically important bank at least one point in time between 2005-2012.

Figure 1. Ranked systemic importance of the advanced indicators



Note. The higher the ranking the larger the systemic risk.

Figure 2. Thirty day moving averages of the advanced indicators 2004-2012

Note. For illustrative purposes, the figures on $\Delta\text{CoVaR-System}$ and $\Delta\text{CoVaR-Bank}$ indicators show the negative outcome of the calculations.

RELATING THE SIMPLE INDICATORS TO THE ADVANCED INDICATORS

We begin studying the relationship between simple and advanced indicators by investigating their correlation. Table 4a below displays the pooled correlations between the indicators, where significant results are highlighted in bold. It shows that only total assets and deposit taking provides consistent signs of the correlation coefficient.²⁶ Total assets, market share in government, mortgage bonds and foreign exchange are all associated with a larger degree of systemic importance according most of the advanced indicators. The same applies to structural liquidity, even though the correlation between structural liquidity

²⁶ We pair observations quarterly in order to get balanced panels. All results are based on standardized variables.

and most vulnerability measures relating to individual banks (MES and $-\Delta\text{CoVaR-Bank}$) are non-significant. However, deposit taking is associated with lower systemic risk across all advanced indicators, which is consistent with expectations. For all other simple indicators, the correlation displays variation from positive to negative across the advanced indicators.

Table 4b displays the ranked correlations of the simple and advanced indicators. It is striking that several advanced indicators display significant ranked correlations with the simple indicators. This is particularly noteworthy for the different variations of MES and SRISK, which display significant correlation with between 5 and 7 of a total of 10 simple indicators. However, the only simple indicators with a consistent sign of the correlation coefficient across all advanced indicators are size, deposit taking, market share in mortgage bonds and stressed liquidity reserve. In the case of deposit taking, the sign is negative, which suggest that those banks that rely on deposit taking tend to be less systemically important. For all other simple indicators, the direction of correlation varies across the advanced indicators. However, market share in government bonds, futures and forwards and foreign exchange display a strong tendency of displaying a positive ranked correlation with most advanced indicators (all but $-\Delta\text{CoVaR-System}$).

However, the ambiguity of the relationship between the advanced indicators and the simple indicator in Table 4 may be a consequence of the linear relationships of the simple correlation matrix being highly influenced by bank specific effects. As such, the simple correlations in table 4 may over- or underestimate the dependence between the advanced and simple indicators. Furthermore, since numerous of the simple indicators are highly correlated (see Annex B), we asses statistical significance through panel data regressions models with fixed effects for each pair of normalized variables.²⁷ The results from the paired panel data regression are displayed in table 5 below, were bold text indicates significance and grey text non-stationarity.²⁸

²⁷ Note that the paired panel data regressions may result in omitted variable bias. However, since we are interested in the direct relationship between the simple and advanced indicators, we ignore this issue in favor of more clearly interpretable results.

²⁸ In general, there is a large discrepancy between the estimated within-group and between-group coefficients of determinations; suggesting that the pooled correlations in table 4 fit the data poorly.

Table 4a. Pooled correlations between the advanced and simple indicators

	MES 1	MES 2	MES 3	SRISK 1	SRISK 2	SRISK 3	-ΔCOVAR-SYSTEM	-ΔCOVAR-BANK	GRANGER
Total assets	0.07	0.12	0.12	0.97***	0.90***	0.98***	0.16*	0.11	0.05
Deposit taking	-0.16*	-0.18**	-0.14	-0.45***	-0.43***	-0.44***	-0.06	-0.16*	-0.24***
Lending	-0.13	-0.10	-0.02	0.84***	0.70***	0.85***	-0.02	-0.09	-0.06
Gov. bonds	0.16*	0.16*	0.16*	0.33***	0.35***	0.33***	-0.01	0.12	0.24***
Mortg. bonds	0.40***	0.40***	0.33***	0.05	0.13	0.04	-0.01	0.31***	0.08
Futures and forwards	0.08	0.13	0.10	-0.15*	-0.11	-0.15	-0.09	0.09	0.02
Foreign ex.	0.03	0.10	0.11	0.33***	0.32***	0.34***	-0.04	0.05	0.09
Deposit taking/equity	-0.07	-0.10	-0.13	-0.84***	-0.73***	-0.84***	-0.01	-0.08	-0.09
Stressed liquidity reserve	0.22**	0.19**	0.11	-0.11	-0.04	-0.13	0.10	0.13	0.06
Structural liquidity	0.13	0.09	-0.01	0.22**	0.21**	0.20**	0.09	0.05	0.17*

Significance codes: '***':1%, '**':5%, '*':10%. Significant results are highlighted in bold.

Table 4b. Pooled ranked correlations between the advanced and simple indicators

	MES 1	MES 2	MES 3	SRISK 1	SRISK 2	SRISK 3	-ΔCOVAR-SYSTEM	-ΔCOVAR-BANK	GRANGER
Total assets	0.13	0.19**	0.21**	0.97***	0.79***	0.97***	0.14	0.17*	0.08
Deposit taking	-0.14	-0.17*	-0.16*	-0.61***	-0.55***	-0.61***	-0.06	-0.15*	-0.26***
Lending	-0.32***	-0.33***	-0.19**	0.56***	0.28***	0.58***	-0.10	-0.29***	-0.13
Gov. bonds	0.20**	0.17*	0.17*	0.29***	0.30***	0.28***	-0.00	0.10	0.11
Mortg. bonds	0.31***	0.33***	0.28***	0.03	0.15	0.00	0.02	0.23**	0.06
Futures and forwards	0.04	0.08	0.08	0.06	0.07	0.07	-0.01	0.07	0.06
Foreign ex.	0.07	0.12	0.13	0.48***	0.38***	0.49***	-0.03	0.05	0.10
Deposit taking/equity	-0.14	-0.15*	-0.18*	-0.80***	-0.66***	-0.80***	0.03	-0.11	-0.16***
Stressed liquidity reserve	0.24**	0.24**	0.14	0.08	0.13	0.06	0.15	0.20**	0.10
Structural liquidity	0.21**	0.16	0.04	0.35***	0.30***	0.31***	-0.03	0.09	0.22**

Significance codes: '***':1%, '**':5%, '*':10%. Significant results are highlighted in bold.

The first conclusion is that size matters. Not only does an increase in the banks' total assets increase systemic risk (according to MES, SRISK and -ΔCoVaR-System indicators); an increase in total assets also tends to increase the banks' sensitivity to systemic shocks (-ΔCoVaR-Bank). All these results are significant. The results also show that deposit taking/equity has a significant and negative relation to systemic risk according to all advanced indicators but -ΔCoVaR-System. The same applies to market share of deposit taking for all

advanced indicators but MES 3, where significance is missing. For other simple indicators, evidence is more mixed. Lending, market shares in government bonds, mortgage bonds and foreign exchange, as well as stressed liquidity reserve, display significant relationships for between two and five advanced indicators. The only simple indicators merely demonstrating one significant relationship is structural liquidity (for the Granger causality indicator).

Approaching the results with the advanced indicators as a basis, one observation is that six of the ten simple indicators have a significant correlation with the Granger causality indicator when controlling for fixed bank effects. However, the direction of the relationship varies and three simple indicators have a positive relationship to both SRISK indicators (total assets; market share in government and mortgage bonds; structural liquidity) and three a negative one (deposit taking; market share in futures and forwards; deposit taking/equity). This result can be explained for deposit taking/equity since a higher rate of deposit funding should make a bank less prone to failure. However, a higher market share in deposit taking should make a bank more systemically important. Hence, the negative relationship to advanced indicators is somewhat harder to explain. For the other advanced indicators, between two and four simple indicators have significant relationships, albeit with different signs for the correlation (both positive and negative). The exceptions are the SRISK indicators with between six and seven significant relationships with simple indicators. However, since these results may be spurious due to non-stationarity (see further below) they should be interpreted with caution.

Another observation is that the structural liquidity indicator has only one significant relationship with the advanced indicators while the stressed liquidity reserve has none. The structural liquidity indicator has a significant positive relationship with the Granger causality indicator, a measure reflecting the interconnectedness of banks. This result is somewhat hard to interpret since one would expect a bank with higher structural liquidity to be less prone to transmit stress through the financial system. However, since the banks' structural liquidity reserves and their total assets are correlated and historically move in tandem (see Annex B), this result may stem from omitted variable bias. Indeed, by controlling for size the relationship turns negative and loses its significance.²⁹

ADJUSTING THE RELATIONSHIP BETWEEN SIMPLE AND ADVANCED INDICATORS FOR TRENDS

A closer comparison of the developments in simple indicators and the advanced indicators reveals that some paired panel data regressions produce non-stationary residuals thus making the results unreliable (see Granger and Newbold 1974). It is evident from the results in Table 5 denoted in grey text that this merely concerns the various SRISK measures. For these indicators we thus proceed with paired panel data regressions on the first differences. From Table 6, it is observable that the only simple indicator that remains significantly related to the SRISK measures is our measure of size (total assets).

²⁹ When controlling for size, as measured by total group level balance sheet assets in relation to GDP, the relationship between the Granger causality indicator and the stressed liquidity reserve is -0,12 and non-significant.

Table 5. Results from the paired panel data regressions with fixed effects. The over-all (left) and the within-group (right) coefficients of determinations are in the parenthesis

	MES 1	MES 2	MES 3	SRISK 1	SRISK 2	SRISK 3	-ΔCOVAR-SYSTEM	-ΔCOVAR-BANK	GRANGER
Total assets	0.88*** (0.25/0.13)	1.03*** (0.30/0.18)	0.61*** (0.17/0.06)	1.40*** (0.98/0.94)	1.77*** (0.94/0.89)	1.33*** (0.98/0.92)	1.27*** (0.23/0.23)	1.15*** (0.24/0.20)	0.59** (0.06/0.05)
Deposit taking	-0.43*** (0.19/0.06)	-0.37** (0.18/0.05)	-0.11 (0.12/0.00)	-0.34*** (0.73/0.11)	-0.43*** (0.55/0.11)	-0.28*** (0.75/0.08)	-0.31* (0.03/0.03)	-0.42** (0.10/0.05)	-0.63*** (0.13/0.12)
Lending	-0.55 (0.15/0.01)	-0.19 (0.14/0.00)	0.04 (0.11/0.00)	2.69*** (0.80/0.34)	2.94*** (0.61/0.24)	2.69*** (0.82/0.36)	0.05 (0.00/0.00)	0.05 (0.05/0.00)	-0.54 (0.02/0.00)
Gov. bonds	0.09 (0.15/0.01)	0.07 (0.15/0.00)	0.05 (0.12/0.00)	0.08 (0.71/0.02)	0.13* (0.51/0.03)	0.07 (0.73/0.02)	0.02 (0.00/0.00)	0.08 (0.06/0.01)	0.30*** (0.09/0.07)
Mortg. bonds	0.30** (0.19/0.05)	0.27** (0.18/0.04)	0.19 (0.13/0.02)	0.14** (0.71/0.04)	0.21** (0.52/0.04)	0.13* (0.73/0.03)	0.05 (0.01/0.00)	0.31** (0.10/0.05)	0.13 (0.02/0.01)
Futures and forwards	0.08 (0.14/0.00)	0.18 (0.15/0.01)	0.09 (0.12/0.00)	-0.07 (0.70/0.00)	-0.05 (0.49/0.00)	-0.06 (0.72/0.00)	-0.37* (0.03/0.03)	0.12 (0.05/0.00)	-0.36* (0.04/0.03)
Foreign ex.	-0.20 (0.15/0.01)	-0.09 (0.15/0.00)	-0.16 (0.12/0.01)	0.09 (0.70/0.01)	0.13 (0.50/0.01)	0.08 (0.72/0.01)	-0.02 (0.00/0.00)	-0.06 (0.05/0.00)	0.10 (0.01/0.00)
Deposit taking/ equity	-1.12*** (0.24/0.12)	-1.12*** (0.25/0.12)	-0.68** (0.15/0.04)	-0.47*** (0.72/0.06)	-0.77*** (0.54/0.09)	-0.40** (0.74/0.05)	-0.48 (0.02/0.02)	-1.31*** (0.19/0.15)	-1.46*** (0.18/0.17)
Stressed liq. reserve	0.12 (0.17/0.01)	0.06 (0.17/0.00)	-0.04 (0.11/0.00)	0.26*** (0.76/0.13)	0.30*** (0.56/0.09)	0.24*** (0.77/0.11)	0.23 (0.03/0.03)	0.03 (0.06/0.00)	-0.03 (0.02/0.00)
Structural liquidity	0.09 (0.17/0.01)	0.03 (0.17/0.00)	-0.07 (0.11/0.00)	0.07 (0.73/0.02)	0.07 (0.52/0.01)	0.04 (0.74/0.01)	0.11 (0.02/0.01)	0.03 (0.06/0.00)	0.17* (0.04/0.03)

Significance codes: '****':1%, '**':5%, *':10%. Significant results are highlighted in bold. Non-stationary results in grey.

Note. For comparison the regressions are based on first order differences on normalized data.

Table 6. Results from the paired panel data regressions with fixed effects on first differences. The over-all (left) and the within-group (right) coefficients of determinations are in the parenthesis

	SRISK 1	SRISK 2	SRISK 3
Total assets	1.13*** (0.72/0.70)	1.66*** (0.66/0.65)	0.88*** (0.37/0.35)
Deposit taking	0.01 (0.04/0.00)	0.02 (0.02/0.00)	-0.00 (0.03/0.00)
Lending	0.49 (0.06/0.02)	0.71 (0.04/0.01)	0.51 (0.05/0.01)
Gov. bonds	0.00 (0.04/0.00)	0.00 (0.02/0.00)	-0.01 (0.03/0.00)
Mortg. bonds	-0.00 (0.04/0.00)	0.01 (0.02/0.00)	0.00 (0.03/0.00)
Futures and forwards	-0.00 (0.04/0.00)	0.02 (0.02/0.00)	-0.05 (0.05/0.01)
Foreign ex.	0.03 (0.05/0.01)	0.04 (0.03/0.00)	-0.03 (0.04/0.00)
Deposit taking/ equity	0.08 (0.05/0.01)	0.03 (0.02/0.00)	0.01 (0.03/0.00)
Stressed liquidity reserve	0.02 (0.05/0.00)	0.03 (0.03/0.00)	-0.01 (0.04/0.00)
Structural liquidity	0.06 (0.06/0.01)	-0.01 (0.03/0.00)	0.06 (0.04/0.01)

Significance codes: '****':1%, '**':5%, *':10%. Significant results are highlighted in bold text.

Note. For comparison the regressions are based on first order differences on normalized data.

Discussion and policy implications

This paper has outlined a range of simple and advanced indicators for the Swedish banking system; compared whether these indicators yield similar assessments of systemic importance; and investigated to what extent these indicators produce consistent indications of systemic importance over time. The results show that the systemic importance attributed to each individual bank varies substantially across indicators. But while the various advanced indicators tend to rank the banks differently in terms of systemic importance, for most indicators the ranking tends to be relatively constant over time as depicted in Figure 1. This holds true regardless of whether the indicator is based on a concept of systemic importance that measures the impact of an individual bank failure on the financial system or the sensitivity of individual institutions to financial system stress. In addition, the indicators show a build-up of systemic risk during the years predating the financial crisis and a sharp rise in individual banks' systemic importance after the collapse of Lehman Brothers. The banks' systemic importance have remained at an elevated level and experienced an increase during the most intensive period of the European sovereign debt crisis. The banks' systemic importance tends to display similar patterns over time, with one exception. Based on the SRISK indicators, Nordea becomes far more systemically important than its peers from 2008 and onwards. A similar pattern is observable for the simple indicator that measures the size of individual banks (see annex B).

The findings of this paper indicate that:

- It is possible to quantitatively assess the banks in terms of their systemic risk. Thus, quantitative indicators can be used in combination with thresholds or simple scoring to distinguish systemic banks from non-systemic banks, or rank banks according to their systemic importance.
- The relatively large variation over time in terms of systemic importance points to the importance of avoiding a static approach to identifying systemic banks. Any approach to identifying systemic banks and differentiating between them, should use a dynamic approach, and carefully consider the appropriate frequency of the identification process.
- Identifying systemic banks merely using a single indicator could lead to premature or wrong conclusions. The results show that systemic importance is highly depending on the definitions and criteria used in the calculation of each indicator. Thus, any approach to identify systemic banks should take a multitude of indicators into account. A mixture of simple and advanced indicators would probably yield more useful results than relying merely on either of these types of indicators. However, taking too many indicators into account increases complexity. Besides, a formalized identification process does imply difficult choices in terms of what indicators to include, as well as deciding on the relative weight the different indicators should be assigned.

- The results also point to the difficulty of using a purely quantitative approach in identifying and differentiating between systemic banks. Given the large variation between banks and over time, using a (single or combined) scoring to identify systemic banks implies a lot of challenges. Not only because alternative important indicators may be omitted; also because it may yield a false sense of actually being able to correctly measure systemic risk. In practice, systemic risk is a complex and multifaceted concept, affected not only by bank-specific conditions but also by various feedback-loops between risks in various parts of the financial system and policy measures. Taken together this calls for a combination of quantitative and qualitative analysis (as proposed in the CRD IV) and a possible avenue for future research could be the development of methods that combine the informational content in each indicator into an index of systemic importance.

Taken together, these results suggest that regulatory authorities responsible for Financial stability face a daunting task in balancing the trade-offs between simplicity, transparency and predictability on one hand, and a more advanced approach that may better capture systemic risk, but with complexity and opaqueness as a side-effect on the other hand. Despite the difficult choices involved in developing a methodology for identifying systemically important banks, policy makers should not delay the process since such work could contribute to reducing systemic risk. The choice between doing something to cumber the externalities that stem from systemically important banks, even though it may suffer from shortcomings, and doing nothing because of the complexities involved should be an easy one.

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Annex

A. ADVANCED INDICATORS – TECHNICAL DESCRIPTION

Annex A discusses the advance indicators used in the analysis and presents the details regarding the estimation procedures. Since all advanced indicators are based on market data, we let r_t^i denote the daily stock return of bank i at time t .

The $\Delta CoVaR$ measures

The Value-at-Risk (VaR) of a bank's firm level risk is defined as the maximum potential loss that will not be exceeded over a given time horizon for some small probability (see Jorion 2007 for a survey) such that the daily VaR for the return r_t^i satisfies:

$$Pr\{r_t^i \leq VaR_{t,\alpha}^i\} = \alpha \quad (\text{A.1})$$

That is, with some small probability α , the bank experiences a negative daily return of less than $VaR_{t,\alpha}^i$. Following Adrian and Brunnermeier (2011) we denote $CoVaR_{t,\alpha}^{j|r_t^i \leq VaR_{t,\alpha}^i}$ as the VaR of bank j conditional on bank i being at its VaR level:

$$CoVaR_{t,\alpha}^{j|r_t^i \leq VaR_{t,\alpha}^i} = VaR_{t,\alpha}^j | r_t^i \leq VaR_{t,\alpha}^i \quad (\text{A.2})$$

Given the above, define $\Delta CoVaR$ as:

$$\Delta CoVaR_{t,\alpha}^{j|i} = CoVaR_{t,\alpha}^{j|r_t^i \leq VaR_{t,\alpha}^i} - CoVaR_{t,\alpha}^{j|r_t^i \leq median} \quad (\text{A.3})$$

The expression in equation (A.3) quantifies bank i 's contribution to bank j 's VaR when bank i moves from its 'normal' median level to its distressed VaR level. By replacing bank j with the financial system, equation (A.3) expresses systemic risk as measured by the indicator $\Delta CoVaR$ -System. By replacing i with the financial system, equation (A.3) expresses systemic risk as measured by the indicator $\Delta CoVaR$ -Bank.

In the analysis, the $\Delta CoVaR$ indicators are estimated using quintile regression and as a first step; the following relation is estimated:

$$r_t^i = \beta_{j,0} + \beta_{j,1}^{\alpha} r_t^j \quad (\text{A.4})$$

which gives the linear relationship between bank i and bank j 's stock returns at the quintile given by α . Given equation (A.4), $\beta_{j,1}^{\alpha}$ can be used in order to calculate bank j 's $CoVaR$:

$$CoVaR_{t,\alpha}^{j|i} = \beta_{j,0} + \beta_{j,1}^{\alpha} VaR_{t,\alpha}^i \quad (\text{A.5})$$

By combining equation (A.5) with equation (A.3), $\Delta CoVaR$ can be calculated. In the analysis, $\Delta CoVaR$ -System is calculated by replacing j with the financial system and $\Delta CoVaR$ -Bank is calculated by replacing i with the financial system. Both $\Delta CoVaR$ indicators are calculated using a 250 trading day rolling window such a bank's market risk is allowed to vary over time.

Marginal Expected Shortfall and SRISK

The Marginal Expected Shortfall (MES) is derived from Expected Shortfall (ES) which is given by the expected loss given that the VaR is exceeded:

$$-ES_{t,\alpha}^i = E_t[r_t^i | r_t^i \leq VaR_{t,\alpha}^i]. \quad (\text{A.6})$$

where E_t corresponds to the expectation conditioned on all available information up to time t . The MES utilizes this concept and measures the expected shortfall of bank i conditioned on the financial system j being in distress:

$$-MES_{t,C}^i = E_t[r_t^i | r_t^j \leq C], \quad (\text{A.7})$$

where C is some extreme negative quintile defining a market in distress. In the analysis, C is -2 per cent such that the MES is the one day expected loss given that market returns are less than -2 per cent

The *SRISK* measure of Brownless and Engle (2011) and Acharya, Engle and Richardson (2012) seek to quantify the Capital Shortfall (CS) of a bank, conditioned on the financial system moving into a distressed state. Given the book value of debt (D)³⁰, the CS of a bank is given by:

$$\begin{aligned} CS_t^i &= k \times D_t^i - (1-k) \times Eq_{t+\tau}^i \times E_t[r_t^i | r_t^j \leq C^*] \\ &= k \times D_t^i - (1-k) \times Eq_{t+\tau}^i \times LRMES_t^i, \end{aligned} \quad (\text{A.8})$$

where Eq is the financial firms market valued equity, C^* is the long run distressed state defining the Long Run Marginal Expected Shortfall ($LRMES$) and where k is a required percentage minimum of equity.³¹ In the analysis, we follow Acharya, Engle and Richardson (2012) and let C^* be a forty per cent market decline over a six-month period such that the $LRMES$ can be approximated with:

$$LRMES_t^i \approx 1 - \exp(-18 \times MES_{t,C}^i), \quad (\text{A.9})$$

³⁰ In the analysis we use linear interpolations between quarters to get daily measurements of the book value of debt.

³¹ In the analysis, k is assumed to be 8 per cent.

where MES is calculated in accordance with equation (A.7). $SRISK$ is then defined as:

$$SRISK_t^i = \max(CS_t^i, 0). \quad (\text{A.10})$$

In the analysis, we use different measures of the MES and $SRISK$. The differences between the measures spring from how a bank's MES is calculated and in the first measure, MES 1, we use a static approach and calculate a bank's MES by the means of equation (A.7) while utilizing the empirical distributions of r_t^i and r_t^j . For the second measure, MES 2, we smooth the estimates by utilizing that MES can be calculated from the banks' betas:

$$MES_t^i 2 = -\beta_t^i \times E_t[r_t^i | r_t^j \leq C], \quad (\text{A.11})$$

where $\beta_t^i = COV(r_t^i, r_t^j)/VAR(r_t^j)$ and where r_t^j represents return of the market (system). However, since financial returns tend to be clustered (see Engle, 1982) the third and final measure, MES 3, model returns as multivariate GARCH processes with dynamic conditional correlation as discussed in Engle and Sheppard (2001). Thus, the estimation procedure for MES 3 is close to the econometrics in Brownlees and Engle (2010) and Engle et al. (2012). Finally, the three MES measures are used together with equation (A.9) and (A.10) in order to retrieve their corresponding $SRISK$ measures. All MES indicators are calculated using a 250 trading day rolling window such a bank's market risk is allowed to vary over time.

The Granger Causality Measure

The systemic risk measure introduced by Billio et al (2012) use Granger causality tests to examine whether the development of a bank's stock price may be useful in forecasting developments in another bank's stock price. The argument used is that the existence of Granger causality could be a sign that there is connection between banks that can cause contagion. The more contagion a bank can cause, the more important the bank is.

Granger causality is a statistical notion of causality based on the ability of one variable to forecast the value of another variable. In terms of the notion above, r_t^i is said to Granger cause r_t^j if past values of r_t^i contain information that helps predict r_t^j above and beyond the information contained in r_t^j alone (Billio et al., 2012). In the analysis, we test for Granger causality by first specifying a bivariate $VAR(p)$ model, i.e. a vector auto regressive model of order p :

$$\begin{bmatrix} r_t^i \\ r_t^j \end{bmatrix} = \begin{bmatrix} \beta_0^i \\ \beta_0^j \end{bmatrix} + \sum_{k=1}^p \begin{bmatrix} \beta_{1,k}^i & \beta_{2,k}^i \\ \beta_{1,k}^j & \beta_{2,k}^j \end{bmatrix} \times \begin{bmatrix} r_{t-k}^i \\ r_{t-k}^j \end{bmatrix} + \begin{bmatrix} e_t^i \\ e_t^j \end{bmatrix}, \quad (\text{A.12})$$

where e_t^i and e_t^j are random error terms subject to the usual assumptions. Within the $VAR(p)$ framework, bank j is said to Granger cause bank i 's stock return if at least one of the parameters $\beta_{2,k}^i$ for $k = 1, \dots, p$ are statistically significant different from zero. In such

a case, previous values of bank i 's stock return have predictive power in determining the future value of bank j 's stock return and Granger causality is said to exist. By the same argument, if at least one of the parameters $\beta_{2,k}^{i,j}$ for $k = 1, \dots, p$ are statistically significant different from zero, bank i is said to Granger cause bank j 's stock return.

In the analysis, we determine the order of lags in the $VAR(p)$ by the means of Schwartz information criteria, restricting the order to a maximum of $p = 20$. All Granger causality tests are based on the 5 per cent significance level and the total number of statistically significant Granger causality tests is used as an indicator of systemic importance.

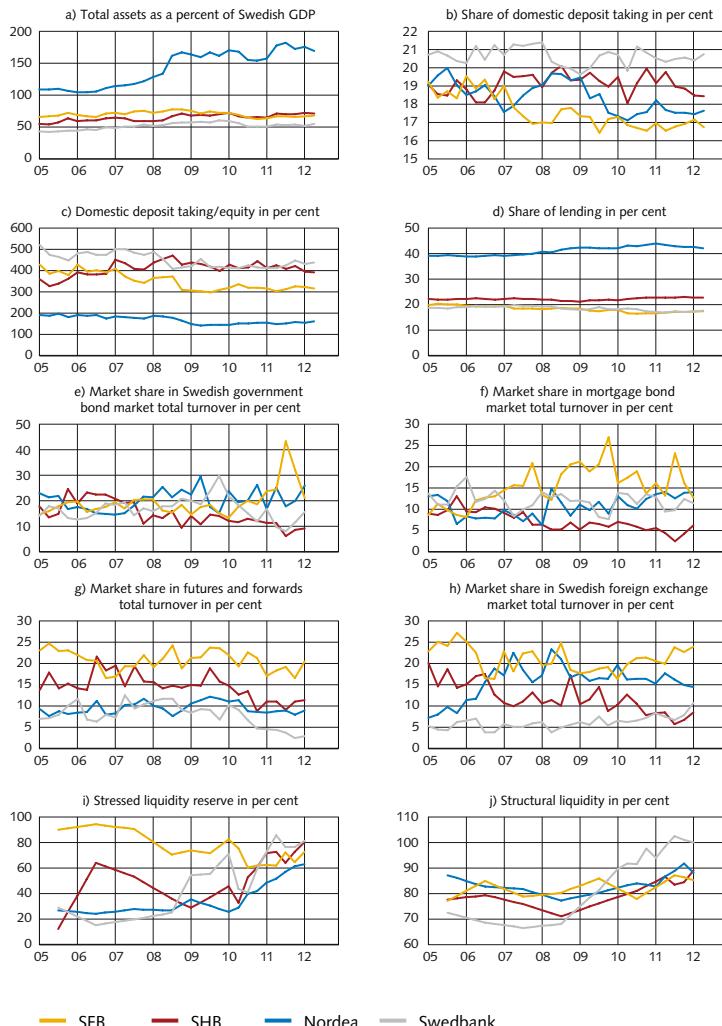
B. SIMPLE INDICATORS

Table B1. Correlations between the simple indicators

	TOTAL ASSETS	DEPOSIT TAKING	LENDING	GOV. BONDS	MORTG. BONDS	FUTURES AND FORWARDS	FOREIGN EX.	DEPOSIT TAKING/EQUITY	STRESSED LIQUIDITY RESERVE
Deposit taking	-0.41***								
Lending	0.93***	-0.22**							
Gov. bonds	0.34***	-0.29***	0.24***						
Mortg. bonds	-0.00	-0.35***	-0.19**	0.39***					
Futures and forwards	-0.20**	-0.57***	-0.36***	0.12	0.30***				
Foreign ex.	0.33***	-0.75***	0.16*	0.34***	0.30***	0.67***			
Deposit taking/equity	-0.90***	0.56***	-0.87***	-0.40***	-0.12	0.09	-0.46***		
Stressed liquidity reserve	-0.22**	-0.35***	-0.44***	0.01	0.29***	0.48***	0.37***	0.18*	
Structural liquidity	0.20**	-0.23**	0.11	-0.00	0.10	-0.22**	0.15	-0.30***	0.51***

Significance codes: ***:1%, **:5%, *:10%.

Note. For comparison the correlations are based on normalized data.

Figure B1. Developments in the simple indicators 2005-2012



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