Sveriges Riksbank Economic Review

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S V E R I G E S R I K S B A N K

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Dear readers,

This issue of the Riksbank's journal contains four articles describing the various consequences of globalisation and the financial crisis on price stability and financial stability.

The globalisation of trade and financial flows is a process that has been going on for a long time, which has an impact on the pricing of goods and services and on the functioning of the financial system. This certainly applies to Sweden, as the Swedish economy is very much affected by developments abroad.

- Auer, Fischer and Kropp analyse how producer prices in Sweden, Denmark and Finland have been affected by the increase in Chinese exports to these countries. They find that China's growing market share has contributed to dampening prices in the Nordic countries, what is known as a positive supply shock, and they discuss the possible implications of this fact for monetary policy.
- Eklund, Milton and Rydén describe how the Swedish banks fund their lending in Swedish krona (for instance, mortgages) by converting loans in foreign currency into Swedish krona on the currency swap market. They show how the currency swap market functions, the risks that can arise on this market and how these risks can be minimised.

In a short-term perspective the economies of many industrial nations still are weighed down by the repercussions of the recent global financial crisis and the sovereign debt crisis following in its wake. This raises a number of questions concerning the relationship between monetary policy and financial stability policy.

- Sellin and Åsberg Sommar describe the Riksbank's operational framework for implementing monetary policy and analyse how this system functioned during the financial crisis. The operational framework, which is designed to stabilise the interbank overnight rate, worked well during the crisis. At the same time, the financial crisis showed that there may be good reason for the Riksbank to add to its toolkit to be better equipped to meet financial shocks that affect interest rate-setting on other markets than the overnight market.
- Apel and Claussen focus on the recently much-discussed theory that low policy rates lead to banks and other financial institutions taking greater risks, that is, monetary policy also has an impact through a so-called risk-taking channel. They observe that there is international empirical evidence to support the theory that low interest rates lead to increased risk-taking. They also highlight several questions to which no clear answers have been provided in the research, and which require further investigation.

Read and enjoy!

Claes Berg, Joanna Gerwin and Kerstin Mitlid

Contents

The Riksbank attempts to influence interest rates in the economy so that the inflation target is met. In this article we describe how the Riksbank steers the risk-free overnight rate for interbank loans in practice. We present the instruments in the Riksbank's toolkit and how these are used to steer the overnight rate. We find that the Riksbank's operational framework for the implementation of monetary policy performs its task of stabilising the overnight rate well. However, we also show that the framework is not adequate to satisfactorily influence interest rates at longer maturities than overnight. Experience from the latest financial crisis has also demonstrated that the Riksbank should be well prepared to conduct monetary policy under extraordinary circumstances. In this context, there may be a need to add to the Riksbank's toolkit. There is also a need to continuously evaluate the operational framework.

The Riksbank began to evaluate its operational framework for the implementation of monetary policy in the spring of 2008. The financial crisis began shortly afterwards, which taught the Riksbank new lessons about how the framework functions. This article should thus be seen as a status report rather than as a final evaluation – especially considering that we are now in a situation in which the crisis measures taken by central banks abroad are still ongoing. Work is also underway on the regulation of the financial sector which may have consequences for the design of the operational framework.

The effects of monetary policy on the risks in the financial system are discussed intensively. One hypothesis that has attracted much attention is that monetary policy does not only act through the previously known channels, but also through a hitherto neglected channel – the risk-taking channel. According to this channel low policy rates lead banks and other financial institutions to take greater risks. In this article we conclude that there is international empirical support indicating that low interest rates result in greater risk-taking, but also that there are several questions that need to be analysed further. One question is to what extent it is monetary policy or the general level of interest rates that is significant for the bank's risk-taking. The general level of interest rates – the neutral real interest rate – is not determined by monetary policy. Another

question is to what extent a link between low interest rates and risk-taking is a sign that the banks are acting in a less responsible manner. It may well be optimal for a bank to increase its risk-taking when the interest rate is low. A third question is the role that the risk-taking channel played in the global financial crisis. If this crisis was partly due to individual banks taking excessively high risks – in the way that is implied by the risk-taking channel – the question arises why this was not detected by micro-prudential supervision.

The arrival of cheap goods: measuring the impact of Chinese import competition on Nordic prices

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ABSTRACT. What is the impact of Chinese import competition on Nordic producer prices? This article examines whether labor-intensive exports from China have an impact on inflation in three Nordic countries. In a panel covering manufacturing sectors from 1995 to 2008, the results show that when Chinese exporters capture 1% of Nordic market share, producer prices decrease by about 2.0%. This Chinese price effect, which entails a drop of 14% in producer prices for the analyzed sample, re-confirms the view that prices in small, open economies are highly susceptible to the dampening effect of low-wage imports. The policy implications of these trade forces are discussed.

1. Introduction

It is well documented that China is relatively abundant in low-skilled labor and exports a significant volume of labor-intensive goods to large economies such as Europe, Japan, and the United States. Numerous studies have therefore attempted to determine whether imports from China have held down inflation in these large economies.[4] Despite the observation that smaller economies tend to be more open to trade than larger economies, these empirical studies have not been able to rigorously examine whether Chinese import penetration has also dampened price growth in small, open economies.

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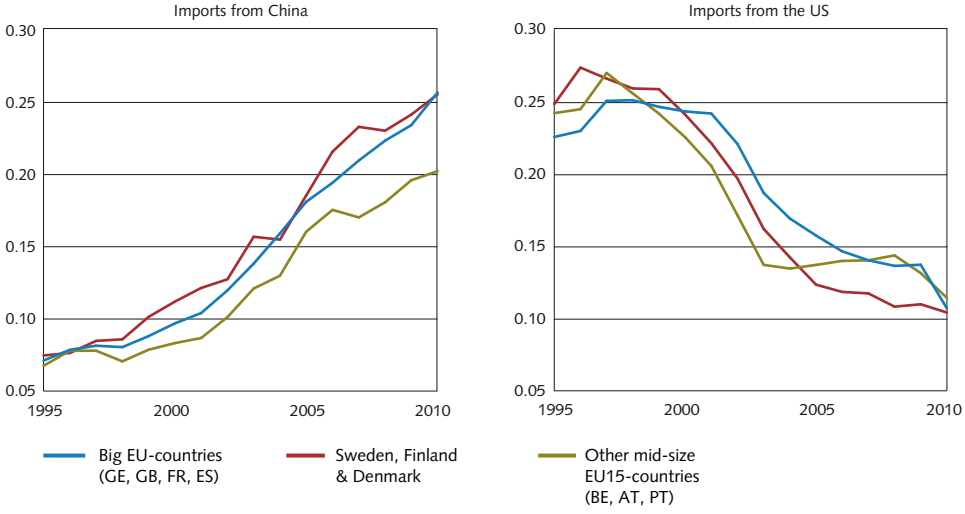
* The authors have benefited from comments from an anonymous referee. The views expressed in this article are solely the responsibility of the authors and should not be interpreted as reflecting the views of the Swiss National Bank.
4 Micro studies using 2- and 4-digit price data include Bugamelli et al. (2010) for Italy, WEO (2006) for Europe, Broda and Weinstein (2010) for Japan, Wheeler for the United Kingdom, and Auer and Fischer (2010) and Kamin et al. (2008) for the United States. Borio and Filardo (2007), Gamber and Hung (2001), Ihrig et al. (2007), Pain et al. (2006), and Tootell (1998) use conventional specifications of Phillips curves to determine the role of foreign output gaps on (aggregate) domestic inflation.

The Nordic region represents an exceptional case of Chinese import penetration, which is evident when we look at Figure 1. The left-hand side of Figure 1 plots the Chinese import share with respect to manufacturing output for three European regions: Nordic (Denmark, Finland, and Sweden – due to lack of data, Norway and Iceland are not included), large European countries (France, Germany, Italy, Spain, and the United Kingdom), and small European countries (Austria, Belgium, and Portugal). It shows that Chinese exports captured only 5% of the Nordic market share of non-EU trade in 1995 and that this percentage climbed steadily to above 25% in 2010. This market share for the three Nordic countries lies above Europe's share for the five largest countries for most of the period. More importantly, this increase in Chinese market share has primarily come at the expense of U.S. exports. The right-hand side of Figure 1 shows a near homogenous fall in U.S. export market share for the three European regions. With this switch from high-wage to low-wage imports, we ask what the impact of Chinese import competition is on Nordic producer prices.

Figure 1. Share of US- & China-imports on all Outside-EU15-Imports



Source: Eurostat.

This article focuses on manufacturing imports and documents the fact that Chinese trade has had a profound impact on Nordic inflation. We use an empirical strategy that assumes that Chinese trade is endogenous to domestic demand. It is therefore important to find a variable that affects Chinese exports to the Nordic countries without having an impact on inflation in these countries except through changes in Chinese exports. The challenge is to find a valid instrumental variable (IV). Our IV strategy follows Auer and Fischer (2010) and is based on the observation that when Chinese manufacturing output grows, Chinese exports to the Nordic region increase in labor-intensive sectors relative to capital-intensive sectors. Nordic imports of Chinese manufacturing products are heavily

concentrated in labor-intensive industries. Regression analysis shows that this specialization also holds at the margin: for example, when China's manufacturing output rises, Chinese exports increase much more in labor-intensive sectors than in capital intensive sectors.

Using this empirical strategy in a panel covering 23 manufacturing sectors from 1995 to 2008 (2-digit sectors classified by the European industrial classification system, NACE), we show that producer prices decrease by about 2.0% when Chinese exporters increase their market share in the Nordic countries by 1%. Because China gained a market share of 7% in the manufacturing sector over the analyzed period, the price effect translates into a 14% reduction in Nordic producer prices. This result re-confirms the view that prices in small, open economies are highly susceptible to the dampening effect of low-wage imports.

This article proceeds as follows: section 2 discusses the empirical framework and the data in the context of Chinese exports. Section 3 presents IV estimates of China's impact on (aggregate) Nordic producer prices. Section 4 offers concluding remarks on the effect of labor-intensive goods and their implications for inflation in small, open markets.

2. Empirical framework and data

The discussion of the empirical framework is presented in two subsections. The regression model and the IV strategy are discussed in subsection 2.1. Data description and sources are offered in subsection 2.2.

2.1 IDENTIFYING THE EFFECT OF IMPORT COMPETITION

Identifying the effect of import competition on prices is difficult because of the problem of distinguishing between supply and demand shocks. For example, winter jackets in Sweden become cheaper when tariffs on imports from China are removed. Nevertheless, if demand was simultaneously increased by a cold winter, the equilibrium price would not necessarily decrease. Yet it is exactly the supply side that we must seek to identify if we want to know how much more expensive jackets would have been without cheap imports. Because current studies using ordinary least squares (OLS) cannot identify the supply and demand shocks that cause changes in trade flows, they cannot establish the true effect of import competition on prices.

At the heart of the Auer and Fischer (2010) strategy lies the simple observation that when labor-abundant nations grow, their exports tend to increase most in sectors that intensively use labor as a factor of production. Auer and Fischer (2010) and Auer et al. (2011) show that U.S. and European imports originating from low-income countries are highly concentrated in labor-intensive sectors. This relation is also shown to hold across time. In other words, if China's output capacity grows, its exports increase most in labor-intensive sectors.

This observation gives Auer and Fischer (2010) an empirical lever on supply side changes that does not depend upon the price. With this lever, the supply and demand effects can be separated. Building on the fact that the change in imports at the sector level is related to

the sector's labor intensity, the effect of import competition from China on Nordic producer prices is estimated controlling for both sector-specific trends and aggregate shocks. When China grows above trend, Nordic imports in labor-intensive sectors increase relative to Nordic imports in capital-intensive sectors. This difference in the reaction of sectoral import volume to Chinese growth is utilized to establish the effect of imports on Nordic producer prices.

More formally, we begin with the true relation between Nordic price changes and Chinese import changes. It is assumed to be specified as follows:

$$\Delta p_{j,t}^{NORD} = \alpha_j + \beta \Delta m_{j,t}^{CHN} + \varepsilon_t + \varepsilon_{j,t}, \tag{1}$$

where $p_{j,t}^{NORD}$ denotes Nordic prices at time t for sector j and $m_{j,t}^{CHN}$ denotes Nordic imports in sector j from China. The industry-specific trend of Nordic prices in sector j is captured by α_j, the common shock to Nordic prices at time t by ε_t, and sector-specific price shocks by $\varepsilon_{j,t}$. The absolute change in a variable is denoted by Δ.

In equation (1), the coefficient of interest, β, measures the true impact of an increase in Chinese trade on Nordic sectoral prices. A prior finding shared by most researchers is that Chinese imports lead to lower domestic prices, i.e., $\beta < 0$, the so-called Chinese price effect.

It is important to be clear what the price effect, stemming from an increase in China's market share, captures in equation (1). The price effect stems from low-wage competition or, in other words, China's comparative advantage in low-skilled, labor-intensive production. This price effect does not capture potential efficiency gains from tariff changes, China's industrial policy, or exchange rate policy.[5] The price effect also does not capture indirect effects arising from China's competition with exporters in other countries or domestic producers. Further, equation (1) does not capture improvements in retail chain management that are linked with Chinese goods.

It is evident that imports are endogenous to local demand conditions in equation (1). To solve this endogeneity problem, Auer and Fischer (2010) instrument for $\Delta m_{j,t}^{CHN}$ by taking the interaction between Chinese (annual) growth of manufacturing output, g_t^{CHN}, and the European sector's (average) labor intensity, $\overline{ls}_j$, yielding $g_t^{CHN}\overline{ls}_j$.[6]

As in Auer and Fischer (2010), the preferred specification is a reduced form relation between labor intensity differentials and price differentials. This difference-in-difference

5 This is not to say that these factors are unimportant, but simply that the empirical strategy cannot identify them. For example, the empirical literature on international trade utilizes one-time tariff reductions to identify the causal effect of trade; see for example Trefler (2004) on the effect of NAFTA on Canadian industry. Unfortunately, large tariff reductions are rare and the literature has yet to find a suitable event that led to a substantial increase of imports from low-cost producers. China's accession to the WTO in 2001 reduced average tariffs by less than two percentage points and did not result in a significant effect on the U.S. economy.

6 A similar strategy has been used in empirical finance. For example, Rajan and Zingales (1998) construct an instrumental variable by interacting between the average external financing needs of U.S. firms across industrial sectors and the size of financial markets for a large sample of countries to examine whether financial development facilitates economic growth.

specification relates Chinese growth changes times labor intensity to relative changes in prices

$$\Delta p_{j,t}^{NORD} - \Delta p_{k,t}^{NORD} = \lambda_{1,j} + \lambda_{2,t} + \gamma \left(\overline{ls}_j - \overline{ls}_k\right) g_t^{CHN} \tag{2}$$

$$+ \varrho(\Delta X_{j,t} - \Delta X_{k,t}) + \varepsilon_{k,j,t},$$

where $\Delta p_{j,t}^{NORD} - \Delta p_{k,t}^{NORD}$ denotes the differential price change between sector j and k, λ_1 and λ_2 are fixed and time effects, $\left(\overline{ls}_j - \overline{ls}_k\right) g_t^{CHN}$ measures the differential in import competition between two sectors, $\Delta X_{j,t}$ are control variables, and $\varepsilon_{k,j,t}$ is the error term. Fixed effects are introduced to filter out sector specific trends in prices. The variation that is exploited relates the difference in how imports change in sectors with different labor intensities to differences in sectoral price changes.

2.2 DATA DESCRIPTION

For the empirical analysis, we merge Nordic sector specific trade, domestic production, and producer price index data classified in the NACE rev 1.1 system. To guarantee a reasonable number of observations the analysis considers only the aggregate of Denmark, Finland, and Sweden. The selection of these countries is based on data availability.[7] While the domestic production data as well as the PPI data are available in NACE rev. 1.1 classification on Eurostat, the trade data has to be converted to NACE rev. 1.1 from CN8 using a correspondence table. To guarantee the largest available panel, the sample begins in 1995. To exclude the world trade collapse in 2009, we conduct our analysis for the years 1995–2008.[8] The quality of PPI data limits the analysis at the 2-digit NACE level, leaving us with 23 manufacturing sectors for most years.

The measure of import penetration is constructed in the following manner. We divide the value of Chinese imports by the value of domestic production in the Nordic countries plus total imports. To make sure that the results are not driven by the endogenous response of Nordic sales to Nordic price developments, the value of domestic production plus total imports is averaged over the full sample. Our measure of import penetration takes the value of 0.01 in a sector where Chinese imports amount to 1% of average Nordic sales in the respective sector.

When examining changes of import penetration, the absolute change in the level of China's import share is evaluated, i.e. Chinese import share at time t minus Chinese import share at $t-1$. This strategy is expedient, because the response of Nordic prices should be related to the increase of imports in proportion to Nordic demand but not in proportion to the percentage growth of Chinese imports. Further, normalizing by sector size in the Nordic

7 All data are from Eurostat.
8 Figure 1 shows that China's takeoff occurred only after 1995.

region does not drop any zero-trade observations. The size of a sector is defined as the value of domestic shipments plus the values of imports from all countries.

To define a representative European measure of sectoral labor share that is free of large variations in time and country characteristics peculiar to the Nordic region, we measure an industry's labor intensity by using the average of the European labor expenditure share for each of the 23 sectors during 1995–2008. In this calculation, labor intensity is defined as the ratio of average labor expenditure divided by the average capital expenditure. Average labor expenditure is measured based on data from France, Germany, Italy, Sweden, and the United Kingdom.[9]

3. Chinese imports and Nordic prices

We begin the discussion of the IV results with the first-stage regressions. These regressions are displayed in Panel A of Table 1. In each specification, the instrument passes several tests of weak identification.[10] The same panel also shows that the instrumental variable, labor intensity multiplied by the change in Chinese industrial output, is significant at the 1% level.

The second-stage IV regressions show that the relative price effect is stable across a number of different specifications. These are presented in Panel B. Column 1 shows that the relative price effect is –2.0 and is highly significant in the baseline regression with time dummies. This point estimate means that a 1% increase in Chinese import share is associated with a 2.0% fall in Nordic producer prices. Next, column 2 adds annual Chinese manufacturing output to the regression with fixed effects. This control variable is significant but it does not change the point estimate for import share. Column 3 introduces sectoral productivity and sectoral wages into the specification defined in column 2. Although productivity is found to be significant, again it has no bearing on the baseline estimate of –2.0 shown in column 1. The last two specifications in columns 4 and 5 control for dynamics and do not alter the baseline estimate.

When we observe that the market share of Chinese imports grows, this could stem from either more goods being imported at constant prices (the channel we want to isolate), or alternatively, the same quantity being imported at higher prices.[11] To capture the first effect, physical import volumes (measured in kilos) in the first-stage regressions are used instead of import values (measured in euros).[12] Also the measure of physical import

9 This measure was used in Auer et al. (2011). The countries were selected because of their wide data availability across sectors.

10 The Cragg-Donald statistics, the associated Stock-Yogo statistic, as well as the F-statistics from the first-stage regressions reveal that the criticism of weak instruments is not an issue.

11 To understand that perverse effects may arise in our use of log differences of market share, consider the following extreme example. Suppose that quantities of goods produced in the Nordic countries and imported from the world and China are constant, however prices vary over time. In such an example, where $\Delta ln \frac{P_j Q_j^{CHN}}{PQ} = \left(P_{j,t} - P_{j,t-1}\right) \frac{Q_j^{CHN}}{PQ}$, even though the true market share is fixed, the estimated market share is time varying as prices vary.

12 Although exchange rate fluctuations are absent in the measure of import volumes, import values remain the preferred measure to make statements about the effect of Chinese import competition on Nordic producer prices.

Table 1 – China Import Value (in €) and Nordic Prices: IV Results (Fixed Effects Panel Estimations)

SPECIFICATION	(1) WITH YEAR DUMMIES	(2) INCL. CHINA IND. GROWTH	(3) INCL. CHINA IND. GROWTH/ PRODUCTIVITY & WAGES	(4) LAGGED PRICES	(5) LAGGED CH. IMPORTS LWC
Panel B: IV Second Stage Estimation – Dep. Var. is the y/y Ln-change in Producer Prices					
Ch. Imports China	-1.978**	-2.016**	-2.043*	-1.970**	-2.040**
(in % of European Industry Size)	[0.871]	[0.988]	[1.049]	[0.918]	[0.856]
Ch. % China Manufacturing		0.329***	0.319***		
Output		[0.076]	[0.076]		
Productivity			0.000***		
			[0.000]		
Wages			0.000		
			[0.000]		
Lag of Producer Prices				0.030	
				[0.055]	
Lag of Ch. Imports China					-0.410**
					[0.178]
Panel A: IV First Stage Estimation – Dep. Var. is the y/y change in (China Import Value in € / European[1] industry Size)					
Labor Intensity * Ch. % China	0.024***	0.024***	0.022***	0.024***	0.024***
Manfct. Output	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]
Ch. % China Manufacturing		-0.061**	-0.058*		
Output		[0.029]	[0.030]		
Productivity			-0.000		
			[0.000]		
Wages			0.000		
			[0.000]		
Lag of Producer Prices				0.003	
				[0.008]	
Lag of Ch. Imports China					-0.196***
					[0.036]
Cragg-Donald Statistic	10.78	10.32	9.483	9.686	12.05
Max Reject Stock-Yogo Crit Value	15%	15%	15%	15%	15%
Level 1st stage F-statistic	5.150	12.30	12.25	2.498	2.874
Year dummies (both stages)	y	n	n	y	y
Observations	713	713	629	671	671
Groups (Destination – NACE)	63	63	63	63	63
R-Square (first stage within)	0.0825	0.0422	0.0510	0.0800	0.196

Notes: [1] Nordic is Sweden, Finland, and Denmark. Panel B displays two-stage least squares estimations. The dependent variable is the annual change in the logarithm of the producer price at the 2-digit NACE (Rev. 1.1) level (only manufacturing industries). "Ch. Imports China" is defined as the y/y absolute change in (China import value in €/European industry size). The industry size is defined as the 1995–2008 average value of European domestic production plus world imports. In columns 2 and 3, "Ch. % China Manufacturing Output" is the growth rate of manufacturing output in China. Productivity is the wage-adjusted labor productivity and wages capture wages and salaries. Column 4 includes lagged producer price changes and column 5 incorporates lagged changes of Chinese import values. In Panel A the first-stage relation is displayed. The instrument is the sector's labor intensity times "Ch. % China Manufacturing Output". All estimations include fixed effects by sector. Clustered standard errors (by country) reported in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 2 – China Import Volume (in kilograms) and Nordic Prices: IV Results (Fixed Effects Panel Estimations)

SPECIFICATION	(1) WITH YEAR DUMMIES	(2) INCL. CHINA IND. GROWTH	(3) INCL. CHINA IND. GROWTH/ PRODUCTIVITY & WAGES	(4) LAGGED PRICES	(5) LAGGED CH. IMPORTS LWC
Panel B: IV Second Stage Estimation – Dep. Var. is the y/y Ln-change in Producer Prices					
Ch. Imports China	-0.815**	-0.802**	-0.714**	-0.793***	-0.741**
(in % of European Industry Size)	[0.290]	[0.340]	[0.350]	[0.291]	[0.292]
Ch. % China Manufacturing		0.395***	0.333***		
Output		[0.091]	[0.089]		
Productivity			0.000***		
			[0.000]		
Wages			0.000**		
			[0.000]		
Lag of Producer Prices				0.021	
				[0.058]	
Lag of Ch. Imports China					-0.141
					[0.120]
Panel A: IV First Stage Estimation – Dep. Var. is the y/y change in (China Import Volume in kilograms / European[1] industry Size)					
Labor Intensity * Ch. % China	0.062***	0.062***	0.058***	0.063***	0.065***
Manfct. Output	[0.022]	[0.021]	[0.020]	[0.022]	[0.024]
Ch. % China Manufacturing		-0.100	-0.127		
Output		[0.090]	[0.102]		
Productivity			-0.000		
			[0.000]		
Wages			0.000*		
			[0.000]		
Lag of Producer Prices				-0.029	
				[0.020]	
Lag of Ch. Imports China					-0.056
					[0.161]
Cragg-Donald Statistic	14.11	12.99	13.58	13.47	14.78
Max Reject Stock-Yogo Crit Value	15%	15%	15%	15%	15%
Level 1st stage F-statistic	7.861	13.44	14.63	3.962	4.819
Year dummies (both stages)	y	n	n	y	y
Observations	613	613	538	575	577
Groups (Destination – NACE)	55	55	55	55	55
R-Square (first stage within)	0.157	0.0867	0.136	0.156	0.158

Notes: [1] Nordic is Sweden, Finland, and Denmark. Panel B displays two-stage least squares estimations. The dependent variable is the annual change in the logarithm of the producer price at the 2-digit NACE (Rev. 1.1) level (only manufacturing industries). "Ch. Imports China" is defined as the y/y absolute change in (China import volume in k g/European industry size). The industry size is defined as the 1995–2008 average value of European domestic production plus world imports. In columns 2 and 3, "Ch. % China Manufacturing Output" is the growth rate of manufacturing output in China. Productivity is the wage-adjusted labor productivity and wages capture wages and salaries. Column 4 includes lagged producer price changes and column 5 incorporates lagged changes of Chinese import volumes. In Panel A the first-stage relation is displayed. The instrument is the sector's labor intensity times "Ch. % China Manufacturing Output". All estimations include fixed effects by sector. Clustered standard errors (by country) reported in brackets; * significant at 10%; ** significant at 5%; *** significant at 1%.

volumes is normalized by market size, which is measured in the same physical quantity as is the import volume. Estimates for Nordic prices and their corresponding specifications as in Table 1 are shown in Table 2. In terms of the instrument's strength, the first-stage regressions show higher F-tests than the regressions with import values. The relative price effect remains highly significant but is now estimated to be around –0.8%.

The lower coefficient estimate for import volume is not surprising. Volume measures defined in kilos or in other units are extremely crude because they do not capture quality aspects which are best reflected by price. Despite this shortcoming in the volume measure, we are still able to identify a price effect for Nordic producer prices.

4. Conclusions and policy implications

The results of our analysis show that labor-intensive imports from China restrain Nordic producer prices. While it is difficult to say how much of the Chinese price effect flows into consumer prices, the fact that China has steadily gained market share in the Nordic region suggests that Chinese import competition will weigh more heavily in future monetary policy decisions. The Nordic exposure to China gives rise to several considerations for domestic inflation.

The first issue concerns interpreting the nature of the price shock. The relative price effect stemming from Chinese imports acts as a positive supply shock. If the supply shock is temporary, this leads to lower transitory inflation and the optimal monetary policy response would be to do nothing. The recent Nordic experience, however, suggests that the pressures associated with China's increasing import share resemble a permanent series of shocks. The danger is that if these shocks are interpreted as simply being temporary, monetary conditions will become contractionary when the nominal policy rate is left unchanged.

A further issue concerns rapid changes in exchange rates and import volumes. Let us first consider the exchange rate issues. China's exchange rate policy towards the U.S. dollar is currently the subject of one of the most prominent debates in international monetary economics. Exchange rate flexibility is repeatedly mentioned as a resolve for global imbalances. Numerous economists and policymakers are calling on China to revalue its currency in the order of 20% to 40%. If such a rapid yuan appreciation occurs, the disinflation effect of Chinese imports could be quickly reversed. Auer (2012) notes that nearly a sixth of all U.S. consumption of manufactured goods is produced in China. Thus, a real appreciation in the yuan would lead to a substantial pass-through effect because of the increasing weight of Chinese goods in U.S. inflation indexes. Auer (2012) examines the 2005 to 2008 period when the yuan appreciated by 17% against the U.S. dollar to estimate the exchange rate pass-through of U.S. producer prices. His pass-through estimates show that a 1% appreciation of the yuan causes U.S. producer prices to increase by about 0.14%. These new pass-through estimates suggest that the timing sequence of an

eventual yuan appreciation may also be crucial. From the perspective of international policy coordination, it would be more desirable to experience a yuan appreciation when global inflationary pressures are receding as opposed to when they are rising.

Supply disruptions represent a similar source of uncertainty. Natural disasters, such as the 2011 Tohoku earthquake, trigger supply disruptions that are difficult to interpret in terms of the fallout's depth and duration. If such events affect Chinese trade flows, this would again reverse the Chinese price effect.

A more important concern is the policy response. In our analysis for the three Nordic countries, only Sweden pursues an independent monetary policy. The Danish and Finnish monetary authorities are unable to respond to regional price pressures stemming from Chinese import competition. This issue becomes redundant if the level of Chinese import penetration is uniform across the euro area. However, Auer et al. (2011) show that this is precisely not the case for individual euro area countries. Their results show that the price effect of Chinese import competition is stronger in Germany than in France. This difference in the price effect is explained by differences in Chinese import exposure for the respective euro area countries. For example, in 2009, China exported more goods to Germany than to France, Greece, Italy, Portugal, and Spain combined. Such diverging trade dynamics imply that the price effects from Chinese import competition are not uniform across Europe and that the optimal monetary policy response is country specific.

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Swedish banks' use of the currency swap market to convert funding in foreign currencies to Swedish kronor

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Swedish banks currently fund some of their lending in Swedish kronor by issuing securities in other currencies. However, this requires a functioning market for currency swaps as the banks have to convert the foreign currency to Swedish kronor.[1]

In this article we describe how Swedish banks use swaps to convert funding in foreign currency to Swedish kronor in order to fund long-term lending in Swedish kronor, such as Swedish mortgage loans. We show that the banks do largely restrict the extent to which they are exposed to the risks arising from these swaps. However, at the same time we conclude that the structure of the long-term swap market means that the swap market, and thus the banks' funding, is susceptible to disruption and is easily affected by uncertainty on other financial markets. In addition, the swap market contributes to a high concentration risk in the Swedish banking system. Perhaps the most important criteria in order to avoid disruptions on the long-term swap market are an effective short-term market in Swedish kronor and a well-capitalised banking system. However, in the longer term there are also other factors which could help to reduce the risks and make the Swedish swap market more robust. We discuss these factors in the latter part of the article.

Swedish banks fund some of their lending in Swedish kronor by issuing bonds and certificates on the capital market abroad, in currencies other than Swedish kronor. Some of these securities fund long-term lending such as mortgage loans. One important reason why the banks issue securities outside Sweden is that they do not want to make themselves dependent solely on the domestic market; instead, they want to ensure that they have flexibility in terms of access to funding. Moreover, credit rating agencies emphasise that

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1 In this article, "currency swaps" refers to both FX swaps and cross-currency basis swaps (CCY swaps). "Swap" is used synonymously with "currency swap" unless stated otherwise in the text. Also, long-term swap is used synonymously with CCY swap and short-term swap with FX swap.

banks should have a diversified investor base, which is facilitated if borrowing takes place in multiple currencies.[2]

However, to fund lending in Swedish kronor by borrowing in foreign currency entails that the banks are exposed to currency risk as their assets are in one currency and their liabilities are in another. The banks manage this currency risk by using derivatives in the form of currency swaps: FX swaps or cross-currency basis swaps (CCY swaps). A derivative contract of this kind means that a bank borrowing in foreign currency exchanges the foreign currency for Swedish kronor with the counterparty in the swap. This allows the banks to create a suitable currency match in their balance sheets, thereby managing the currency risk between assets and liabilities. A more detailed description of how FX swaps and CCY swaps are constructed and used is presented in Appendix 1.

Although only a smaller proportion of the banks' total lending in Swedish kronor is funded in this way, it is not irrelevant. Moreover, the swap market has proven to be susceptible to disruptions and unease on other financial markets in Sweden and abroad. Hence, through the swap market, uncertainty elsewhere in the world can affect the Swedish financial system. The problems which arose on the CCY market for swaps between euro and kronor in the autumn of 2010 provide one example of this. At that time, liquidity on the CCY market was impaired, while at the same time the cost of converting funding in euro to kronor, known as the cross-currency basis spread, rose considerably. This led to Swedish banks finding it both expensive and difficult to convert funding in foreign currency to kronor at longer maturities via the swap market. These problems were due to the uncertainty that arose regarding the shortest maturities of the Swedish money market as the last of the three extra ordinary loans that the Riksbank offered to the banking system during the crisis matured. Similar problems have also occurred on other occasions when the cause was problems outside Sweden. Nevertheless, since currency swaps are traded OTC; that is to say, bilaterally outside regulated marketplaces, only very little information has been compiled about the swap market and the banks' use of currency swaps.

The purpose of this article is to describe how the Swedish banks use currency swaps to convert funding in foreign currency to Swedish kronor in order to fund lending in Swedish kronor at longer maturities, such as mortgage loans. We also look at the risks this may entail. Consequently, the article concentrates on the conversion of long-term funding in foreign currency to kronor. It does not cover the banks' use of the swap market to convert short-term funding in, for example US dollars to kronor, in order to fund short term assets. As the emphasis in this article is on the currency swap market, we will not discuss the risk of disruptions on the foreign securities market which affect the banks' access to market funding in foreign currency. For the same reason, we will not discuss the interest rate risks which the banks hedge with interest rate swaps.

2 For the four major banks – Handelsbanken, Nordea, SEB and Swedbank – around half of the total funding is market funding, of which around two-thirds is in currencies other than Swedish kronor. Much of the borrowing in foreign currencies funds assets in these currencies. For example, in the Baltic countries the major banks' lending in euro is funded by means of borrowing in euro. However, some of their assets in Swedish kronor are funded with funding in foreign currency.

We start by describing how the Swedish banks use currency swaps to fund long-term lending in Swedish kronor. This description is based partly on data concerning Swedish banks' long-term swaps which was collected by the Riksbank in June 2011, partly on interviews with the Swedish banks and other participants in the swap market. In Section 2, we show the risks to which the banks are exposed as a consequence of using currency swaps, and how this can lead to risks in the Swedish banking system. In Section 3, we discuss what criteria have to be met in order for the swap market to function smoothly, as well as a number of factors which could help to make the Swedish swap market more robust henceforth. The article ends with a summary of our conclusions.

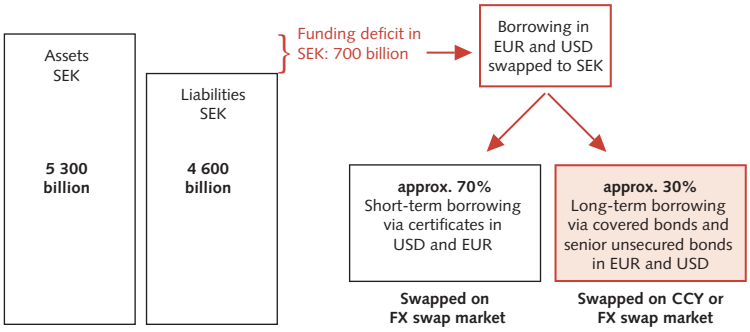
1 The Swedish banks' use of the currency swap market to fund long-term lending in Swedish kronor

Seven Swedish banks currently fund some of their lending in Sweden by borrowing on the capital markets: Handelsbanken, Nordea, SEB, Swedbank, SBAB, Länsförsäkringar bank and Landshypotek. In total, these banks have approximately SEK 5 300 billion in assets in Swedish kronor, of which they fund approximately SEK 700 billion by borrowing foreign currency on the capital markets abroad which they convert to Swedish kronor in the swap market.[3] Approximately two-thirds of this amount relates to short-term funding via certificates, while around one-third is long-term funding through covered bonds and other bonds. This article concentrates on the latter (see the coloured box in Figure 1).[4]

3 The remainder is funded by means of deposits and market funding directly in Swedish kronor.

4 The banks' total funding deficit in Swedish kronor – that is to say, how much of the assets in Swedish kronor are funded by borrowing in other currencies – can be derived from their balance sheet and has been calculated on the basis of the situation in June 2011. The calculation of long-term and short-term borrowing swapped is based on information from the Riksbank's survey of June 2011. The need for funding in foreign currency and the breakdown between short-term and long-term funding may vary over time depending on the banks' funding strategies.

Figure 1. Swedish banks' use of the swap market to fund assets in Swedish kronor



Note. The numbers in the figure relate to Handelsbanken, Nordea, SEB, Swedbank, SBAB, Länsförsäkringar bank and Landshypotek. They are based on assets and liabilities reported in the banks' financial reports in June 2011 and the Riksbank's survey. The need for funding in foreign currency and the breakdown between short-term and long-term funding may vary over time depending on the banks' funding strategies.
Source: The Riksbank.

In 2011, the Riksbank carried out a survey on how Swedish banks are using currency swaps to convert their long-term funding in foreign currency to Swedish kronor. Some of the information presented in this article is taken from that survey. This includes sample data from the seven Swedish banks' currency swaps in June 2011. Interviews with the banks and other participants which were carried out as part of the survey also form the basis for the description in the following sections and the subsequent discussion.

1.1 USE OF FX SWAPS AND CCY SWAPS TO FUND LONG-TERM LENDING IN SWEDISH KRONOR

Essentially, the banks could convert their funding in foreign currency to Swedish kronor on the spot market. However, this could give rise to a large currency risk, so that the banks could risk parts of their earnings.[5] Due to the large currency risks, significant further capital requirements are also imposed on the banks if they have large open – i.e. unhedged – currency positions in the balance sheet. Therefore, the banks use currency swaps to hedge themselves against the currency risk.

As regards the banks' covered bonds, the Swedish Act on Issuance of Covered Bonds and the credit rating agencies also lay down specific requirements for the banks to limit the currency risk between these and the underlying collateral; that is to say, the Swedish mortgages against which the banks issue their covered bonds (known as the cover pool). If the bonds are issued in a different currency to the mortgage loans, the banks must hedge

5 When the bank converts funding in foreign currency to Swedish kronor on the spot market, the bank receives an asset in Swedish kronor and a liability in another currency, which gives them an open currency position. Large open currency positions can lead to the bank making major losses even in the event of relatively minor exchange rate fluctuations. From a business perspective, therefore, there is no justification for a bank to take such a risk. See Appendix 2 for a more detailed example.

the cover pool against changes in currency exchange rates by means of swap agreements. Alternatively, the banks can ensure that the cover pool contains sufficient additional collateral (over-collateralisation) so that the value is above or equal to the value of the bonds even in the event of large currency exchange rate changes. However, to protect the owners of the covered bonds, the banks have opted to use swaps as far as possible to match the underlying mortgages in the cover pool with the covered bonds in respect of currency and interest rate period. In practice, the banks swap all (Swedish) covered bonds in foreign currency to Swedish kronor. Moreover, these swaps have more or less always the same maturity as the covered bonds.

As far as the owners of the bonds are concerned, it is sufficient that the swap is carried out with an internal counterparty, for example between the mortgage institution that issued the covered bond and its parent company. However, from the standpoint of the banking group, this does not change the currency distribution between assets and liabilities. Provided that a bank does not have assets in foreign currency which are equivalent to the value of the covered bonds in foreign currency, this could mean that the banking group has a currency risk. If the banks issue large amounts of covered bonds in foreign currency in relation to their balance sheet, they have to maintain large quantities of capital for the currency risk. As capital is generally perceived as expensive, the banks opt instead to eliminate this currency risk by making a further swap with an external counterparty. This protects both the owners of the covered bonds and the banking group against currency exchange rate fluctuations. The swap made internally is, from the standpoint of the group, comparable with a bookkeeping action (as it does not alter the currency distribution between the group's assets and liabilities). Therefore, in this article we will be concentrating on the swaps made by the Swedish banks with other banks in the market. Hence we will disregard the swaps which the banks opt to make internally between two legal entities within the banking group.

Data from the Riksbank's survey shows that different banks convert different proportions of their long-term funding in foreign currency to Swedish kronor in swap transactions with other banks. Essentially, the Swedish banks can be ranked on a sliding scale, from the banks which almost only have assets in Swedish kronor and which essentially swap all their funding in foreign currency to Swedish kronor, to the banks which hold most of their assets in currencies other than Swedish kronor and which swap only a small proportion of their long-term funding in bonds in foreign currency to Swedish kronor. However, all banks which also raise short-term funding through issuance of certificates in foreign currencies swap a relatively large proportion of this funding to Swedish kronor.

When the banks swap long-term funding in bonds, they have – in somewhat simplified terms – two options:

(i) to use a CCY swap with the same maturity as the bond

(ii) to use a swap with a shorter maturity than the underlying bond which is then renewed regularly during the bond's maturity, such as an FX swap.

The Riksbank's survey indicates that the banks largely match the maturity of their swaps with the maturity of the bonds they issued and want to convert to kronor. Still, it also happens that the banks do not match the maturity of the swap and the bond entirely, but use swaps with shorter maturity. A five-year bond can, for example, be converted to kronor by means of a one-year swap which the bank then renews (rolls over) every year.

Regardless of whether a bank chooses to use a maturity-matched CCY swap or to continuously renew a more short-term CCY swap or an FX swap, it is hedged against the currency risk that would arise if the foreign currency was instead converted to Swedish kronor on the currency spot market. However, one prerequisite for this is that the bank must renew the FX swap every time it falls due throughout the entire maturity of the bond. When the bank uses a swap with a shorter maturity than the maturity of the underlying bond, a maturity-mismatch occurs between the bank's assets and liabilities (on and off the balance sheet) in Swedish kronor and the foreign currency respectively. The bank's lending in Swedish kronor – that is, the asset – will have a longer maturity than the funding in kronor from the swap, while the bank's position in euro is vice versa. This can be said to constitute a refinancing risk in Swedish kronor as the bank does not know for certain whether it will be able to borrow kronor, or on what terms, when the FX swap falls due. A bank using a CCY swap has therefore, all things being equal, secured its access to Swedish kronor (and not just the foreign currency) for a longer time than a bank using an FX swap. We present a simplified example of this in Appendix 3.

However, if the bank matches the maturity of the swap and the bond, it needs to manage a greater counterparty risk compared with if it uses an FX swap or a CCY swap with a shorter maturity. To reduce these risks all Swedish banks use standardised contracts with more or less all their financial counterparties. In practice this includes all the swaps made by the banks in order to convert funding in foreign currency to Swedish kronor (see Section 2.1).

1.2 THE BANKS' COUNTERPARTIES IN LONG-TERM SWAPS

Most of the banks' long-term funding in foreign currency which is converted to Swedish kronor in the swap market is converted in CCY swaps with long maturity. Data shows that the Swedish banks have two main categories of counterparty in these swaps: foreign banks and other Swedish banks. In June 2011, these two groups were the counterparties to more than 80 per cent of the transactions executed by the Swedish banks in order to convert long-term funding in euro to kronor (see Table 3). The banks had other counterparties for less than one-fifth of the swaps. These included, for example, so-called arbitrage issuers[6], as well as a couple of Swedish insurance and pension companies, although overall these did not have a particularly prominent part to play.

6 Arbitrage issuers issue in the currency that gives the lowest total funding cost. If the price for lending (i.e. supplying) Swedish kronor in a derivative contract is advantageous, they can opt to issue in Swedish kronor and swap the funding to the currency that they need, e.g., euro, instead of issuing directly in the currency that they need, so as to reduce their overall funding cost.

In general, the banks thus have a limited number of counterparties in the CCY swaps. This can be explained in part by the fact that the banks generally do not split a bond issue into a number of swaps. However, in the few instances in which this does take place, the banks concerned have a larger number of counterparties than other banks.

Table 1. Counterparties to the Swedish banks in CCY swaps

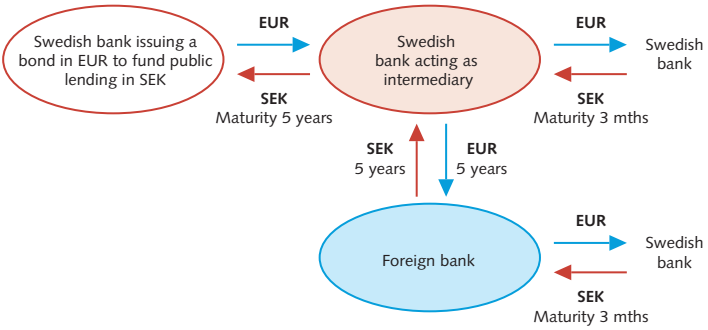
TYPE OF COUNTERPARTY	PERCENTAGE OF SWAPS WHERE A SWEDISH BANK RECEIVES KRONOR IN EXCHANGE FOR EURO
Other Swedish bank	40%
Swedish institution or company	15%
Foreign bank*	45%
Other foreign participant or company	< 5%

Note. The details in the table are based on data indicating the banks' gross exposures to their biggest counterparties in long-term CCY swaps in SEK/EUR during the period June-July 2011. The figures in the table are rounded and so add up to more than 100 per cent.
*Also includes supranational participants.
Source: The Riksbank.

However, both the foreign and the Swedish banks which lend Swedish kronor in CCY swaps must themselves get hold of the kronor which they then lend. The foreign banks in many cases do this at a shorter maturity than they lend on in the CCY swaps; often by entering an FX swap with a Swedish bank. Thus the foreign banks transform short-term funding to long-term lending in Swedish kronor in the swap market to a large extent, although the foreign banks at times obtain Swedish kronor at longer maturities for example from an arbitrage issuer which has issued in Swedish kronor but needs funding in euro. Consequently, when the foreign banks carry out the maturity transformation in the swap market they accept the liquidity risk associated with this.

Insofar as Swedish banks lend kronor in CCY swaps, it is typically the major banks that do this. This activity takes place within the scope of the banks' trading activities, which is separated from the banks' treasury. The Riksbank's survey shows that in swap transactions where the Swedish banks are a counterparty to another Swedish bank, also the Swedish banks borrow some of the kronor which they lend in the CCY swaps at a short maturity, thereby making a maturity transformation in Swedish kronor in the swap market. Yet, a large proportion of the kronor that they lend in CCY swaps they borrow at longer maturities by entering into a different CCY swap with a counterparty outside the Swedish banking system. In other words, they do a CCY swap with the same maturity, but in the opposite "direction". Typically, the counterparty in the other swap is a foreign bank. Hence, in these transactions the Swedish banks can instead be viewed as intermediaries, which "pass on" the risks stemming from the Swedish bank which issues a bond in euro to the foreign bank that carries out the maturity transformation (see Figure 2).

Figure 2. Example of a maturity transformation in the swap market



Note. A typical transaction in the swap market starts with a Swedish bank issuing a five-year bond in euro. This bank then enters into a swap with another bank, often a Swedish bank. This swap has the same maturity as the bond which the Swedish bank first borrowed euro in. The other Swedish bank funds half of the lending of Swedish kronor in the swap by entering into another swap with a foreign bank at the same maturity as the first swap. The remaining half is instead borrowed at a shorter maturity, often also from another Swedish bank, in the example at three-months. The foreign bank often funds its lending of kronor in the swap by borrowing from a Swedish bank at a shorter maturity.
Source: The Riksbank.

Consequently, data of the banks' swap transactions suggests a certain degree of segmentation in the swap market, in the sense that the banks seem to carry out maturity transformation in the swap market to a varying extent. This may be linked with the banks' different abilities to manage risks. For example, foreign banks with large balance sheets in many currencies and a diversified business are generally in a good position to take risks and seem to carry out a large proportion of maturity transformation. They do this either as a direct counterparty to the Swedish banks which swap bonds in euro to kronor, or by providing other Swedish banks with kronor which they in turn lend to the issuers. In addition, the major Swedish banks themselves are responsible for part of the maturity transformation towards the smaller banks, while the smaller banks generally do not carry out any maturity transformation at all in the swap market.

A rough estimate of the risks taken by the Swedish banks in terms of CCY swaps alone indicates that they directly transfer their positions in approximately half of the swaps where they are counterparties to another Swedish bank. As the Swedish banks mostly do not carry out the maturity transformation themselves when they convert their own foreign currency funding to kronor, this means that the banks which are counterparty to other Swedish banks in swaps probably take a greater refinancing risk in Swedish kronor in swaps than they, or other Swedish banks, do in swaps in which they convert their own funding to kronor.

2 Risks associated with the use of currency swaps

The banks use currency swaps to hedge themselves against the currency risk occurring when their funding is in a currency other than the one in which they lend. Still, currency swaps result in that the banks are exposed to other risks. These include what we can refer to as *bank-specific risks*. As we have already pointed out, the choice of matching the maturity of the swap with the maturity of the underlying bond affects the bank's refinancing risk in Swedish kronor and its counterparty risk. Moreover, the banks are exposed to *structural risks* associated with the swap market, in particular the CCY swap market. The structural risks in turn are due to the market's structure which makes the swap market susceptible to disruptions.

2.1 BANK-SPECIFIC RISKS

When currency swaps are used to facilitate the funding of long-term assets in Swedish kronor, the bank-specific risks involve a refinancing risk in Swedish kronor, spread (or basis) risk, counterparty risk and settlement risk (see Table 2).

Table 2. Bank-specific risks

Currency risk	The risk of the value of the assets or liabilities being affected by changes in currency exchange rates
Refinancing risk (currency)	The risk of not being able to get funding in the same currency as the one in which the bank has assets
Spread risk (basis risk)	The risk of the bank making a loss as a consequence of a change in the surcharge above the market interest rate (spread) which the bank pays for the swap
Counterparty risk	The risk of the counterparty to the swap defaulting
Settlement risk	The risk of the bank transferring funds to the counterparty during settlement of transactions without getting paid in turn

Refinancing risk in Swedish kronor

Refinancing risk in Swedish kronor relates to the risk of the bank not getting hold of funding in kronor in order to fund lending in kronor, but essentially a refinancing risk can occur in any currency.

Refinancing risk in a particular currency occurs as a consequence of the banks funding themselves in a certain currency over a shorter maturity than the maturity of its assets in the same currency. This means that a bank issuing a bond in Swedish kronor in order to fund mortgage loans is taking a refinancing risk in Swedish kronor as the banks' lending in Swedish kronor consists largely of mortgage loans with very long maturities while the banks rarely issue bonds with a maturity in excess of five years. This risk is difficult, and not desirable to, avoid completely as it is one of the functions of the banking system to carry out a certain amount of maturity transformation. However, in this article we are concentrating on the refinancing risk in Swedish kronor which may occur beyond what is

due to the difference in the maturities of the bond and the lending; that is, when Swedish banks convert long-term funding in another currency to Swedish kronor in the swap market.[7]

As described previously, the refinancing risk in Swedish kronor occurs in the swap market when a bank uses a swap with a shorter maturity than for the bond in the foreign currency that is to be converted to kronor. Only when the bank enters a CCY swap with the same maturity as the foreign bond has it also secured funding in kronor during the entire period over which it originally borrowed currency via the bond. If the bank instead enters an FX swap with a shorter maturity, it has to renew the swap repeatedly during the maturity of the outstanding bond in order to continue to have funding in kronor.

But what could happen to a bank taking a refinancing risk in Swedish kronor by relying on the renewal of FX swaps? Normally, one can imagine that the bank would renew the swap with the original counterparty, that is, allow it to roll over for a further period. However, there is a risk that the bank's counterparty for some reason will be unwilling or unable to renew the swap. In that case the Swedish bank will have to acquire kronor in some other way. The bank will probably first attempt to replace the swap with a similar swap, or a swap with a shorter, maturity with another counterparty. However, for a Swedish bank wishing to convert long-term funding to kronor a more short-term swap does in itself mean an increased refinancing risk in kronor. If the Swedish bank fails to renew the swap or enter into a new swap, a currency mismatch occurs in its balance sheet which is equivalent to the mismatch occurring if the bank converts kronor for itself on the currency spot market. This means that the bank is exposed to currency risk. However, in principle the bank will always be able to repay kronor to a swap counterparty not wishing to renew the swap as it can borrow either on the interbank market or from the Riksbank's standing facilities.

Spread risk

However, it is unusual for banks to not be able to renew their swaps at all. Instead, problems in the swap market typically manifest themselves by impairment in liquidity, increases in the cost of entering into a swap and shortening of maturities which the banks can use for swaps. The cost of entering into a swap is often expressed as the difference between two market interest rates, what is known as a *basis spread,* and the risk of this cost increasing is therefore known as a basis (spread) risk.

To understand what basis risk is and how it affects a Swedish bank which converts funding in foreign currency to kronor, we can consider the costs of a swap on the basis of the interest payments included in the swap. These can be expressed as a variable market interest rate, such as three month STIBOR, plus a fixed spread. In very simplified terms, the spread can be viewed as the additional cost which a bank pays to convert funding in

7 For a discussion about the Swedish banks' overall refinancing and liquidity risks, see for example Financial Stability 2011:2.

euro to kronor in the swap market, and it is specific to the swap in question. As the spread is fixed throughout the maturity of the swap, this means that a bank which swaps its euro funding in a CCY swap with the same maturity as the underlying bond knows what its funding cost will be throughout this entire period (in excess of the market rate). On the other hand, a bank which converts its euro funding to kronor in an FX swap risks changes in the spread to the disadvantage of the bank when the swap is to be renewed. Hence, with this strategy, it does not know what its future funding cost will be.

Counterparty risk

Counterparty risk relates to the risk of the bank making a loss as a consequence of the counterparty being unable to fulfil its obligations. Normally the counterparty risk is very small at the time the parties enter into the swap agreement, and it increases for example when currency exchange rates between the two currencies exchanged in the swap are changed. This is because the bank that received the weakened currency in the swap holds a currency that is worth less than the amount it lent and, therefore, risks making a loss on the difference if the counterparty defaults. Generally, the longer the maturity of a derivative and the more volatile the price of the underlying asset (in this case the currency), the greater the counterparty risk. This is because the longer the agreement remains in force, the greater the uncertainty concerning the future value of the swap agreement. In addition, the bank is bound by its counterparty for a long time in a longer agreement, while it may change counterparty more often if it enters into a shorter agreement. Thus a short-term FX swap does not give rise to such great counterparty risks. On the other hand, in long-term CCY swaps the counterparty risk can be considerable.

If a counterparty defaults, the bank also needs to replace its swap by entering into a swap with a new counterparty as the bank will otherwise have an open currency position in its balance sheet. In this case, the bank may obtain poorer terms with its new counterparty, which essentially means that an interest rate risk and spread risk arise when the counterparty defaults. The consequences of a swap counterparty defaulting are irrespective of whether the bank entered into an FX swap or a CCY swap. However, there is a risk of a greater loss in the case of a CCY swap as the value of the swap over time may have changed more.

Settlement risk

When two parties enter into a CCY swap, the underlying currencies are exchanged. A corresponding transfer occurs when the swap agreement matures. A settlement risk then arises, which means that one party transfers funds to the counterparty without getting paid in turn. Unlike most other financial contracts, FX and CCY swaps are settled on a gross basis, which means that both parties transfer the entire nominal amount in the relevant currency. Therefore, the settlement risk in these contracts is considerably greater than in other derivatives which are settled on a net basis; that is to say, when only one of the

parties transfers the market value of the contract at maturity. However, by settling the swaps in a settlement system, it is possible to transfer the underlying currencies in the swap simultaneously, which essentially means that the settlement risk is eliminated.

How do the Swedish banks manage bank-specific risks in currency swaps?

The Riksbank's survey shows that the banks normally use CCY swaps when converting bonds in foreign currency to Swedish kronor and largely fully match the maturity of the swap with the maturity of the underlying bond. This means not only that the banks are hedged against the currency risk resulting from the fact that they fund lending in Swedish kronor by borrowing in another currency. Moreover, they also limit the refinancing risk in Swedish kronor and the spread risk arising when they swap their long-term funding. On the other hand, the Swedish banks do take refinancing risk in their role as counterparties in the swap market. This risk-taking is regulated within the scope of the banks' trading operations and is normally separate from the funding activities of the banks. Nevertheless, the fact that the Swedish banks carry out maturity transformation is of significance to the structural risks in the swap market (see Section 2.2).

To reduce the counterparty risk in the swaps, the banks comply with a number of standards and market practice for OTC trading. For example, the banks use standardised netting agreements which enable them to offset their positions if a counterparty defaults. There are also special agreements which regulate how the banks transfer securities to one another as compensation for the counterparty risks arising in swap transactions.[8]

As regards the settlement risks, statistics from the fourth quarter of 2011 indicate that around 90 per cent of all currency transactions entered into by the Swedish banks were settled via the settlement system Continuous Linked System (CLS).[9] The proportion of transactions settled via CLS varies among the banks. The main reason as to why the banks do not settle all their swap transactions via CLS is either because the system does not handle the specific currencies involved[10] or the derivative type[11] – which is the case for CCY swaps – or because the bank's counterparty does not participate in CLS.

2.2 RISKS WITH THE STRUCTURE OF THE SWAP MARKETS

The Swedish banks largely match the maturity of the swaps with the maturity of the underlying bond and hence execute very little maturity transformation. Instead, the maturity transformation is carried out by the counterparties in the Swedish banking system

8 These agreements are often so-called ISDA Master agreements, with a supplementary agreement called a Credit Support Annex, (CSA).

9 Find out more about CLS in the Riksbank publication The Swedish Financial Market in 2011.

10 The currencies settled via CLS are US dollars, Australian dollars, British pounds, Danish kroner, euro, Hong Kong dollars, Japanese yen, Canadian dollars, Korean won, Norwegian kroner, New Zealand dollars, Swiss francs, Singapore dollars, South African rand, Mexican pesos, Israeli shekels and Swedish kronor.

11 The currency derivatives handled by CLS are FX spot, FX forwards, currency options, FX swaps and non-deliverable forwards.

or by the foreign counterparties. Although the banking system normally carries out the maturity transformation, there are risks associated with this structure.

i. Risks of foreign banks acting as counterparties to Swedish banks

One thing the foreign banks have in common is that they typically do not have deposits or issue securities in Swedish kronor. Nor do they have access to a *lender of last resort* in kronor.[12] Consequently, to be able to supply kronor in long-term swaps, they first have to borrow them from someone with access to kronor. This often takes place on short maturities from the Swedish banks. In turn, this means that these foreign banks – unlike the Swedish banks – meet a large part of their funding needs for Swedish kronor on the short-term market. This makes them susceptible to disruptions that occur in this market. Besides, the foreign banks' incentive to participate in the swap market is often speculative in nature. This increases the likelihood of the foreign banks leaving the Swedish market if problems arise which temporarily affect their earnings negatively.

Overall, this means that disruptions on the Swedish money market may have implications for the supply of long-term swaps, or other financial instruments at short-term maturities, which will affect liquidity and pricing in this market. During times when uncertainty increases, the spreads on market interest rates often rise and their volatility increases, which is also true of the spreads in the swap market. As the foreign banks borrow Swedish kronor in short-term swaps, their funding cost increases when the spreads rise. However, the spreads included in the interest rates which the foreign banks receive in the CCY swaps are locked for longer periods which they entered into in order to lend kronor. This means that the foreign banks may be forced to take a loss. To compensate for the increased uncertainty, the foreign banks must then raise the spreads included in the interest rates which they charge for new long-term CCY swaps or when they renew their outstanding CCY swaps.[13] If the short-term interest rates are unpredictable – that is to say, there is a high degree of volatility in the interest rates – it will also be difficult for the foreign banks to assess their future funding cost. If there is too much uncertainty, this may lead to the foreign banks deciding to reduce their activity in the market.

As indicated previously, however, it is unusual for banks to be unable to renew their swaps at all. Foremost it is instead the liquidity in the swap market and the funding cost for the Swedish banks that is affected. When this happens, liquidity often deteriorates most for the longer maturities, which means that the banks are forced to fund themselves through swaps with even shorter maturities or pay a higher spread in the longer term swaps. This was in broad terms what happened in October 2010 when the last of the three long-term loans offered by the Riksbank during the financial crisis matured, which caused strain and

12 Some of the foreign banks are members of the Riksbank's payment system RIX and hence have access to Swedish kronor via the Riksbank's facilities. However, discussions with these banks have shown that membership of RIX is formal in nature and not something which the traders of swaps in these banks could utilise in order to access Swedish kronor, as this means that they could "inflate" the bank's balance sheet.

13 As the bonds issued by the banks have a shorter maturity than their lending, the banks have to renew the bonds when they mature and then also renew their CCY swap.

increased volatility, first, in the overnight-market and, thereafter, in the tomorrow-next market and ultimately along the yield curve. In turn, this led to a sell pressure on the CCY market which increased the costs for using the swap market and reduced the liquidity. The sell pressure on the CCY market was partly caused by the foreign banks which had funded their krona positions in CCY swaps with short-term FX swaps. In the long run, reduced liquidity and higher swap costs lead to increases in the banks' lending rates as the banks have to compensate for the increase in the funding cost.

ii. Risks of having a large number of swap counterparties within the Swedish banking system

Besides the foreign banks, the maturity transformation in the swap market is currently carried out by Swedish banks themselves. Certainly, they have access to kronor via the Riksbank's facilities and deposits from the general public and so are perhaps better suited to executing the transformation than foreign banks. However, from the standpoint of the Swedish banking system, the banks' long-term swaps cancel out one another and which means that the risks only are redistributed within the banking system. Since the Swedish banking system in total has more long-term assets than liabilities in Swedish kronor, this imply that the Swedish bank's lending of kronor in CCY swaps at some point are funded at shorter maturities. This means that the banking system's overall need for long-term funding is secured by the banks borrowing foreign currency with long maturity, but the need for Swedish kronor is only secured for a shorter period. If Swedish banks act as counterparties to one another to a great extent, this also increases the interconnetedness between them.

3 Criteria for a more robust swap market

So what criteria are required to reduce the risk of disruptions occurring in the swap market and to achieve a more robust swap market? To start with, there are two basic factors which are important so as to ensure that no disruptions take place on the long-term swap market:

1) an effective short-term market in Swedish kronor
2) a well-capitalised banking system.

These things may seem obvious, but at the same time they are often the factors that cause problems on the long-term swap market in Swedish kronor or in other currencies. The problems have been reinforced by specific circumstances in the swap market.

As the Swedish banks nowadays are dependent on foreign banks as counterparties in long-term swaps and these foreign banks often fund their lending of kronor to the Swedish banks on short maturities, the terms on the short-term market for kronor are particularly important. If either their access to or the price of Swedish kronor is perceived by foreign participants to be uncertain, this can lead to disruptions in the swap market. In addition, an effective swap market requires confidence in the Swedish banks, which in turn presupposes that the Swedish banks are well capitalised. If the foreign banks believe that

the counterparty risk in the Swedish banks is too great, they will be less willing to enter into swaps with long maturity with the Swedish banks. This applies to some extent on all financial markets, but it may be even more important in the swap market. This is because the Swedish banks are dependent on the foreign banks as counterparties to be able to fund their operations, while at the same time the foreign banks are not dependent on the Swedish banks in the same way. In this sense, the relationship between the Swedish banks and their counterparties is asymmetrical.[14]

Alongside an effective market and a well-capitalised banking system, there are a number of other factors which could help to bring about a more robust swap market.

i. The banks' own risk-taking on the currency swap market

Firstly, the banks themselves can reduce their susceptibility to disruptions in the swap market by handling and minimising their own risk-taking in swaps. The Riksbank's survey shows that the banks are already greatly reducing their bank-specific risks arising in currency swaps. All things being equal, this means less risk for individual banks and less susceptibility to disruptions in the swap market if they match the maturity of the swap and the underlying bond. Given the high degree of interconnectedness in the swap market, there may also be a risk of spill over if one bank has problems. At the same time, the risk of spill over between institutions justifies the banks making themselves less dependent on individual counterparties. Although the market at present comprises few participants, it should be possible for the banks to increase the number of counterparties they use to some degree.

However, for the Swedish banking system as a whole to benefit from the Swedish banks fully matching the maturity of their swaps with the maturity of the bond or increasing the number of counterparties, some participant outside the Swedish banking system has to take over the risks. This can be either a participant with a fundamental need to borrow long-term euro and lend long-term kronor, or a foreign bank. If an increase in matching leads to more swaps between Swedish banks, in a best case some of the banks will end up being less susceptible to idiosyncratic shocks.[15] However, the overall refinancing risk in the Swedish system will remain unchanged.

ii. More participants with natural counterflows to the Swedish banks

Normally, it is the banking system that provides borrowers with long-term funding by carrying out the maturity transformation. However, even though the banking system is

14 The fact that capitalisation in banking systems is important to the swap market was also apparent during the crisis in 2007-2008. For example, it has been demonstrated that a factor which contributed strongly to the effects seen at that time in the swap market in EUR/USD was the fact that the counterparty risk was perceived to be much higher in European banks compared with American banks. See – for example – Baba and Packer, 2009.

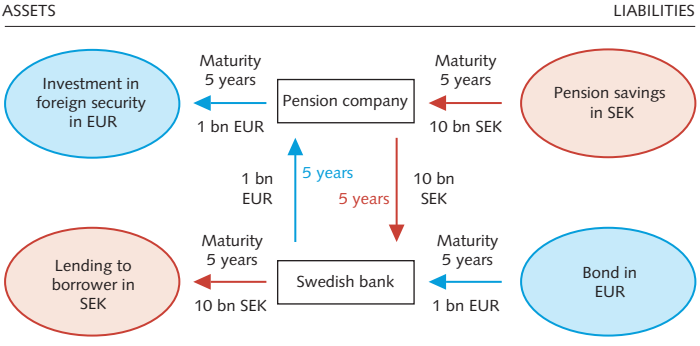
15 An idiosyncratic shock is an event specific to an institution; that is to say, it is not dependent on macroeconomic changes, for example. One example is if a bank makes a major loss due to a single trader exceeding his risk limits.

especially suitable for creating long-term lending, there are also other parties that can fulfil the same function. One example is life insurance and pension companies that acquire long-term kronor through their operations.

The Swedish life insurance and pension companies have long-term liabilities in kronor in the form of savings which they invest in part in long-term assets abroad. This means that these companies have a currency mismatch in their balance sheets which is the opposite of the currency mismatch in the balance sheet of a Swedish bank which funds part of its long-term lending in Swedish kronor with long-term funding in foreign currency (before the bank makes the currency swap).

To the extent that the life insurance and pension companies choose to hedge the currency risk that originates from the this currency mismatch they already do so using swaps. However, these companies mainly use FX swaps and so are not particularly active on the long-term CCY swap market, as confirmed by data from the Riksbank's survey. As the life insurance and pension companies have liabilities and assets with long maturity, they can achieve a better maturity match in their balance sheets in each currency by entering into a long-term swap whereby they lend kronor and receive euro. In particular, they could hedge the currency risk in this way where they today use short-term swaps. In this case, they would make a natural counterparty to the Swedish banks (see Figure 3).

Figure 3. Schematic illustration of transactions in a long-term CCY swap between a Swedish pension company and a Swedish bank



Reading instruction: The figure shows a pension company which has long-term (five-year) liabilities in Swedish kronor in the form of pension savings, but wants to invest these savings in long-term securities in euro. To do this, the pension company has to enter into a swap whereby it lends the kronor and borrows euro. The Swedish bank, on the other hand, borrows euro in a five-year bond in order to lend Swedish kronor for five years. The bank also needs to swap, but unlike the pension company the bank needs to borrow kronor in exchange for euro. By entering into a five-year swap with one another, both the pension company and the Swedish bank can gain access to the currency they need for five years. If either of them chooses instead to swap at a shorter maturity, this means that they are taking a greater refinancing risk as the swap will have to be renewed more frequently. If this is not possible, the swap counterparty must be refinanced when the swap matures, in kronor in the case of the bank and in euro in the case of the pension company.
Source: The Riksbank.

There are a number of reasons as to why the life insurance and pension companies nevertheless choose short-term FX swaps over CCY swaps. One reason is that it is

difficult for some of these companies to enter into long-term swaps as they are constantly rebalancing their investments and hence would also need to adjust their CCY swaps, which they do not need to do to the same extent with FX swaps with short maturity. Another reason is that these companies already invest directly in the banks' bonds and either cannot or do not want to further increase their exposure to the banks. Furthermore, these companies sometimes lack technical systems and, in some instance, risk limits for making CCY swaps. However, information from participants in the swap market indicates that life insurance and pension companies have recently increased their participation in long-term swaps. If this continues, it may help in the long term to reduce the imbalance between supply and demand for Swedish kronor in long-term swaps and to make this market more robust.

Besides life insurance and pension companies, *arbitrage issuers*[16] which issue in Swedish kronor could also contribute to balancing the demand and supply of kronor in the CCY swap market as these participants also need to convert long-term Swedish kronor. For the arbitrage issuers to be willing to participate in the Swedish swap market, they have to be able to reduce their total funding cost by funding themselves *via* the Swedish krona instead of issuing directly in the foreign currency that they need. This in turn requires that they receive a high interest rate for supplying kronor in the swaps. Compared to before the financial crisis, the cost for converting euro to Swedish krona has been relatively high. This is favourable for the arbitrage issuers, and in line with that their issues in Swedish kronor seem to have increased somewhat since then.

i. Use of systems in the financial infrastructure to manage risks on the currency swap market

The counterparty risk and settlement risk arising on the back of the trading in currency swaps can be reduced by market participants using systems in the financial infrastructure. Even today, market participants are using settlement systems for currencies, but to further reduce the risks and promote a more transparent market, new systems such as central counterparties and trade repositories for currency derivatives may be developed.

More currencies, derivatives and participants in the settlement system

It is up to the respective market participants to determine whether they should expose themselves to settlement risk by not settling their swap transactions via a global infrastructure for currency settlement or reducing the settlement risk by using this infrastructure. The proportion of FX swaps settled via CLS may increase further by increasing the number of currencies and participants in the system. CLS could also increase the number of derivatives which it manages, such as CCY swaps, which would further reduce the settlement risk on the currency swap market.

16 See footnote 6 for an explanation.

Central counterparty for currency derivatives

As things stand at present, there is no central counterparty (CCP) for currency swaps. A CCP replaces the original agreement with two new contracts and becomes the legal counterparty to both sides of the transaction – buyer to each seller and seller to each buyer. At the same time, the participants entering into a swap agreement must also provide collateral to the CCP for the commitments they have made. This means that the counterparty risk between two participants on the currency market could be reduced if a CCP were to be introduced on the currency swap market.

For CCP clearing to take place, the instruments to be cleared must be liquid and standardised. However, the CCY swaps which the banks are using at present are largely customised and, in some instances, difficult to standardise. Moreover, liquidity in the market for these swaps is often limited. Therefore it is not necessarily appropriate to use CCP clearing for CCY swaps. Instead, it could be the case that it is more reasonable for participants to provide collateral in order to reduce the counterparty risk for the currency swaps not cleared via a CCP. In this case, the participant in question has to make a fair valuation of the positions entered into and provide collateral in relation to these. The participant does not have the same opportunity to net its positions as with the derivatives cleared via a CCP. However, given the fact that Swedish banks have a structural need to borrow kronor against foreign currency, the option of netting these transactions via a CCP should be very limited.

Trade repository for currency swaps

The market for FX swaps and CCY swaps could also be made more robust if its transparency were to increase and both authorities and private participants were to have better opportunities to assess risks in this market. Mandatory reporting to a trade repository would lead to greater transparency and increase financial stability. Authorities would then have better chances of monitoring the positions of individual banks and their counterparties, and of assessing the systemic risk on the currency swap market. Market participants would also be able to assess some of this information, albeit at a general level.

4 Conclusion

Overall, the Swedish banks fund around SEK 700 billion of their lending in Sweden with market funding in foreign currency swapped to Swedish kronor, of which approximately one-third funds long-term lending such as mortgage loans.

The information collected by the Riksbank in June 2011 indicates that the banks hedge themselves against a major part of the bank-specific risks arising in currency swaps. More specifically, the data indicate that banks largely match the maturity of their swaps with the maturity of their underlying bonds when they convert funding in foreign currency to kronor, thus limiting their refinancing risk in Swedish kronor. In addition, the banks largely

use standardised agreements with their counterparties as well as the specific infrastructures for settlement of the transactions which are currently available in the market in order to reduce counterparty risks and settlement risks respectively.

At the same time, the use of currency swaps to fund long-term lending in Swedish kronor means that the Swedish banks become dependent on a small and concentrated market that is susceptible to disruptions. One important reason for this is that most of the transactions on the long-term swap market take place either between two Swedish banks or between Swedish banks and foreign banks. As the foreign banks often fund their krona lending in the swaps on a short-term basis, the Swedish swap market is susceptible to disruptions on the short-term interest rate market in Swedish kronor. However, the risks on the currency swap market would not be reduced if the Swedish banks were only to enter into swap transactions with one another.

Given this, for the swap market not to suffer from disruption, it is essentially necessary for the short-term interest rate market to be stable and predictable and that the Swedish banking system is well-capitalised to maintain the confidence in the Swedish banking is sustained.

Lastly, we can conclude that there is a mismatch between the demand and the supply for kronor in long-term swaps. However, recently participants such as life insurance companies, pension companies and arbitrage issuers, which all have a need to exchange long-term kronor for other currencies, seem to have increased their participation in long-term currency swaps. In the long term, this may have a stabilising effect on the Swedish swap market. The fact that more participants are using systems within the financial infrastructure may also reduce risks on the currency swap market, and also have a positive influence on the market by helping to increase transparency.

References

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Appendix 1. How does a currency swap work?

Assume that a bank has access to unsecured funding in euro for three months, but has no access to funding in kronor. By entering into a currency swap, the bank can convert this euro funding to Swedish kronor over a set period of time and at the same time eliminate the currency risk arising if an asset is held in one currency and a liability is held in another. Essentially, there are two types of currency swap: *FX swaps* and *cross-currency basis swaps (CCY swaps)*. These two instruments are similar in structure, but they differ in at least two important aspects. An FX swap normally has a maturity of less than one year and does not include any interest payments, while a CCY swap has a maturity in excess of one year and includes periodic interest payments.

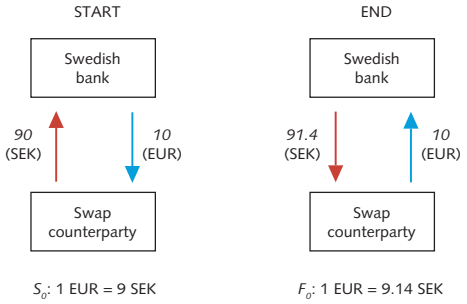
FX swap

An FX swap is an agreement between two parties to simultaneously buy and sell one currency against another at two different dates: when the parties enter into the agreement and when the agreement matures. As the transaction involves one currency being exchanged for another, it can be regarded as being partially secured. An FX swap often has a maturity of just a couple of days or months, and sometimes up to one year.

Figure A1 shows an example of the payment flows in an FX swap. The nominal amounts are exchanged both when the parties enter into the swap and when it matures. In this case, the Swedish bank exchanges kronor for euro at the current exchange rate (spot rate). If the spot rate is 1 EUR = 9 SEK, the Swedish bank pays 10 million euro and receives 90 million kronor (9 × 10 million). At the same time, the Swedish bank agrees with the swap counterparty to buy back 10 million euro in, say in three months' time. The amount to which this equates in kronor and that the Swedish bank will pay back when FX swap matures is determined using the forward rate at the time when the swap agreement is entered into: $F_{0.}$ In turn, the forward rate is determined by the interest rate differential between the two currencies which the parties exchange in the swap.[17] If the forward rate in this case is 1 EUR = 9.14 SEK, the amount which the Swedish bank must pay back to the swap counterparty will be 91.4 million kronor.

17 $F_0 = S_0 * \frac{(1 + \text{Interest rate}_{SEK})}{(1 + \text{Interest rate}_{EUR})}$

Figure A1. Schematic representation of the flows in an FX swap
Millions



Note. In the figure S_0 is the spot rate between kronor and euro when the contract is entered into. When the swap matures, the repayment is determined by the forward rate between the currencies F_0. The forward rate is agreed when the parties enter into the swap agreement and is based on the interest rate differential between the two swapped currencies at this time.

In an FX swap, the parties do not exchange interest rate flows during the maturity of the swap, but the interest expenses for the respective "loans" of currency are included in the payment made when the swap matures. The total cost of borrowing domestic currency via the swap market is known as the *FX swap-implied interest rate*.

Cross-currency basis swap (CCY swap)

A bank may, however, need to hedge its currency risks over a longer maturity than what is possible with an FX swap. Assume that a bank needs funding in kronor for six months but only has access to three-month FX swaps. In this situation, the bank can enter into a three-month FX swap today and then enter into a new three-month FX swap when the first swap matures. In this way, the bank can create funding in kronor for six months despite only having access to three-month FX swaps. Of course, this option is not limited to six months. The same transaction can be repeated so as to create funding in kronor with the required maturity. Thus a bank can use short-term FX swaps to manage currency risks at maturities which are considerably longer than for the individual swaps.

However, it is possible that the bank will not want to rely on its option of renewing or "rolling over" FX swaps over a long period. There is a risk that the bank for some reason may be unable to acquire kronor via the FX swap market in the future. To avoid this risk, the bank can opt today to enter into a transaction which provides access to funding in kronor over a longer period. For example, a bank can acquire funding for six months by entering into two transactions at once: an FX swap with a start date of today and maturity in three months, and an FX swap that will start in three months' time and mature in six months' time. To facilitate this type of transaction, an instrument has been developed which comprises such a package of FX swaps, which is known as a *CCY swap* (see Figure A2).

Figure A2. Long-term synthetic funding in kronor via a number of three-month FX swaps

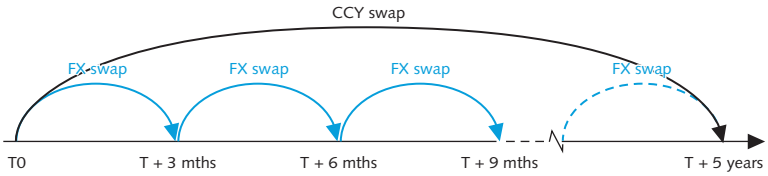
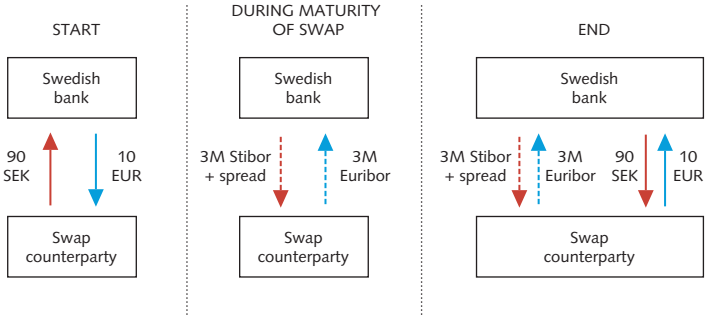


Figure A3 shows in schematic form the possible structure of the payments in a CCY swap. When the parties enter into the swap, the Swedish bank receives kronor from its counterparty and at the same time pays the equivalent amount in euro. If one euro is worth 9 Swedish kronor, that is to say $S_0 = 9$ SEK/EUR, and the Swedish bank pays 10 million euro to the counterparty, it is able to borrow 90 million kronor. During the maturity of the swap, the Swedish bank pays quarterly interest on the kronor it has borrowed, typically specified as the Swedish three-month interest rate, STIBOR, plus a spread (that is to say, the price of the swap which the parties agreed upon when entering into the agreement). At the same time, the Swedish bank also receives three-month interest for euro from the counterparty every quarter. At the end of the contract, the Swedish bank pays back 90 million kronor to the counterparty, which at the same time pays back 10 million euro to the Swedish bank. The parties then also exchange the final interest payments.

In terms of structure, a CCY swap is thus very similar to an FX swap. In both contracts nominal amounts in the respective currency are exchanged when the contract is entered into and terminated. The difference lies in the periodic interest payments which take place between the parties during the maturity of the swap and in the fact that the maturity of the CCY swap is typically longer than in an FX swap. The size of the interest payments is not fixed; instead, a variable interest rate and a spread are specified.

Figure A3. Payment flows in a CCY swap
Millions



S_0: 1 EUR = 9 SEK

Appendix 2. Currency risks related to open positions on the balance sheet

Essentially, a bank can convert funding in foreign currency to Swedish kronor by exchanging it on the spot market. However, this would involve a significant currency risk for the bank since it would result in an open currency position in the bank's balance sheet. That is to say, after the exchange the bank would have its assets in Swedish kronor and its liabilities in foreign currency, in euro in this example (see Table A1).

Table A1. Balance sheet of a bank borrowing in a five-year bond in euro and exchanging for kronor on the spot market

	ASSETS	LIABILITIES
Balance sheet items:	SEK 9 billion lending, 5 years	EUR 1 billion issued securities, 5 years
Off-balance sheet items:	0	0
Total position in SEK	SEK 9 billion	SEK 0 billion
Total position in EUR	EUR 0 billion	EUR 1 billion

The currency risk involves the bank being susceptible to currency rate fluctuations. If the krona were to weaken against the euro, the bank would then be forced to recognise a loss as the bank's liabilities, measured in krona terms, have increased. This would also affect the bank's capital. The bank may make significant losses even with only minor exchange rate fluctuations if its open currency position is large. For a retail bank, therefore, there is no justification from a business perspective to have large open currency positions on the balance sheet. A bank with an average profit margin on lending of approximately 0.5 per cent would lose all its earnings in the event of an exchange rate fluctuation of 0.5 per cent in this example, where the bank has a completely open currency position.

Moreover, if the krona remains weak against the euro after the five years have passed, the 9 billion kronor which the bank receives back from its customers will not be enough to repay the investors in the bond. On exchanging back to euro, the bank will have a lower spot rate in this case, and hence the amount that the bank obtains will not be sufficient to cover its obligation. The bank will then need to sell assets in order to cover the missing amount. Due to the major risks associated with open currency positions on the balance sheet, banks with large positions of this type are subject to significant further capital requirements.

Appendix 3. Currency and refinancing risks when the banks use FX swaps and CCY swaps

Assume that a Swedish bank on two occasions lends 9 billion Swedish kronor over five years in a mortgage loan and funds this by issuing 1 billion euro in a five-year bond in euro. The bank converts the bond in euro to kronor on the market using a swap. On one occasion, the bank enters into a CCY swap with the same maturity as the bond in euro, that is to say five years, while on the other occasion it enters into an FX swap with three-month maturity which is renewed every three months over a period of five years.

In both cases, the bank exchanges 1 billion euro which it has borrowed in the bond for 9 billion kronor with a swap counterparty, and can then lend the kronor to its Swedish customer. In the bank's balance sheet, there is a claim of 9 billion kronor to the bank's borrower (lending) and a liability to the bond investor of 1 billion euro (see Tables A2 and A3). Moreover, off-balance the bank has an asset in the form of a 1 billion claim in euro which is equivalent to the lending in the swap, and a liability of 9 billion kronor equivalent to the borrowing in the swap.

Table A2. Balance sheet for a bank which swaps a five-year bond in euro to kronor in a CCY swap with a maturity of five years

	ASSETS	LIABILITIES
Balance sheet items:	SEK 9 billion lending, 5 years	EUR 1 billion issued securities, 5 years
Off-balance sheet items:	EUR 1 billion lending in CCY swap, 5 years	SEK 9 billion borrowing in CCY swap, 5 years
Total position in SEK	SEK 9 billion	SEK 9 billion
Total position in EUR	EUR 1 billion	EUR 1 billion

Table A3. Balance sheet for a bank which swaps a five-year bond in euro to kronor with an FX swap with a maturity of three months

	ASSETS	LIABILITIES
Balance sheet items:	SEK 9 billion lending, 5 years	EUR 1 billion issued securities, 5 years
Off-balance sheet items:	EUR 1 billion lending in FX swap, 3 months	SEK 9 billion borrowing in FX swap, 3 months
Total position in SEK	SEK 9 billion	SEK 9 billion
Total position in EUR	EUR 1 billion	EUR 1 billion

In both cases presented above, the position which appears off-balance for the bank is a mirror to its position on the balance sheet. This means that an increase in the value of the

bank's euro liability in the balance sheet as a consequence of a currency exchange rate fluctuation will be perfectly offset by an increase in the bank's off-balance euro asset. Provided that the bank enters into a new FX swap every three months when the old one matures, throughout the entire five-year period, any increase in the bank's liabilities as a consequence of a fluctuation in the currency exchange rate will in both cases be offset entirely by an equally large increase on the bank's asset side. This means that the value of the bank's assets in both cases will be equivalent to the value of the bank's liabilities, irrespective of how the exchange rate between Swedish kronor and euro fluctuates. Hence the bank takes no currency risk.

However, as can be seen from Table A3, there is a maturity mismatch between assets and liabilities in kronor and euro respectively when the bank uses an FX swap, which is not the case when the bank executes a CCY swap. To avoid the currency risk, the bank must in the first instance regularly renew the FX swap during the maturity of the bond. However, the bank does not know whether it will be able to borrow kronor when the FX swap matures, or on what terms. Hence the bank takes a refinancing risk in Swedish kronor when using swaps with a shorter maturity than the underlying bond.[18]

18 In the example, the bank's lending also has the same maturity as the bank's funding in the bond in euro. In this case, therefore, the bank has access to kronor from its customer while at the same time having to repay kronor to its swap counterparty. However, this is a simplification. In reality, most of the banks' lending for mortgage loans has a considerably longer maturity than five years. As a consequence of this, the banks are dependent on being able to renew both their funding in foreign currency – that is to say, the bond in euro – and the CCY swap.

Review of the Riksbank's operational framework for the implementation of monetary policy

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The Riksbank attempts to influence interest rates in the economy so that the inflation target is met. In this article we describe how the Riksbank steers the risk-free overnight rate for interbank loans in practice. We present the instruments in the Riksbank's toolkit and how these are used to steer the overnight rate. We find that the Riksbank's operational framework for the implementation of monetary policy performs its task of stabilising the overnight rate well. However, we also show that the framework is not adequate to satisfactorily influence interest rates at longer maturities than overnight. Experience from the latest financial crisis has also demonstrated that the Riksbank should be well prepared to conduct monetary policy under extraordinary circumstances. In this context, there may be a need to add to the Riksbank's toolkit. There is also a need to continuously evaluate the operational framework.

The Riksbank began to evaluate its operational framework for the implementation of monetary policy in the spring of 2008. The financial crisis began shortly afterwards, which taught the Riksbank new lessons about how the framework functions. This article should thus be seen as a status report rather than as a final evaluation – especially considering that we are now in a situation in which the crisis measures taken by central banks abroad are still ongoing. Work is also underway on the regulation of the financial sector which may have consequences for the design of the operational framework.

The operational framework plays a central role for the Riksbank's ability to implement monetary policy. The Riksbank changed its approach to conducting monetary policy in the 1990s. In connection with the crisis in 1992, the Riksbank abandoned the fixed exchange-rate regime and decided instead to conduct inflation targeting.[1] In order to provide a more transparent system for the implementation of monetary policy, a new operational framework was introduced in June 1994. The Riksdag (the Swedish parliament) subsequently increased the Riksbank's ability to attain the inflation target by adopting a new Sveriges Riksbank Act that since 1 January 1999 ensures the Riksbank's independence.

1 Under the Sveriges Riksbank Act, the Riksbank shall maintain price stability, which means that inflation should be low and stable. The Riksbank has specified the target for monetary policy such that inflation should be 2 per cent a year, measured as the annual percentage change in the Consumer Price Index (CPI). Any deviation from the target does not have to be immediately corrected as this could have negative consequences for economic growth.

An Executive Board consisting of six members was entrusted to independently decide on a policy rate at monetary policy meetings held at intervals of six to eight weeks.

Since 1999, the Riksbank has conducted monetary policy by the Executive Board deciding on and signalling the level of the most important policy rate – the repo rate – that is compatible with the inflation target. The Riksbank's operational framework for the implementation of monetary policy is designed to steer the market's overnight rate, that is the interest rate on overnight loans between the banks. The idea is that the framework should stabilise the overnight rate at a level close to the repo rate. In this way the overnight rate should act as an anchor for the yield curve (interest-rate formation at longer maturities). However, in an attempt to steer interest-rate formation at longer maturities more directly, the Riksbank also publishes a forecast of future repo rates, a so-called repo-rate path, that are compatible with the inflation target. The Riksbank's ambition is to stabilise the shortest, risk-free interest rate while the market is allowed to determine interest rates at longer maturities that include various risk premiums.

In the spring of 2008, the Riksbank began to evaluate how well the operational framework for the implementation of monetary policy works. This evaluation mainly entails reviewing how the framework performs its tasks of effectively implementing the Riksbank's monetary policy decisions and steering liquidity in the payment system. This review was started in 2008, but the financial crisis began shortly afterwards and this taught the Riksbank new lessons about how the framework functions under different circumstances. The evaluation thus needs to continue so that we can take these lessons into account. In the meantime, however, we can present a status report that describes how the framework works today and identifies some areas for improvement.

This article consists of three sections. The first section describes how the operational framework works and explains how it came to take its present form by looking back at some high points in its historical development. The second section describes the Riksbank's counterparties and the securities these use as collateral for loans from the Riksbank and in the monetary policy repos. In the third and final section, we discuss some areas in which the framework can be improved.

Steering the overnight rate and liquidity in the banking system

We begin by briefly describing payments during the day in the payment system (intraday payments) and on the overnight market, that is the market for loans overnight between the banks. It is the interest rate on this market – *the overnight rate* – that the Riksbank tries to steer.[2] The Riksbank offers the banks that participate in the RIX payment system the opportunity, when necessary, to borrow from the Riksbank during the day without paying interest but against collateral via so called intraday loans. The conditions for these loans are generous. In this way, the Riksbank encourages the banks to use intraday loans in order

2 A more detailed description of the overnight market is given in Kronestedt Metz (2005) and Eklund and Åsberg Sommar (2011).

to make payments more easily and more efficiently. However, in order to avoid individual banks systematically funding their operations via the Riksbank the conditions for overnight loans are not as generous. The banks therefore balance out their liquidity positions in relation to each other at the end of the day. In this balancing process, banks with a surplus lend to banks with a deficit so that that the banking system as a whole is balanced before the payment system closes for the day.

The liquidity surpluses or deficits that remain after the banks have balanced their liquidity positions with each other constitute the banking system's net position in relation to the Riksbank. If the banking system has a liquidity surplus in relation to the Riksbank this can be deposited overnight with the Riksbank. If, on the other hand, the banking system has a liquidity deficit then the system as a whole can borrow the corresponding sum from the Riksbank overnight.

The conditions governing how the banks can deposit and borrow liquidity overnight form the core of the operational framework. By setting the conditions for the banks' deposits and borrowing at the Riksbank, the Riksbank can steer the interest rate for loans at the shortest maturity – overnight loans. As the Riksbank focuses on balancing the banks' liquidity at the end of the day in this way, the interest rate for overnight loans – the overnight rate – becomes the operational target for monetary policy. The Riksbank stabilises the overnight rate and thus creates an anchor for interest rate formation at longer maturities, which is necessary but far from sufficient to stabilise interest rate formation at longer maturities.

If the banking system has a large liquidity surplus to deposit at the end of the day this may push down the overnight rate. This gives the Riksbank a reason to use some form of instrument to try do draw in this liquidity at longer maturities. In the next section we therefore discuss which instruments the Riksbank uses for this purpose. We also discuss the Riksbank's liquidity management during the financial crisis when it took a number of extraordinary measures, the main measure being to lend to the banks at longer maturities. As we shall see, this had consequences for the Riksbank's steering of both liquidity and interest rates.

THE CONDITIONS GOVERNING INTRADAY CREDIT AND CREDIT OVERNIGHT FORM THE CORE OF THE OPERATIONAL FRAMEWORK.

If two people have accounts in the same bank, a payment between them may be carried out simply by the bank debiting the account of one of them and crediting the account of the other. We then say that the payment is settled (or carried out) in *commercial bank money*. However, if the two people concerned have accounts with different banks, a payment must also be made between these banks. Such interbank transactions are usually

settled in central bank money, that is by debiting and crediting the banks' accounts in the Riksbank's payment system RIX.[3]

RIX participants can increase their credit limit in the payment system by using securities or foreign currency as collateral for intraday loans or by transferring banknotes and coins to the Riksbank. Intraday loans, which are interest free, are registered in the RIX participants' loan accounts in the system. Although the loans are interest free this does not mean that that they are cost free, as the loans are provided against collateral and there are certain costs associated with the management of the securities used as collateral.

Central bank money can also be created on the initiative of the Riksbank. The Riksbank can lend Swedish kronor at longer maturities than intraday and can also buy assets. For example, the Riksbank can buy foreign currency from a RIX participant and pay by crediting the participant's RIX account with Swedish kronor. RIX is open every Swedish banking day between 7 a.m. and 5 p.m. RIX participants who are not entitled to overnight loans have to settle their intraday loans by close of business. Otherwise, they have to pay a fee. In the case of the other participants the procedure is that if the balance of their RIX account is negative then it is considered that they have requested a loan from the Riksbank's lending facility. If, on the other hand, the balance of their RIX account is positive when the payment system closes, then it is considered that they have requested to use the Riksbank's deposit facility. The maturity of the loans and deposits under these so-called standing facilities is overnight from the time RIX closes until it opens the following banking day.

As a rule, the banks can get better conditions for loans and deposits from each other than the conditions that apply in the standing facilities. This is because in a normal situation the banks believe that lending to each other overnight entails no risk. In the first instance, they therefore use the so-called overnight market to lend or deposit money overnight at the *overnight rate*. If, on the other hand, the banks believe that there is a risk of not getting their money back they will not lend to each other. Banks with a liquidity surplus will instead deposit money in the Riksbank's deposit facility and thus in practice refer banks with a liquidity deficit to the Riksbank to borrow from the Riksbank's lending facility.

HOW DOES THE RIKSBANK STEER THE OVERNIGHT RATE?

The operational framework for the implementation of monetary policy is designed so as to make it possible to steer the overnight rate towards the level of the repo rate adopted by the Executive Board of the Riksbank. The primary instruments for steering the overnight rate are the Riksbank's standing facilities, the so-called deposit and lending facilities, and the fine-tuning transactions.

3 The RIX participants are the Riksbank, the Swedish National Debt Office and a number of credit institutions and clearing organisations. Settlement in RIX takes place under the principle of real-time gross settlement. This means that payments are settled one at a time and that the funds transferred to a RIX account become immediately accessible in the account and can be used for other payments.

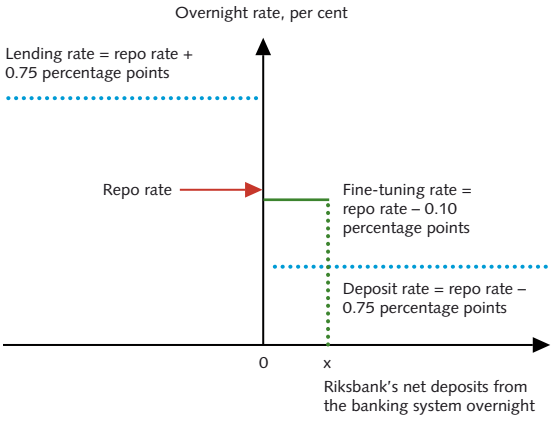
Standing facilities

The Riksbank provides a deposit facility with a deposit rate equal to the repo rate minus 0.75 percentage points and a lending facility with a lending rate equal to the repo rate plus 0.75 percentage points (see Figure 1). At close of business, that part of a bank's loan account that is equal to the bank's holdings in its main RIX account is automatically repaid. If the balance of a bank's loan account with RIX shows a deficit when the payment system closes for the day, the bank has to pay the lending rate on the balance overnight (that is until the next bank day). If the balance of a bank's main account shows a surplus when the payment system closes, the bank earns the deposit rate on the sum overnight. The sum that can be borrowed from the lending facility is limited by the adjusted value of the collateral provided by the bank. There is no limit on how much a bank may deposit in the deposit facility.

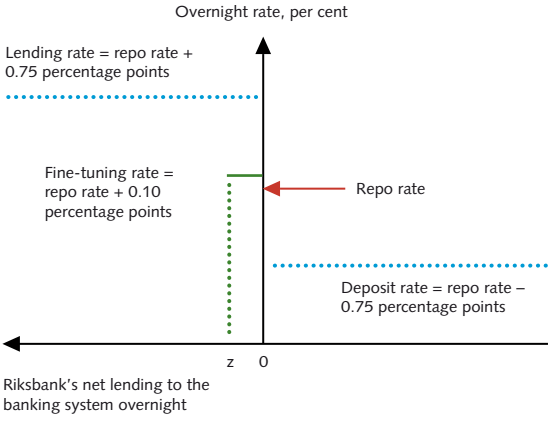
Due to the standing facilities, a bank will never deposit a surplus on the overnight market at a rate lower than the deposit rate or borrow at a rate higher than the lending rate. It will be more advantageous to leave the balances in RIX until it closes. The deposit and lending rates thus form a corridor for the overnight rate. The position of the overnight rate within the corridor is a matter for negotiation between the banks on the overnight market.

Chart 1. The Riksbank's operational framework for the implementation of monetary policy

Panel A. The banking system has a liquidity surplus in relation to the Riksbank



Panel B. The banking system has a liquidity deficit in relation to the Riksbank

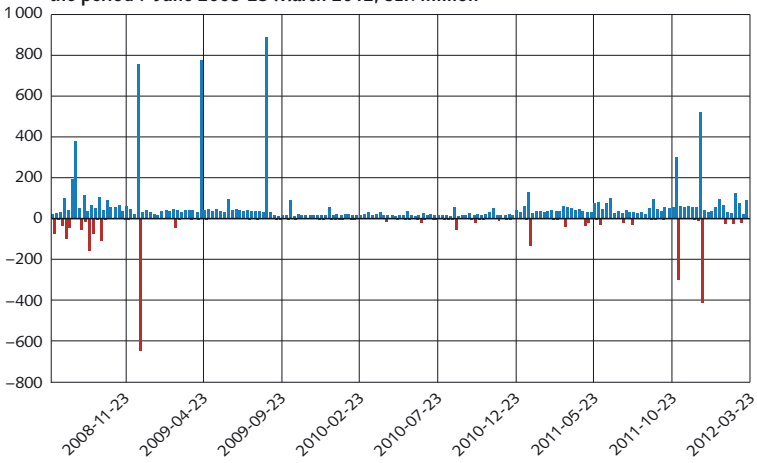


Note. Panel A shows a situation in which at the end of the day the banking system has a liquidity surplus of SEK x million in relation to the Riksbank, while panel B shows a situation in which at the end of the day the banking system has a liquidity deficit of SEK z million in relation to the Riksbank. The figure also shows that the repo rate is the reference rate for the Riksbank's other policy rates.

Several million kronor remain in the standing facilities at the end of almost every banking day (see Figure 1). Why isn't the banking system fully balanced before RIX closes? This is because the surpluses often consist of smaller items divided between several banks. None of these banks is particularly interested in completing a transaction as the transaction costs will be higher than the interest income. Usually, therefore, it is only small sums that end up in the standing facilities. There are, however, some exceptions, as we can see in Figure 1. The extreme values that can be noted at a few points in time in Figure 1 are probably due to liquidity-management mistakes on the part of one of the banks.

During the financial crisis it was unusual for a bank to have a deficit at the end of the day as the Riksbank offered extra liquidity to the banks, which also meant that the lending facility was seldom used in this period.

Figure 1. Deposits (+) and lending (–) in the standing facilities, weekly data for the period 7 June 2008-23 March 2012, SEK million



Source: The Riksbank's weekly reports.

Fine-tuning transactions

Daily fine-tuning transactions were introduced in 1995 as a way for the Riksbank to stabilise the overnight rate around the repo rate and thus avoid fluctuations in the overnight rate being interpreted as policy signals by the market participants.[4]

The fine-tuning transactions are normally carried out every banking day between 4 p.m. and 4.40 p.m.[5] In the fine-tuning transactions, the Riksbank offers credit against collateral or overnight deposits at an interest rate equal to the repo rate plus/minus 0.10 percentage points (see Chart 1). If the banking system as a whole has a liquidity deficit, the Riksbank lends funds, although not to an amount that exceeds the banking system's total deficit. A similar procedure applies if the banking system as a whole has a liquidity surplus. In this case, the Riksbank receives funds, but not to an amount that exceeds the banking system's total surplus.

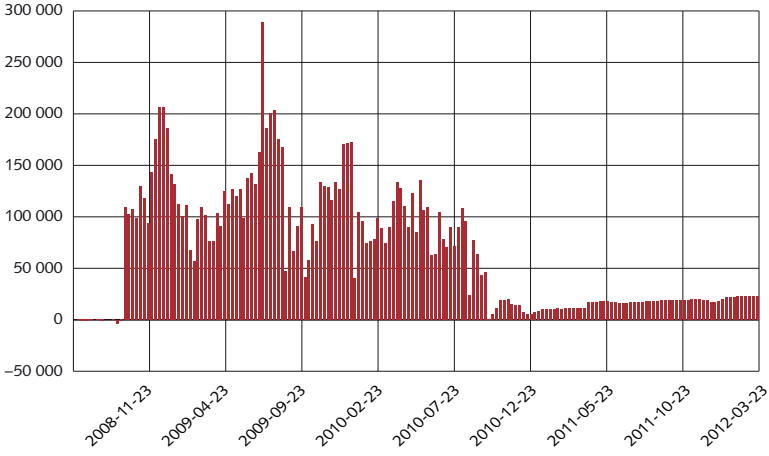
The banks know that the banking system's liquidity position in relation to the Riksbank will largely be in balance after the Riksbank has carried out the fine-tuning transactions. This means that the total lending requirement of the banks with deficits will be as large as the surplus of the other banks in the system. If a bank with a deficit finds a bank with surplus, they usually perform a transaction with an interest rate equivalent or almost

4 See Holmberg (1996).
5 As all the monetary policy counterparties have been able to participate in fine-tuning transactions since 8 October 2008, the Riksbank has expanded the period allowed for fine-tuning, which previously began at 4.20 p.m.

equivalent to the repo rate. According to the banks themselves, the knowledge that the system will largely be in balance at the end of each day contributes to this pricing practice.

Before the Riksbank began to provide extra liquidity during the financial crisis the fine-tuning transactions amounted to very small sums (see Figure 2). However, from mid-October 2008 it was not unusual for the banks to deposit over SEK 100 billion overnight in fine-tuning operations as they did not want to tie up liquidity by bidding to the full in emissions of Riksbank certificates with a maturity of one week. Even after the Riksbank stopped providing extra liquidity the banks have preferred to be liquid. Since the end of October 2010 interest in Riksbank certificates has been non-existent and the entire liquidity surplus has been placed in the fine-tuning transactions.[6]

Figure 2. Fine-tuning transactions, weekly data for the period 7 June 2008-23 March 2012, SEK million



Source: The Riksbank's weekly reports.

The width of the interest rate corridor has varied

Prior to 1 January 1999, the deposit and lending rates were decided on by the General Council of the Riksbank. The Governor of the Riksbank was then able to decide on the level of the repo rate within the interest rate corridor that followed from the General Council's decision. The deposit and lending rates could thus be used to signal monetary policy in the slightly longer term. At its meeting on 6 December 2000, the Executive Board decided that the monetary policy signalling function of the deposit and lending rates would be abolished. The deposit and lending rates would instead be changed when the repo rate was changed, so that the repo rate would always be in the middle of the interest rate corridor. The main reason for this change was that the market attached greater importance to other

6 There has only been one exception. In mid-December 2010 a bank purchased Riksbank certificates for SEK 500 million.

methods that the Riksbank used to signal the long-term direction of monetary policy, for example the speeches of the members of the Executive Board.[7]

Since the new framework came into operation on 1 June 1994, the width of the corridor has been 1.50 percentage points, with only two exceptions.

- Between 11 August 1994 and 12 April 1995 the width of the corridor was 2.00 percentage points. On 11 August, the Riksbank announced that it had increased the lending rate to 8 per cent while the deposit rate was left unchanged at 6 per cent. At the same time, the repo rate was raised from 6.92 per cent to 7.20 per cent.
- When the Executive Board decided to cut the repo rate to 0.50 per cent on 20 April 2009, they also decided to narrow the interest rate corridor from 1.50 to 1.00 percentage points to avoid a negative rate for the deposit facility.[8] The width of the corridor was restored from and including 7 July 2010.

HOW DOES THE RIKSBANK STEER LIQUIDITY IN THE BANKING SYSTEM?

Given that the Riksbank carries out the fine-tuning transactions at the repo rate plus/minus 0.10 percentage points, liquidity in the banking system may be of some significance for the level of the overnight rate. For example, the overnight rate was pushed down by almost 0.10 percentage points when the Riksbank lent large sums to the banks during the financial crisis. There are two reasons for this: first, what the Riksbank lends automatically comes back at the end of the day as deposits and, second, the banks to a large extent make deposits using the Riksbank's fine-tuning transactions at the repo rate minus 0.10 percentage points. It is therefore important for the Riksbank to steer liquidity in the banking system. The Riksbank does this primarily by using monetary policy repos or by issuing Riksbank certificates. These transactions are carried out at the repo rate. According to the Riksbank's regulations for RIX and monetary policy instruments, the Riksbank can also use FX swaps or direct purchases and sales of securities.[9] The different types of transaction that the Riksbank uses to steer liquidity in the banking system are called *open market operations*.

Monetary policy repos and issues of Riksbank certificates

Each week, the Riksbank offers to borrow money from the banks by issuing Riksbank certificates with a maturity of one week. If the banking system has a liquidity deficit instead, which was the case before October 2008, the Riksbank can lend money by conducting a monetary policy repo. The repo procedure entails the Riksbank purchasing acceptable securities from a monetary policy counterpart at the same time as this

7 The speeches of the members of the Executive Board are no longer used as a signalling tool. The Riksbank publishes a forecast for the repo rate instead.

8 However, when the repo rate was cut to 0.25 per cent on 8 June 2009, the width of the corridor was left unchanged and the deposit rate thus became -0.25 per cent. In Figure 1 we can see that the sums in the deposit facility were unusually low during the following year when the deposit rate was negative.

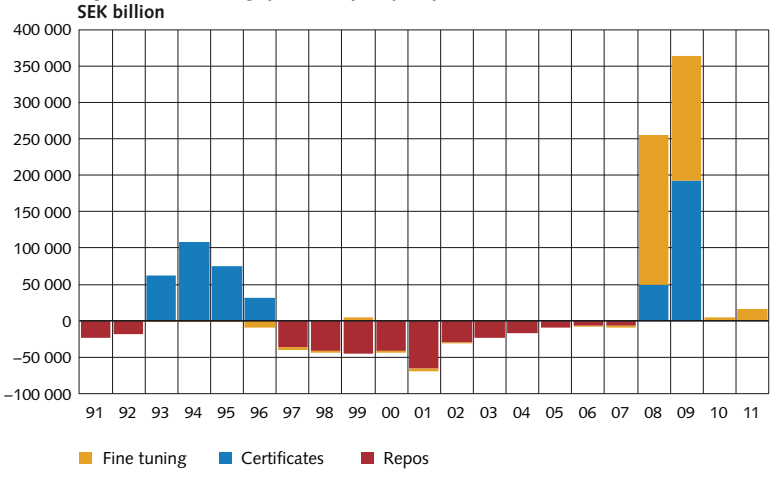
9 Sveriges Riksbank, Terms and conditions for RIX and monetary policy instruments.

counterpart undertakes to repurchase corresponding securities for a predetermined price a week later. The difference between the prices of the repos and certificates in connection with sale and repurchase is determined by the Riksbank's repo rate.

One week was chosen as the period for the maturity of certificates and the frequency of repos and certificates because the Riksbank wanted to be able to change the repo rate every week.[10] This was changed on 1 October 1999 when it was decided that the Executive Board would in the future only decide on policy rates at the special monetary policy meetings held at intervals of six to eight weeks. This dissolved the close relationship between the repo-rate decisions and the weekly market operations.

The banking system had a liquidity deficit throughout the period 1997-2007. The Riksbank therefore used weekly repos with a maturity of one week to supply liquidity to the banking system (see Figure 3). During the summer of 2008, the repos were so small that there was a risk of having to alternate between supplying liquidity to or draining liquidity from the banking system. This would have made liquidity management more complicated for the monetary policy counterparties. In order to be able to continue with the monetary policy repos, the Riksbank carried out a structural foreign currency transaction. Beginning on 8 September 2008, the Riksbank sold foreign currency and bought kronor to a value of SEK 5 billion so that the banking system would continue to be in deficit. The intention was to subsequently begin issuing Riksbank certificates once the banking system returned to a situation with an ongoing liquidity surplus in relation to the Riksbank. This happened sooner than expected.

Figure 3. The banking system's liquidity surplus 31 December 1991-2011, SEK billion



Source: The Riksbank.

10 See Mitlid and Vesterlund (2001).

Steering liquidity during the financial crisis

In October 2008 it was clear that the international financial unease was also affecting the financial markets in Sweden. The market for long-term loans was working less and less effectively. In this situation, the Riksbank launched a loan facility in Swedish krona to increase access to loans at longer maturities. In the first auction of three-month loans on 6 October, the banks borrowed SEK 100 billion. At a stroke, the banking systems' liquidity deficit with the Riksbank became a liquidity surplus.

Initially, the Riksbank borrowed back the liquidity surplus using the daily fine-tuning transactions. To reduce the size of these transactions, the Riksbank began, on 14 October, to issue Riksbank certificates with a maturity of one week. Later, in the period 1 June to 13 October 2010, the banks were also offered, once a week, Riksbank certificates with longer maturities than one week. These certificates fell due at the time of the next monetary policy meeting. In addition, the Riksbank offered loans in US dollars to the Swedish banks during the crisis. The reason for this was the strained situation on the markets for short-term borrowing in US dollars that arose after Lehman Brothers filed for bankruptcy in September 2008. This lending was made possible by an agreement between the Federal Reserve and a number of other central banks, including the Riksbank, under which the Federal Reserve agreed to lend US dollars to these central banks. On 1 October 2008, the Riksbank lent USD 7 billion for a month in a first auction.[11] This was followed by an additional 14 loans at maturities of one and three months. The final loan was offered in August 2009. In the auctions the Riksbank typically offered USD 10 billion (apart from two smaller loans of USD 7 and 5 billion dollars respectively). The last loans were far from fully subscribed as the situation on the market had normalised. The US dollar lending facility was thus phased out.

The structural liquidity position of the banking system

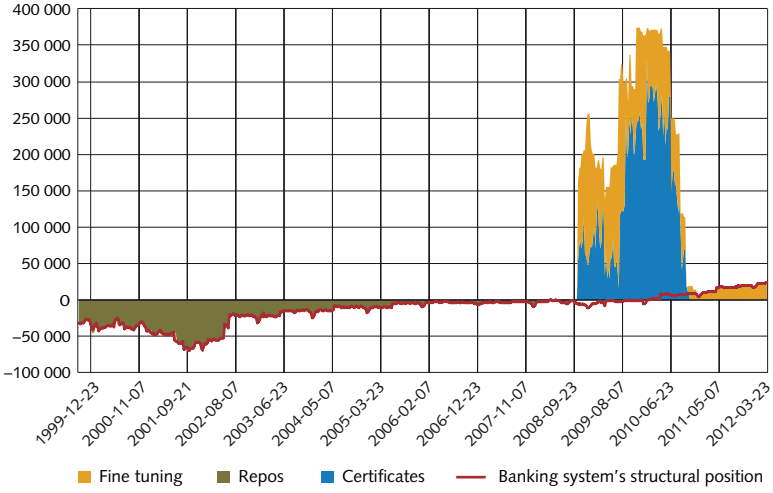
Figure 4 shows that the banking system continues to have a liquidity surplus even after the extraordinary measures in the form of loans to the banks have expired. In other words the banking system has moved from a structural liquidity deficit to having a structural liquidity surplus in relation to the Riksbank. How did this happen? To answer this question we have to go back a decade.

We can see in Figure 4 that the monetary policy repos have decreased in size over time since 2001 and that this trend means that the banking system's structural liquidity position moves from deficit to surplus during the financial crisis. What is this trend due to?

If items on the asset side other than the monetary policy transactions increase (for example through purchases of foreign or domestic assets with payment in kronor), the banking system will have a greater surplus (or a smaller deficit) in relation to the Riksbank. If items on the liability side other than the monetary policy transactions increase, the banking system will have a greater deficit (or a smaller surplus). So what are the items that have driven the banking system towards a surplus?

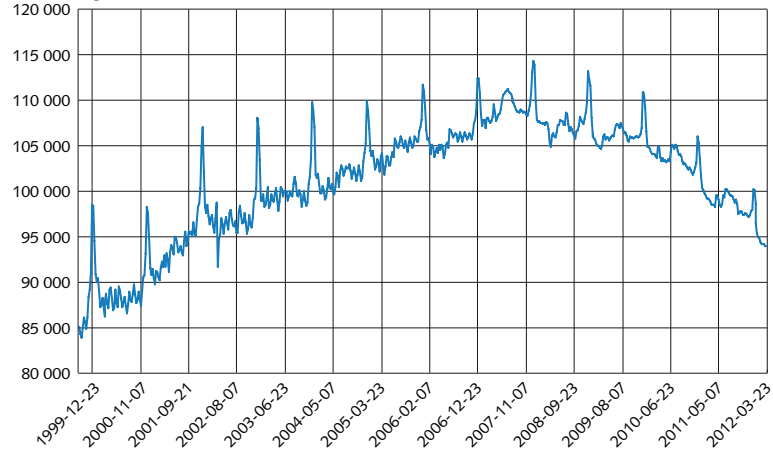
11 This first loan in US dollars was, however, funded through the Riksbank's foreign exchange reserve.

Figure 4. The banking system's structural liquidity position and the Riksbank's open market operations, SEK million



Source: The Riksbank's weekly reports.

Figure 5. Public demand for banknotes and coins, SEK million



Note. The public's demand for banknotes and coins is illustrated in the figure on the basis of movements in the item "Banknotes and coins in circulation" in the Riksbank's balance sheet.
Source: The Riksbank's weekly reports.

The Riksbank's annual payments of profits to the Treasury have had the greatest impact on the development of the banking system's structural position.[12] Part of the Riksbank's profits are paid to the Treasury each year.[13] This is done by crediting the National Debt Office's account in RIX with a sum equivalent to the amount of profits to be transferred.

12 See Nessén, Sellin and Åsberg Sommar (2011) for a more detailed discussion.
13 A detailed description of the method for calculating the transfer of profits to the Treasury is given in Gardholm and Gerwin (2011).

The National Debt Office then deposits the money with a commercial bank as the Riksbank does not pay any interest on the Office's account. This increases the structural liquidity surplus of the banking system. The money in the transfer thus affects the size of the open market operations. This is the main explanation of the fall in the volume of monetary policy repos since 2001 and the fact that there is now a liquidity surplus in the banking system.

Another factor that has contributed to the banking system having a structural surplus in relation to the Riksbank is that the public demand for banknotes and coins has declined (see Figure 5). We can see that the demand for banknotes and coins increased until 2007 but began to fall thereafter. When the public demand for banknotes and coins decreases the banks return more banknotes and coins to the Riksbank and the banks' RIX accounts are credited by the corresponding amounts. This increases the banks' liquidity surplus in relation to the Riksbank and, consequently, their deposits with the Riksbank, for example through the fine-tuning transactions, also increase.

How is the size of the weekly operations determined?

The emission volumes for Riksbank certificates (or previously the size of the repos) are calculated with the help of a forecast of the banking system's liquidity surplus (or previously deficit) for the coming week. Table 1 shows how to calculate the surplus on the basis of the items in the Riksbank's balance sheet. The example is based on the Bank's balance sheet as of 31 August 2011. The banking system's surplus on this day was calculated to amount to SEK 17 571 million. The Riksbank then offered an emission volume of SEK 17 600 million, but no bids were received in the auction. This is because the banks now prefer to use the fine-tuning transactions when they want to have liquidity available on a daily basis. The Riksbank instead drew in SEK 17 539 million of the surplus in fine-tuning transactions. The remaining SEK 32 million were deposited in the deposit facility.

Table 1. The banking system's liquidity surplus 31 August 2011

	SEK million
Gold and foreign currency reserve	324 172
Other assets	4 084
Banknotes and coins in circulation	–99 082
Other liabilities	–144 826
Equity	–66 777
The banking system's surplus	**17 571**

That which above all needs to be forecast in order to determine emission volumes is the public demand for banknotes and coins. This item usually increases in connection with salary payments, before the Christmas shopping period and in connection with holidays. As these increases come at regular intervals from year to year, the forecasts are based on information from the corresponding week in the previous year. The difference between the liquidity forecast and the actual daily surplus (or deficit) is covered by the daily fine-tuning transactions.

If the banks had bid for the entire issue volume of SEK 17 600 billion on 31 August 2011, then the banking system's liquidity position in relation to the Riksbank would have been more or less in balance during the week concerned. Daily changes in the public demand for banknotes and coins would probably then have led to a situation in which, at the end of the day, the banking system would have had a surplus on some days and a deficit on others. In the case of a deficit the Riksbank would have lent money in the fine-tuning transactions, while on the days when the banking system had a surplus the Riksbank would have borrowed money.

Issues of Riksbank certificates are announced by the Riksbank asking for bids at a fixed rate (volume bids). The conditions for each issue (or repo) are announced every Tuesday at 9.30 a.m. and cover

- the type of operation (drawing in liquidity by issuing certificates or supplying liquidity through repos)
- maturity (usually one week)
- the applicable interest rate (the current repo rate)
- the lowest and highest bid volume (in the example SEK 1 million and the total issue volume on 31 August 2011).

The period for submitting bids expires at 10 a.m.. The allocation is then calculated and announced at 10.15 a.m.. If the sum of the bids exceeds the size of the issue (or the repo) the bids are met proportionately in accordance with the ratio between the sum to be allocated and the total sum of the bids. The settlement date is the day after the announcement, which means that certificates (repos) will normally run from Wednesday to Wednesday.

Foreign exchange swaps

Instead of withdrawing liquidity from the banking system by issuing Riksbank certificates the Riksbank could use foreign exchange swaps. This involves selling foreign currency spot for Swedish kronor at the same time as performing the reverse transaction forward (normally from one week up to three months). The Riksbank and the counterparty then agree on a spot price and a forward price for the transaction. By means of this transaction the Riksbank withdraws Swedish kronor from the banking system during the period of the swap agreement. The foreign currency is taken from the foreign exchange reserve. If the Riksbank wishes instead to add liquidity it sells Swedish kronor spot for foreign currency at the same time as performing the reverse transaction forward.

In contrast to when the Riksbank uses monetary policy repos or issues Riksbank certificates, open market operations with foreign exchange swaps are normally carried out using a bilateral procedure. This means that the Riksbank performs a transaction with one or more foreign exchange policy counterparties without a bidding procedure.

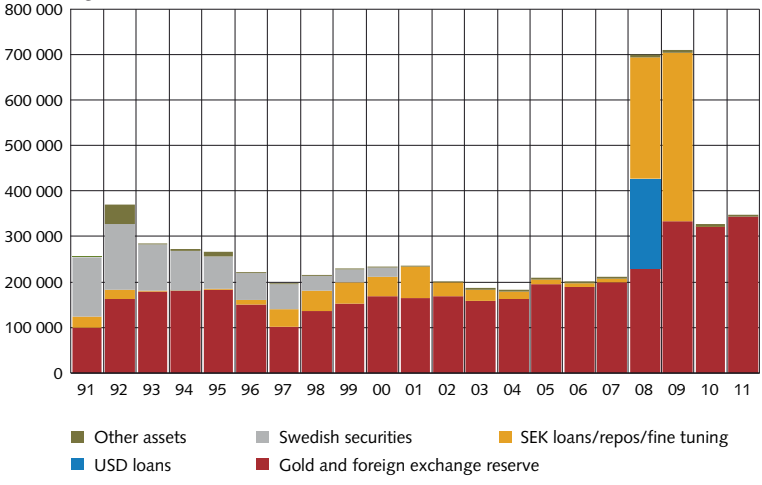
Purchases or sales of securities

The Riksbank can also buy or sell securities on the market in order to affect the financial system's structural deficits or surpluses. However the Riksbank has not used this type of market operation in recent years.

The Riksbank's portfolio of Swedish securities was disposed of in 2001, which is shown in Figure 6. As early as in 1998, the Riksbank reported that it intended to reduce its holdings of government securities by SEK 20 billion. This was because it was considered that the Riksbank's domestic securities portfolio no longer fulfilled any monetary policy function.[14] At the end of the 1990s, the portfolio was mainly used for market maintenance purposes, which meant that the Riksbank provided a repo facility in Swedish securities to the market participants. In this way the Riksbank lent Swedish securities that were attractive on the market.

In November 1999, it was decided to transfer the market-maintaining repo facility to the Swedish National Debt Office. It was then that the question was raised as to whether there was any remaining reason for the Riksbank to hold a portfolio of domestic securities, which at this point in time mainly consisted of government bonds (the Riksbank also had a small holding of treasury bills and mortgage bonds, but these matured in 2000). The conclusion was that this was not the case. The assessment of the General Council was that the Riksbank's equity could be reduced by SEK 20 billion. On 17 May 2001, the Riksdag consequently decided that the Riksbank should make an extraordinary transfer of profits to the treasury. On 13 June, the Riksbank transferred its remaining portfolio of Swedish government bonds, to value of SEK 20 billion, to the Swedish National Debt Office.

Figure 6. The Riksbank's assets on 31 December 1991–2011, SEK billions



Note: Gold is reported at market value from 1995.
Source: The Riksbank.

14 The nominal value of the portfolio at that time was SEK 47 billion. For more information see the Riksbank's press release no. 11, dated 9 March 1998.

The Riksbank's counterparties and collateral

So far we have described how the Riksbank can steer the overnight rate and liquidity in the banking system by carrying out different types of transaction with its counterparties in the money and foreign-exchange markets. But how does the Riksbank select the circle of counterparties? In this section we try to provide an overall description of the different categories of counterparty and the securities they use as collateral for loans from the Riksbank and in the monetary policy repos.

COUNTERPARTIES

Which counterparties does the Riksbank need? Since the operational target of the monetary policy operational framework is to stabilise the overnight rate it is natural that the participants who need to be active in the overnight market should be included among the Riksbank's counterparties. This is also the case. When there is friction on the market for short liquidity it is good for the Riksbank to have a large number of counterparties so that the Riksbank can carry out effective liquidity support measures in the form of loans to the market participants that need them. But normally there are only a few large agents on the Swedish market who want to bear the costs of being a counterparty.[15] Different counterparties also have different capacities and needs and there are thus different categories of counterparty.

In Chart 2 we outline how the different categories of counterparty can overlap. A *primary monetary policy counterparty* is a counterparty in fine-tuning transactions and in monetary policy repos/certificates, has access to the standing facilities and is a RIX participant.[16] A *counterparty in monetary policy repos/certificates* is a RIX participant that, unlike a primary monetary policy counterparty, is not a counterparty in fine-tuning transactions. During the financial crisis, however, these institutions also gained access to the fine-tuning transactions and still have that access today. There is also a category of counterparties that are RIX participants with *access to the standing facilities*. In addition, there are *RIX participants* that do not have access to either the Riksbank's facilities or market operations. A *counterparty in foreign exchange transactions* may also belong to one of the categories above, but could equally be an institution that does not even participate in RIX.

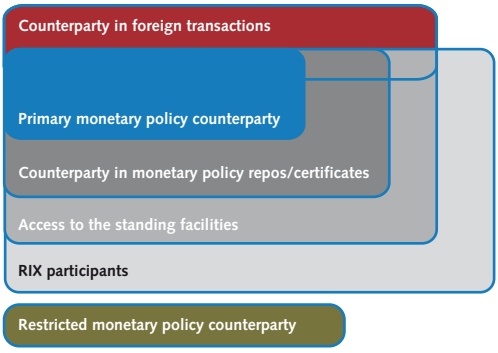
In spring 2009, the category *restricted monetary policy counterparty* was introduced to facilitate funding for the credit institutions that were not monetary policy counterparties to the Riksbank. They could in fact have applied to be monetary policy counterparties. But the Riksbank did not want to extend the circle of participants in RIX with institutions that do not have a natural need to participate in the payment system, since this could entail

15 Counterparties incur costs for having necessary systems in place and the staff to manage them, and also pay a fee for participating in RIX.

16 The primary monetary policy counterparties are a restricted circle of the major banks: Nordea, SEB, Svenska Handelsbanken and Swedbank AB. A current list of RIX participants and counterparties can be found on the Riksbank website www.riksbank.se.

increased operational risks in the system. A credit institution with its registered office in Sweden can instead apply to be a restricted monetary policy counterparty. The Riksbank then decides which operations a restricted monetary policy counterparty is entitled to participate in. Since the Riksbank does not currently have any extraordinary lending there is no reason for any institution to apply to be a restricted monetary policy counterparty.

Chart 2. Different categories of counterparty



Monetary policy counterparties must be RIX participants. The reason is that the Riksbank has considered that those who benefit from participating in the implementation of monetary policy should also contribute to an efficient payment system.

RIX participants have a main account with the Riksbank, where balances are recorded, and a loan account, where credit is recorded.[17] A RIX participant can be granted intraday loans against collateral in accordance with the basic principle that says that a RIX participant also has access to intraday credit.

There are also clearing institutions among the RIX participants.[18] It may seem that a clearing institution should not need intraday loans, since it only mediates payments between other institutions. But the payment system will be more efficient if an institution can make its own payments. The introduction of a central counterparty function can thereby be facilitated without creating further concentration to a number of settlement banks. Consequently the Riksbank also provides intraday loans to clearing organisations.

Only credit institutions can be *counterparties in foreign exchange transactions*. Unlike the monetary policy counterparties, a counterparty in foreign exchange transactions does not need to be a RIX participant.

17 A participant can also have a liquidity settlement account and a central bank credit account with the Riksbank. These accounts are to facilitate securities settlement in Euroclear Sweden and are therefore administered by that clearing institution. In addition, there are five LOM accounts with special settlement procedures that the counterparty can choose to participate in. See Appendix H3 to Terms and Conditions for RIX and monetary policy instruments.

18 A clearing institution mediates payments between its members (or their customers) and functions as a central counterparty in relation to a member (or its customer). The following clearing organisations are RIX participants: Bankgirocentralen, CLS Bank, EMCF, Euroclear Sweden and NASDAQ OMX.

COLLATERAL

According to the Sveriges Riksbank Act, the Riksbank can provide loans for monetary policy purposes, but these must only be granted against adequate collateral. In December 1999, the Executive Board of the Riksbank decided to make some changes to the collateral management process. The aim was to become more flexible with regard to the securities the Riksbank accepts as collateral for loans. There was also an intention to harmonise the Riksbank's regulations with those of the Eurosystem with regard to the assessment and risk control of collateral. The parts of the Riksbank regulations for RIX and monetary policy instruments that concern collateral thus by and large follow the principles of the Eurosystem.[19]

Since then the Riksbank has routinely examined whether securities issued by the Swedish government and Swedish mortgage institutions should be approved as collateral. When investigating securities issued by issuers other than the government and mortgage institutions, the Riksbank uses an application procedure. A counterparty can send an inquiry to the Riksbank as to whether a given security is eligible as collateral.

As part of the management of the financial turmoil of 2007–2008, the Riksbank extended the number of debt instruments eligible as collateral to enable greater lending from the Riksbank. Consequently, on 13 December 2007 the Riksbank decided to accept covered bonds issued by the counterparty itself, or by an institution closely related to the counterparty, as collateral for credit in RIX or as part of the monetary policy operational framework. At that time it was considered that the risk associated with covered bonds was so low that they could be accepted as collateral, even if they were issued by the counterparty itself or by a related institution. At the same time the Riksbank wanted to aim for diversification of the securities a counterparty put up as collateral. It was therefore decided to restrict the proportion of a counterparty's collateral that could be issued by one and the same counterparty or group of related counterparties to a maximum of 25 per cent of the total value of the collateral pledged by the counterparty.

At the outbreak of the financial crisis the Riksbank decided on 22 September 2008 to change the above-mentioned restriction from 25 per cent to 75 per cent.[20] The change was deemed to have a positive effect on the efficiency of the money and bond markets while at the same time not significantly increasing the Riksbank's credit risk. On 8 October 2008 the restriction was completely removed.

19 However, there are significant differences. The Riksbank does not accept bank loans nor securities issued by banks or by credit institutions abroad that are domiciled in the same country as the counterparty pledging them. The Riksbank also makes an extra haircut for its own covered bonds and has higher haircuts for securities without continuous public pricing. A proposal submitted for comments regarding amendments to these regulations with regard to collateral, which is intended to come into force in 2012, is reported in Sveriges Riksbank (2011).

20 See Sveriges Riksbank, basis for decision Ref no. 2008-728-KAP.

Does the operational framework for monetary policy need to be changed?

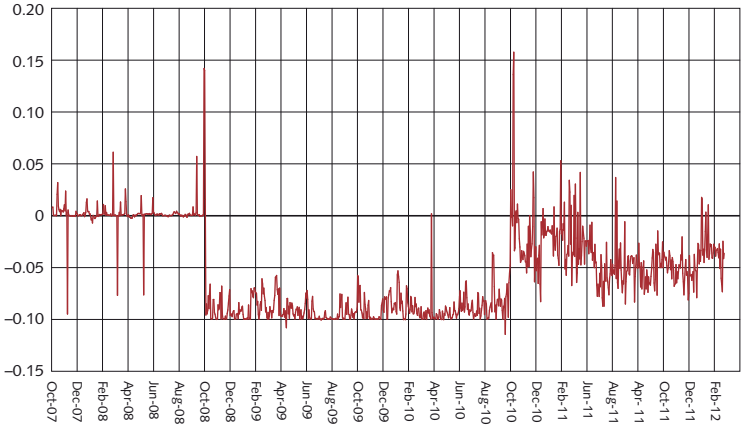
As part of the review of the Riksbank's operational framework for monetary policy we have also studied and compared other central banks' systems with the Riksbank's system. We are not able to present the results of this work in detail here, but we can note that the Riksbank's operational framework is relatively simple, transparent and efficient in an international comparison. It is therefore important that in our future efforts to develop this framework we always carefully weigh the advantages we wish to achieve against the disadvantages that might entail our framework becoming unnecessarily complicated, less transparent and less effective.

Bearing this in mind, we will in this section discuss the question of whether the operational framework is built up in such a way that the Riksbank is sufficiently prepared in terms of competence, market presence and appropriate instruments to be able to efficiently manage shocks to the financial system. First, however, we must focus on the more concrete issue of how well the operational framework performs its task of stabilising the intraday rate around the repo rate signalled by the Executive Board.

We have reached the conclusion in the course of our review that the operational framework for the implementation of monetary policy in Sweden is well able to stabilise the overnight rate both under normal conditions on the financial markets and during a financial crisis. Figure 7 shows that during the entire period from October 2007 to the end of December 2010, the overnight rate remained largely within a deviation interval no greater than 0.10 percentage points above or below the repo rate. After the Riksbank began to implement its extraordinary measures in the form of long-term loans to the banking system in October 2008 and until the extraordinary measures were withdrawn in October 2010, the overnight rate was pushed down to the rate on fine tuning operations. This meant that the overnight rate was 0.10 percentage points below the repo rate. As the banking system was able to invest its liquidity surplus in the fine-tuning operations, the downward pressure on the overnight rate was limited to a maximum of 0.10 percentage points below the repo rate.

Unlike most other central banks, the Riksbank does not explicitly state a target for the *overnight rate*, despite this being the operational target for the Riksbank's monetary policy. Instead, the Riksbank stipulates that the *repo rate*, which is the most important reference rate for the Riksbank's monetary policy operations and standing facilities, will remain at a particular level. This relationship can cause uncertainty over which interest rate the Riksbank is actually trying to steer. The clarity of the operational framework for monetary policy could thus be improved if the Riksbank began to signal a desired level for the overnight rate. This could increase the transparency of the operational framework even further, without needing to radically change it.

Figure 7. The overnight rate's deviation from the repo rate, percentage points



Source: Eklund and Åsberg Sommar (2011).

During the recent financial crisis, the Riksbank implemented a number of extraordinary crisis measures without needing to make any radical changes to the operational framework for monetary policy.

The crisis measures largely entailed the Riksbank

- lending Swedish kronor to the banks at longer maturities
- lending US dollars to the banks at one-month and three-month maturities
- deciding to allow more types of securities and to extend the range of securities accepted as eligible assets for loans from the Riksbank
- extending the number of counterparties allowed to participate in the fine-tuning transactions
- introducing a new category of counterparty: restricted monetary policy counterparties.

Similar measures were taken at roughly the same time by other central banks. Unlike a number of other central banks, however, the Riksbank did not buy any securities. This made the exit process for the Riksbank much simpler when the extraordinary measures were no longer needed.

We can note that the Riksbank dealt very successfully with the crisis with these relatively limited measures. But this does not mean that the next crisis can be dealt with in the same way. There are therefore good reasons for considering whether the readiness of the operational framework to deal with future crises should be improved and in that case how this should be achieved. As part of our review we have identified some areas where there is scope for improvement.

First, the Riksbank has no mechanism apart from the standing deposit and lending facilities and fine-tuning transactions to deal with any frictions in the interbank market that arise as a consequence of an uneven balance in liquidity between the banks. Such frictions are increased by the fact that the banks introduced a restriction at the time of the

financial crisis which means that an individual bank may not have a deficit of more than SEK 10 billion at the close of the day. This restriction means that the banks now try to avoid deficits on the overnight market by meeting their liquidity needs one day earlier, in other words via loans that run from tomorrow to the next day (T/N - Tomorrow/Next loans).

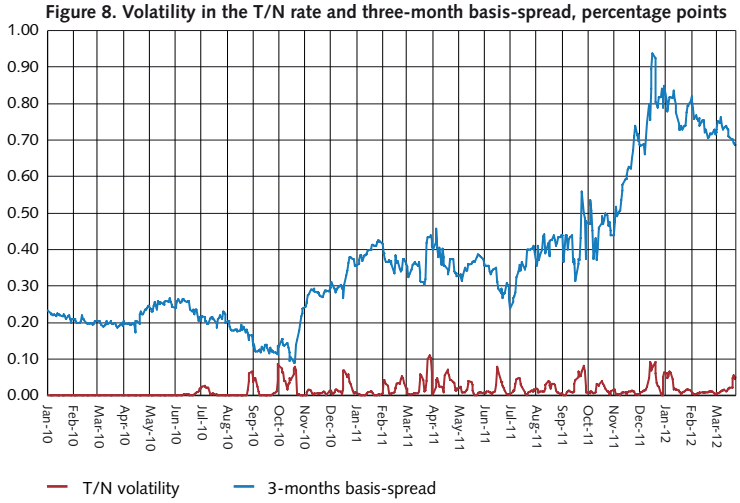
The operational framework is ultimately based on the banks realising that they all gain from balancing liquidity between them at an interest rate close to the repo rate at the close of the day. A bank that has a liquidity surplus today may need to borrow from other banks tomorrow to cover a deficit, and all banks thus stand to gain from the friction-free balancing of liquidity at the close of business. A weakness of this is, however, that it gives individual banks the possibility to abuse the system and indulge in strategic gambits. Individual banks may refuse to cooperate for strategic reasons. Banks with deficits may then be forced to borrow overnight from the lending facility at a penalty rate. The consequence of such frictions when balancing liquidity between banks is an unnecessary volatility in the overnight rate.

It is also difficult to reduce frictions on the interbank market, since the banks do not lend to each other without collateral if there is a counterparty risk in their transactions. However, they would be able to lend to each other against collateral intended for intraday loans overnight that they have deposited with the Riksbank. At present, however, the banks cannot use the collateral deposited for this purpose for administrative reasons.

Second, the Riksbank has no framework for steering the interest rate for the T/N maturity. The reason for highlighting this rate in this context is that interest rate derivatives in Sweden, unlike many other countries, are based on the T/N rate and not the overnight rate. This means that the development of the T/N rate has a direct connection to other interest rate instruments and the formation of interest rates in these submarkets.

As we have noted previously, a stable overnight rate is a necessary but not sufficient anchor for stabilising the formation of interest rates at longer maturities. The rate on the market for the T/N maturity used to be firmly anchored at 0.10 percentage points above the overnight rate. In connection with the phase-out of the Riksbank's extraordinary measures in the form of long-term lending in October 2010, volatility on the T/N market became high at the same time as the three-month rate rose in relation to the overnight rate (see Figure 8). This indicates that the monetary policy transmission mechanism has started to function less well. Nor does it seem to be sufficient that the overnight rate remains within a narrow interval around the repo rate for it to be considered that monetary policy has been implemented in an effective way.

Figure 8. Volatility in the T/N rate and three-month basis-spread, percentage points



Note: Volatility is calculated as the standard deviation of the T/N rate's deviation from the repo rate, calculated using a five-day rolling window. The basis-spread is calculated as the three-month interbank rate minus the three-month STINA rate, which is the average T/N rate for a three month period. It reflects the risk for three-month loans on the interbank market.

Third, the Monetary Policy Department at the Riksbank has no portfolio of domestic assets and hence no systems or routines adapted to the direct purchase of Swedish securities. Consequently, it may take the Riksbank a long time to begin conducting unconventional monetary policy when necessary through quantitative easing.[21] When the Riksbank's portfolio of Swedish securities was disposed of in 2000, it was considered that a domestic portfolio did not fulfil any monetary policy function. However, this conclusion rests on the premise that the markets are effective, which means that central-bank interventions have no long-term impact on the formation of interest rates. The financial turmoil and crisis of 2007–2010 have shown, however that it cannot be assumed that the markets will always function effectively. We have also seen that short-term interest rates may approach zero in a crisis situation. If further stimulation of the economy is desired in such a situation, one alternative is to directly influence long-term interest rates by buying bonds on the market. It is very unusual for a central bank not to have a portfolio of assets in its own currency. Other central banks trade in bonds in their own currency routinely and can thereby take measures at very short notice to directly influence domestic bond yields in a situation where this is called for.[22]

Finally, in practice it has proved difficult to extend the Riksbank's circle of counterparties. It is true that the Riksbank introduced the category of *restricted monetary*

21 Quantitative easing means that the central bank buys assets and finances these purchases by increasing the banks' reserves in the central bank. The purpose of such a measure is to push down interest rates for longer maturities.

22 On 10 May 2012 the Executive Board of the Riksbank decided to establish a securities portfolio to a value of SEK 10 billion.

policy counterparty in spring 2009 to facilitate funding for credit institutions that were not monetary policy counterparties of the Riksbank. However, only a few institutions decided to avail themselves of this opportunity. Nevertheless, this has meant that the Riksbank has an infrastructure in place that enables it to rapidly lend money to more counterparties in a crisis.

Concluding comments

In this article, we have presented a status report on the Riksbank's efforts to evaluate the operational framework for the implementation of monetary policy. The work began in the spring of 2008 but the outbreak of the financial crisis in September of that year taught the Riksbank new lessons about how the system works in different circumstances. At the same time, work is also underway on the regulation of the financial sector which may have consequences for the design of the operational framework. The Riksbank thus needs to continue its evaluation work to take into account all these lessons and the results of the ongoing regulatory work.

To date, however, we have been able to complete a review of how the operational framework functions today. This shows that the Riksbank's monetary policy operational framework functions well both under normal circumstances and during a financial crisis. However, there are good reasons to strengthen preparedness in the system so as to be able to meet future crises that may demand other measures than those taken by the Riksbank in 2007–2010.

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Monetary policy, interest rates and risk-taking

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The effects of monetary policy on the risks in the financial system are discussed intensively. One hypothesis that has attracted much attention is that monetary policy does not only act through the previously known channels, but also through a hitherto neglected channel – the risk-taking channel. According to this channel low policy rates lead banks and other financial institutions to take greater risks. In this article we conclude that there is international empirical support indicating that low interest rates result in greater risk-taking, but also that there are several questions that need to be analysed further. One question is to what extent it is monetary policy or the general level of interest rates that is significant for the bank's risk-taking. The general level of interest rates – the neutral real interest rate – is not determined by monetary policy. Another question is to what extent a link between low interest rates and risk-taking is a sign that the banks are acting in a less responsible manner. It may well be optimal for a bank to increase its risk-taking when the interest rate is low. A third question is the role that the risk-taking channel played in the global financial crisis. If this crisis was partly due to individual banks taking excessively high risks – in the way that is implied by the risk-taking channel – the question arises why this was not detected by micro-prudential supervision.

A new monetary policy channel?

There were many reasons behind the global financial and economic crisis. Some of the explanations that have been affected are relatively obvious – for example that there were significant failings in the regulations and supervision whose role was to maintain stability on the financial markets. Other explanations are more controversial for example the hypothesis that the crisis was at least partly caused by the expansionary monetary policy with very low interest rates that several central banks, including the American central bank, the Federal Reserve, had pursued in the years before the crisis. Some commentators argue that this expansionary monetary policy was an important driving force behind the major credit expansion and the boom on the property market, which was the focus of the crisis in many respects.[1]

* We would like to thank colleagues at Sveriges Riksbank for useful comments. The views expressed herein are solely the responsibility of the authors and should not be interpreted as reflecting the views of the Executive Board of the Riksbank.

1 See, for example, Taylor (2009). For examples of the opinion that monetary policy did not play an important role in the emergence of the financial crisis, see Bernanke (2010), Dokko et al (2011) and Svensson (2010).

The hypothesis that low policy rates contributed to the crisis has also had an impact on the theory of how monetary policy affects the economy – the 'transmission mechanism'. One theory that has attracted a lot of attention recently is that monetary policy does not only act through the previously known channels, but also through what is known as a 'risk-taking channel'.[2] In brief, the risk-taking channel means that low policy rates can induce banks to take higher risks in different ways. An expansionary monetary policy could therefore not only result in an increase in lending, in accordance with conventional transmission mechanisms, but could also result in lending being riskier. If the risks that are built up are high enough, they could eventually lead to a financial crisis. The risk-taking channel could therefore constitute a link between monetary policy and the work to ensure financial stability – two policy areas that used to be seen as essentially separate.

Traditional monetary policy channels

One common way of describing the monetary policy's transmission mechanism is to divide it into three main channels: the interest rate channel, the exchange rate channel and the credit channel.[3]

The interest rate channel refers to the effect of the central bank's policy rate on household decisions to save or consume, and firms' decisions to invest. As prices and inflation expectations are sticky, a reduction in the policy rate will also reduce the real interest rate in the economy. This makes it more beneficial for households to consume and borrow and less beneficial to save. Similarly, it becomes more beneficial for companies to borrow and invest. The increase in demand in the economy gradually results in prices and wages starting to increase more quickly.

In addition, a reduction in the policy rate normally weakens the domestic currency. As prices are sticky, the exchange rate also weakens in real terms. A weaker real exchange rate makes domestically-produced goods cheaper compared to foreign goods. This leads to an increase in the demand for exports and in the demand for products that compete with imported goods, which gradually results in inflation rising as well. This *exchange rate channel* also has a more direct effect on inflation as the domestic price of imported goods, which are included in the consumer price index, rises when the exchange rate weakens.

Banks do not play a prominent role in either the interest rate channel or in the exchange rate channel. However, the banks and credit supply play a central role in the *credit channel*. A lower interest rate generally leads to an increase in the price of various kinds of assets. For example, it leads to an increase in the net present value of the future cash flows that a financial asset, such as a share, can be expected to generate. This means that the price of the financial asset increases. When the interest rate is low, the demand for and prices of real assets such as houses also increase. As these assets are used as collateral for loans and

2 The concept of the risk-taking channel was introduced in a paper by Borio and Zhu (2008), but at least some of the mechanisms had already been discussed previously.

3 For a more detailed description of the transmission mechanism, see, for example, Hopkins, Lindé and Söderström (2009).

the collateral increases in value, the banks become more willing to lend money. In addition, the future wages of households and the future profits of companies rise when demand increases as a result of the lower level of interest rates. On the whole, the credit channel is a mechanism through which the effect of changes to the policy rate is enhanced through lending from the banks.

Hence, the banks also play a role in the credit channel of the traditional transmission mechanism. But it is a different role from the one they play in the risk-taking channel. In the credit channel the increase in lending is due to an improvement in the debtors' collateral and repayment capacity which makes it less risky for banks to lend money. In the risk-taking channel lending increases because the banks are more willing to take on higher risks. The risk-taking channel is therefore more about the behaviour of banks than about how a change in interest rates affects the situation of the borrowers.

Risk-taking channel – theory

The risk-taking channel is not a specific, well-defined monetary policy channel, but a collective term for different kinds of mechanisms, where monetary policy can affect the risk-taking of banks, financial institutions and the economy as a whole.

In the theoretical literature on the risk-taking channel, it is common to consider monetary policy as a risk-free interest rate controlled by the central bank. One important question in this respect is to what extent the central bank actually influences the interest rate that is significant for bank risk-taking. If the interest rate is low, this is not necessarily because the central bank is pursuing an expansionary monetary policy. The general level of interest rates can also be low for reasons that have little to do with monetary policy, and the central bank has simply adapted its policy to this low level of interest rates. We will come back to this after we have studied how risk-taking may depend on the general level of interest rates.

LOWER LEVEL OF INTEREST RATES CAN MAKE INDIVIDUAL BANKS MORE WILLING TO TAKE RISKS

A lower interest rate can influence the risk-taking of banks through several mechanisms.

One mechanism is that a low interest rate can result in a search for yield, whereby the banks start to search for riskier investments with a higher expected return (Rajan, 2005). For example, this could involve moving from government bonds to riskier, but high-yield securities during periods when the interest rate is particularly low. One reason for doing this could be that the banks have a specific nominal rate of return that they have to achieve.

Another mechanism is that when the economy has experienced a period of low risk and low interest rates over a long period of time, economic actors may extrapolate and let their assessments of the future be coloured too much by the prevailing situation. They simply become too complacent. As suggested by Yellen (2011): "[W]ith interest rates at very low levels for a long period of time, and in an environment of low volatility, investors, banks,

and other market participants may become complacent about interest rate risk. Similarly, in such an environment, investors holding assets which entail exposure to greater credit risk may not fully appreciate, or demand proper compensation for, potential losses."

In both of these mechanisms the banks disregard risk, either consciously or unconsciously. However, even if they take explicit account of risk, it might be part of a bank's *optimal adjustment* to take on more risk when the interest rate falls. Let us take a closer look at how the interest rate can affect risk-taking in a bank that applies this optimal adjustment and takes explicit account of risk. We use a model that is based on standard portfolio and investment theory.[4]

We study a bank that is striving for a high return on its equity capital, but is also risk-averse and balances its expected return and risk. The bank is willing to give up some of its expected return if this will lead to a lower level of risk. Similarly it is willing to increase its risks if the expected return increases. We measure the risk by the standard deviation of the return. The convex curves at the top right of diagram 1 represent the bank's preferences and show all the combinations of the expected return on its equity capital R_K and the standard deviations for the return σ_K which provides the same level of 'utility' for the bank; the higher up the indifference curves are in the diagram, the greater the utility will be.

Let us assume that the bank can lend and invest at a risk-free interest rate r. Let us also assume that the bank can adapt its level of risk by regulating two parameters – its debt-to-equity ratio and the risk profile of its lending.

We start by assuming that the risk profile is given and can be described as R_p and σ_p, where R_p is the expected return per Swedish krona lent and σ_p is the standard deviation for the return on each Swedish krona lent. The expected return on the bank's equity capital would then be

$$R_K = b\left[R_p - r\right] + r \qquad (1)$$

where b is the bank's leverage, defined as the total assets divided by its equity. The standard deviation for the return on the bank's equity capital is

$$\sigma_K = b\sigma_p \qquad (2)$$

When the risk profile R_p and σ_p are given, the bank can only influence its expected return and risks by regulating its debt-to-equity ratio b. Using (1) and (2) we can therefore derive the following expression for the bank's budget line.

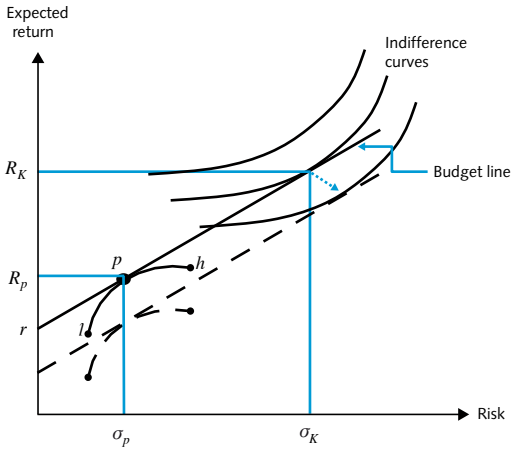
$$R_K = \sigma_K \frac{R_p - r}{\sigma_p} + r$$

The budget line shows the combinations of the expected return and risks (R_k and σ_k) that the bank can choose for a given risk profile for its lending.

4 See for example Elton and Gruber's (1991) text book on portfolio theory and investment analysis.

The budget line, which has the intercept r and the slope $(R_p - r)/\sigma_p$, is marked in diagram 1. If the bank chooses a combination of risk and return that lies somewhere on the line between r and the point p, it will mean that the bank does not have any leverage, and that a proportion $(1\text{-}b)$ of the bank's capital is invested at the secure interest rate r. If the bank is located to the right of point p, it means that it has some leverage and that the bank lends its equity and all the capital it has borrowed; the further along the budget line it is, the higher its debt-to-equity ratio.

Diagram 1. Optimal adjustment to different interest rate levels



When the bank adjusts optimally, it means that it cannot increase its benefit by selecting another point on the budget line, i.e. another debt-to-equity ratio. This criterion is only met at the point of tangency between the budget line and an indifference curve, as illustrated in the diagram.

Before we move on to studying how changes in the interest rate r affect this optimum adjustment, it may be useful to outline how the risk profile (R_p and σ_p) is determined. Let us assume for the sake of simplicity that there are two kinds of lending projects: high-risk projects with an expected return R_h and risk (variance) σ^2_h, and low-risk projects – for example mortgages – with an expected return R_l and risk (variance) σ^2_l. The expected return and risks in high-risk projects are higher than in low-risk projects ($R_h > R_l$ and $\sigma^2_h > \sigma^2_l$). The proportion of the bank's lending to low-risk projects is represented by a. The curve between l and h shows how the risk profile (R_p, σ_p) depends on the proportion a. If the bank only lends to low-risk projects, the expected return on its lending portfolio will be R_l and the risk σ_l. If the bank increases its proportion of high-yield projects (reduces a), the expected return and risks will increase. If the return on high and low-risk projects do not completely covary, it will result in a diversification benefit, and the curve showing the bank's risk profile will be concave, as shown in the diagram. We call this curve the bank's risk profile menu.

As we explained earlier, the bank's budget line is shown as a straight line that starts at point r and goes through the selected risk profile. The optimum solution for the bank is to select the risk profile where the budget line is tangent to the risk profile menu. If the budget line is not tangent to the risk profile menu, the bank can increase its expected return R_K by changing its risk profile, without increasing its risks.

What happens if the interest rate falls? In the model, the bank's (expected) interest rate margin is $R_K - r$. This is determined by competition between the banks. Let us assume that the interest rate margin does not change when the interest rate falls. In the diagram this can be illustrated by the risk profile menu shifting downwards to the same extent as the interest rate. The lower interest rate would result in a parallel shift downwards for the bank's budget line. What happens to the bank's risk-taking would depend on the shape of the indifference curves, i.e. the bank's preferences. One possibility is that the slope of the indifference curves are flatter the lower the value of R_K. The bank will then choose to take higher risks when the interest rate falls, as shown in the diagram.

However, the preferences do not necessarily look like this. They may instead be of a type that makes the bank maintain the same level of risk or reduce it when the budget line shifts downwards. It may also be that the expected interest rate margin increases when the interest rate falls. The slope of the budget line $(R_p - r)/\sigma_p$ would then become steeper. This would mean that it costs less (in the form of higher risk) to increase the expected return, which, all things being equal, indicates that the bank will take greater risks when the interest rate falls. However, note that the proportion of high-yield loans in the lending portfolio will fall if the interest rate margin increases when the interest rate falls.

Hence, it is not clear from economic theory whether a bank that adjusts its risk-taking optimally will take higher or lower risks when the interest rate falls – even though optimal adjustment *could* very well lead to an increase in risk-taking. There are several mechanisms that counteract each other and their respective strengths vary. The theoretical literature on the risk-taking channel is relatively limited at the moment, but there are a few examples of models where several mechanisms act at the same time, and where banks compete with each other.[5] All of these models support the hypothesis that the banks take greater risks when the interest rate is low, but the models are based on specific assumptions on, for example, the banks' preferences.

One result from these models is that a lower interest rate reduces risk-taking in the short term, but increases risk-taking in the longer term. This is because it takes time for the bank to change its capital ratio and adapt its lending portfolio to the new desired levels. If the bank's lending rate falls when the risk-free interest rate falls, it will be easier for the bank's customers to manage the payments on their existing loans. The value of the collateral for

5 See for example Dell'Ariccia, Laeven and Marquez (2010), Valencia (2011), Cociuba, Shukayev and Ueberfeldt (2011), and Agur and Demertzis (2010). As well as the studies that *explicitly* analyse the risk-taking channel, there are previous studies that also contain a risk-taking channel, even if the main focus of the studies was different. Thakor (1996) assumes that the banks can lend to risky projects or invest in secure long-term bonds. In this model the banks increase their holdings of bonds and reduce their lending if the short interest rate falls more than the interest rate on their long-term bonds. If the interest rate on long-term bonds falls more than the short interest rate, the effect will be the opposite.

the bank's loans may also increase – a mechanism similar to the one in the traditional credit channel. In the short term the bank's risks therefore fall.

However, over time the banks will increase their lending and their risk-taking. But it is important to realise that this higher risk-taking may be a result of optimal adjustment rather than of the banks being careless or taking excessively high risks. The banks may increase their risks, but they do not increase them in an *excessive* way, which most of the discussion around the risk-taking channel seems to assume.

The general level of interest rates is not determined by monetary policy

Another important question in this respect is how much the central bank actually influences the interest rate that is significant for the banks' risk-taking. The banks probably use quite a long-term perspective when they adjust their risk-taking. It is therefore likely that the relevant interest rate is the expected average interest rate over a longer period of time. The question is to what extent this is determined by monetary policy.

The natural interest rate is an important concept in modern monetary policy. This is the level of the real interest rate that would prevail if resource utilisation in the economy was normal today and was expected to remain normal in the future.[6] The natural interest rate varies over time and is determined by factors such as productivity development and the society's time preference, i.e. how much consumption today is valued in relation to consumption tomorrow.

Let us assume that the demand in the economy is determined by a simple New Keynesian demand relationship

$$y_t = \mathrm{E}_t \mathrm{y}_{t+1} - \sigma(r_t - \rho_t), \qquad (3)$$

where y_t is (the logarithm for) the production in the economy for the time t, $\mathrm{E}_t \mathrm{y}_{t+1}$ the expected production at time $t+1$, r_t is the short real interest rate (which monetary policy can influence) and ρ_t society's time preference; the higher the real interest rate and the lower the time preference (the greater the willingness to save), the lower production will be today.

Normal resource utilisation is represented by production coinciding with the level of potential production $y_t = \bar{y}_t$. Using the definition that the natural interest rate is the interest rate that would prevail if resource utilisation were to be normal now and in the future, it would follow that:

6 For a more detailed discussion on the natural interest rate, see Lundvall and Westermark (2011).

$$\bar{y}_t = \mathrm{E}_t \bar{y}_{t+1} - \sigma(\bar{r}_t - \rho_t), \tag{4}$$

where $\bar{r}_t$ is the natural interest rate. The natural interest rate can then be expressed as

$$\bar{r}_t = \rho_t + \frac{1}{\sigma} \mathrm{E}_t (\bar{y}_{t+1} - \bar{y}_t).$$

In this simple model, the higher the time preference and the higher the expected growth in potential production, the higher the natural interest rate will be, and vice versa. Society's time preference and growth in potential production – and consequently the natural interest rate – are determined by other factors than monetary policy.

Expression (3) minus (4) provides the perhaps more common demand relationship expressed in terms of output gap:

$$y_t - \bar{y}_t = \mathrm{E}_t (y_{t+1} - \bar{y}_{t+1}) - \sigma(r_t - \bar{r}_t).$$

Monetary policy can (temporarily) affect the short real interest rate r_t by changing the short nominal interest rate. By getting the short real interest rate to deviate from the natural interest rate $\bar{r}_t$, the central bank can influence resource utilisation in the economy. However, the central bank can influence the real interest rate only in the short-term. For example, the central bank cannot keep resource utilisation high over a long period of time by keeping the real interest rate systematically below the natural interest rate. Over longer periods the central bank has to act to ensure that the real interest rate on average ends up close to the natural interest rate; otherwise the economy will either overheat or fall into recession.

Thus, the fact that interest rates are low does not necessarily mean that the central bank is pursuing an expansionary monetary policy. It could also be because the natural interest rate, or the general level of interest rates, is low for reasons that are not related to monetary policy, and the central bank has just adjusted its policy to this low interest rate. It is only the effects of the *difference* between the short real interest rate and the natural interest rate that should be attributed to monetary policy, not the effects of the low interest rate itself.

To summarize, banks may increase their risk-taking when *the general level of interest rates* is low. This is interesting in itself, but it does not necessarily mean that there is a risk-taking channel that acts through *monetary policy*. The literature on the risk-taking channel often studies the link between a short interest rate and risk-taking, not the link between risk-taking and how expansionary the monetary policy is. To discover the effect of monetary policy on risk-taking, it is necessary to distinguish the general level of interest rates, or the natural interest rate, and monetary policy.

The risk-taking channel – empirical support

What empirical support is there for the risk-taking channel? In recent years an increasing number of studies have been produced that investigate whether there is an empirical link between different interest rates, and banks' risk-taking. Here we briefly summarize the main findings of these studies.

Most of the studies use microdata. When measuring the risks that a bank takes, factors such as the rating institution's risk assessments, the proportion of problem loans in the bank's balance sheet, the bank's risk-weighted assets in relation to its total assets, etc. are used. Some studies use macrodata and look at the link between the level of interest rates and different aggregated risk measures, such as the proportion of problem loans in a consolidated banking sector, the proportion of banks that change their collateral requirements for their lending, etc.[7] Practically all studies support the hypothesis that a low interest rate leads to higher risk-taking.

Only a few studies take into account that a low interest rate may reflect a low general level of interest rates – a low natural interest rate – and not an expansionary monetary policy. These studies typically estimate the natural interest rate, by employing a Hodrick–Prescott filter, and then use the deviation from the actual short interest rate as a measure of monetary policy. Some studies also use the deviation of the short interest rate from a Taylor rule. However, it is problematic to interpret this as a measurement of how expansionary monetary policy is as the Taylor rate is typically based on a constant, long-term neutral real interest rate.[8]

Altunbas, Gambacorta and Marques-Ibanez, (2010) find that the probability of bankruptcy in American and European banks increase by the deviation between the real three-month interbank rate and the neutral interest rate. Gambacorta (2009) uses a similar dataset and finds a positive link between the probability of bankruptcy and monetary policy, irrespective of whether monetary policy is measured as the deviation of the interest rate from the natural interest rate, or if monetary policy is calculated using a Taylor rule. López, Tenjo and Zárate (2012) find that risk-taking in Colombian banks depends on the deviation between the natural interest rate and a real short interest rate. In several other studies that use the deviation between the short interest rate and a Taylor rule it is also found that risk-taking increases if the short interest rate is below the Taylor rate.[9]

One relatively common result is that a low interest rate tends to *reduce* the risk in the banks' portfolios in the short term but *increases* it in the long term.[10] This reflects that in

7 See for example Angeloni, Faia and Duca, (2010), Maddaloni and Peydró (2011) and Karapetyan (2011).

8 The Taylor rule stipulates how the central bank should change its policy rate based on the development of inflation and production. It can be expressed in the following way: $i_t = i^* + \alpha(\pi_t - \pi^*) + b(y_t - \bar{y}_t)$, where i is the policy rate, i^* the nominal long-term normal (natural) policy rate, π inflation, π^* the inflationary target, y production and $\bar{y}$ potential production. When inflation is on target and production is the same as its potential, the policy rate must be at its long-term normal (natural) level.

9 See for example Bekaert, Hoerova and Lo Duca (2010), Gaggl and Valderrama (2010), Lou, Biefang-Frisancho Mariscal and Howells (2011), Maddaloni and Peydró (2011), and Michalak (2010).

10 See for example Jiménez, Ongena, Peydró-Alcalde and Saurina (2007), Altunbas, Gambacorta, and Marques-Ibanez (2011), López, Tenjo and Zárate (2010, 2012), Michalak (2010), and Delis, Iftekhar and Mylonidis (2011).

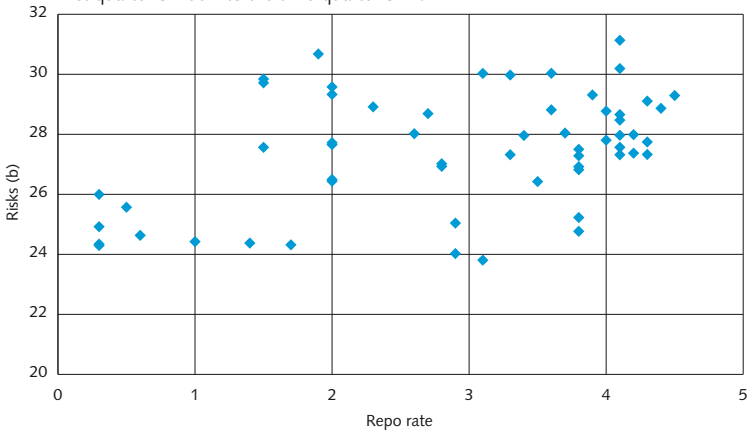
the short run the reduction in the interest rate reduces the risk in the outstanding stock of loans, and probably that the banks take higher risks in their new lending – in accordance with the theory described above.

The empirical studies often consider a number of different possible explanatory factors, including the size of the banks, the markets they operate in, etc. For example, Jiménez, Ongena, Peydró-Alcalde and Saurina (2007), who study Spanish banks, find that small banks, banks that are net debtors on the interbank market, savings banks and cooperative banks take more risks than others. Lopez, Tenjo and Zárate (2012) find that the risk-taking channel is stronger for small banks. Ioannidou, Ongena and Peydró (2009) study the banks in Bolivia and find that the banks with more liquid assets and a lower level of funding from foreign institutions take more risks than others.

On the whole there is much international empirical support for the hypothesis that a lower interest rate results in higher risk-taking. There is also support, although somewhat more limited, for a link between more explicit measurements of monetary policy and banks' risk-taking.

None of the empirical studies that have been published so far have specifically investigated whether there is a risk-taking channel in Sweden.[11] In diagram 2 we have plotted the risks of Swedish banks in terms of leverage (b) and the repo rate. There is no obvious link between the two variables, but a simple diagram like this is of course not enough to draw any solid conclusions as to whether there is a risk-taking channel in Sweden or not. More detailed studies would need to be performed to investigate this, using more developed risk measurements and other types of detailed data, in the same way as has been done in the studies of other countries.

Diagram 2. Repo rate and the general debt-to-equity ratio risk in the four largest Swedish business banks
First quarter of 1997 to the third quarter of 2011



Source: The Riksbank.

11 Altunbas, Gambacorta and Marques-Ibanez (2010) and Gambacorta (2009) use data that includes Swedish banks, but do not report separate results for Sweden.

The risk-taking channel and the focus on macro-prudential supervision

The risk-taking channel is based on individual banks taking on more risk. The theory that exists normally refers to the behaviour of a representative bank and much of the empirical literature is based on data from individual banks. Research on the risk-taking channel therefore focuses mostly on the micro level, just as supervision and regulatory activities did before the financial crisis.

If it is correct that the risk-taking channel played a key role in the emergence of the crisis – that low interest rates led to the banks taking on too much risk – the question arises why the supervisory authorities did not detect this excessive risk-taking. As we have stated in this article, the empirical research on the risk-taking channels suggests that it is possible to identify higher risk-taking when the interest rate is low.

One explanation could be that the methods that the micro-prudential supervision used before the crisis were not well-developed enough to detect the increase in the risk-taking of individual banks that took place. The solution would then be to strengthen the traditional micro-prudential supervision and make it more effective.

Another explanation could be that the methods that the micro-prudential supervision used before the crisis were well-developed, but that risks could still build up in the financial system as a whole – risks at the macro level – and that the problems in individual institutions did not appear serious enough for the alarm bells to start ringing in the micro-prudential supervision. Such a view is in accordance with the rapidly expanding research and policy discussion on macro-prudential regulation and supervision in recent years.[12] However, it still requires an explanation as to how risks in the financial system as a whole can build up without being detected by micro-prudential supervision.

LOW INTEREST RATES CAN LEAD TO HIGHER BALANCE SHEETS AND INCREASE THE SENSITIVITY OF THE BANKING SYSTEM

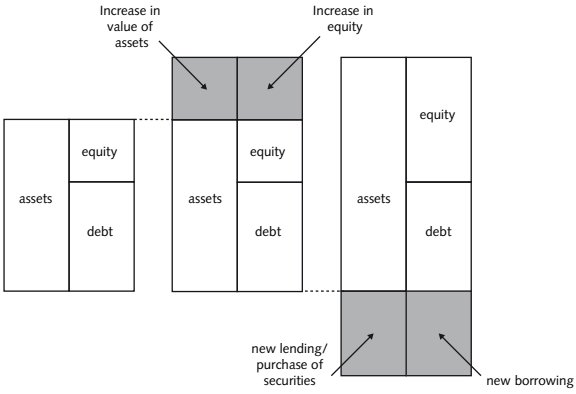
An explanation is to why risks in the financial system as a whole can build up without being detected by micro-prudential supervision relates to the traditional credit channel. But while the focus in the traditional credit channel is on how the amount of credit is affected by the interest rate, the focus here is on how the interest rate affects the risks in the banking system and its sensitivity to shocks.

Let us suppose that banks attempt to maintain a certain relationship between equity and debt – a desired capital ratio. As we stated when discussing the monetary policy's credit channel, a lower interest rate generally leads to the price of various assets increasing. The value of the bank's collateral rises and in turn the value of its assets. This can be seen in diagram 3. The lower interest rate leads to a 'valuation effect', which means that the

12 See for example Galati and Moessner (2011) for an overview into research on macro-prudential supervision.

total assets in the banks' balance sheets increase from the balance sheet to the left, to the balance sheet in the middle.

Diagram 3. The effect of a lower interest rate on the banks' balance sheets



Source: Adrian and Shin (2010).

But in this situation the capital ratio has exceeded the desired level. To restore the relationship between equity and debt, the banks expand their lending and borrowing, i.e. they expand their balance sheets. This makes asset prices increase even further, which in turn makes the banks expand their balance sheets even more, and so on.[13]

In this example it is a desire to keep their capital ratio *constant* which leads the banks to expand their balance sheets. Thus, the risk in the bank's *operations* – measured as their capital ratio – remains unchanged. But even if the risk in each bank remains unchanged, the banking system as a whole may have become more sensitive to shocks.

Let us suppose that the interest rates have been low for a period of time and this has resulted in the prices of assets rising and the banks' balance sheets significantly expanding. Let us also suppose that a bank is suddenly affected by an event that results in its capital ratio falling under the desired (or statutory) level. If only one individual bank is affected, the effects on the macro-economy will be limited. The bank can try to restore its capital ratio by reducing its assets side – it limits new lending and sells its existing assets. There will probably be others that are willing to buy the bank's assets and take over new lending. The prices of the assets that the bank wants to sell off will not fall that much and there will be no noticeable reduction in credits in the economy as a whole.

However, if all of the banks are affected by a joint disruption, it can have major macro-economic consequences.[14] When all the banks reduce their new lending at the same time, there is a significant halt to credits in the economy, known as a 'credit crunch'. If all banks also try to sell their assets in what is normally referred to as a 'fire sale', the prices of the

13 It is worth emphasising that a process where the banks' balance sheets expand does not necessarily have to be initiated by an interest rate decrease. It could very well be due to the asset prices and the value of the banks' assets rising over a longer period of time, more or less detached from the interest rate.

14 See, for example, Hanson, Kashyap and Stein (2011).

assets will fall dramatically. Falling asset prices can create a further need for the banks to shrink their balance sheets, which leads to a further drop in the level of new lending, and so on. This kind of development can lead to a financial crisis – and this will have major negative effects on growth and employment. The global financial crisis in 2008–2009 is a prime example of this.

The effects on the economy can be magnified if other actors, in addition to the banks, need to adjust their balance sheets when the prices of assets fall. For example, in many countries households reacted to the major drop in property prices by prioritising their repayments above consumption to enable them to reduce their debts and get better control of their balance sheets. When this happens, the economy goes into a 'balance sheet recession', where development is significantly weak over a long period of time.[15]

Low interest rates can therefore contribute to an expansion of banks' balance sheets, which makes the banking system as a whole, and therefore the macro-economy, more sensitive to shocks. If a big enough disruption takes place, it can start a process whereby the banks quickly start to shrink their balance sheets and we end up in a downward spiral with falling asset prices, a credit squeeze and weaker economic development.

Thus, the key factor here is not that the banks necessarily lend to riskier projects during upturns, even though this can make the system particularly sensitive to disruptions. It is possible, at least in theory, for there to be a sufficiently high stock of assets with the same risk level that could allow every bank to expand their balance sheet, without lending having to be riskier. The risks would then remain unchanged for each individual bank, but the banking system as a whole would be sensitive to disruptions as a result of the expanded balance sheets.

Conclusion and reflections

In this article we have discussed various aspects of the link between monetary policy and risk-taking and have provided an overview of the research into the monetary policy's risk-taking channel. This research is currently relatively limited, but it is growing rapidly; and in recent years a number of empirical studies have been published, based on different methods and data from different countries. These studies indicate almost unanimously that low interest rates lead to higher risk-taking by banks. It can therefore be said that there is empirical support for the notion of a risk-taking channel.

But we have also discussed a number of central issues that still need to be analysed, particularly in relation to the practical and quantitative significance of the risk-taking channel. For example, we have stated that from a theoretical standpoint it can be optimal to increase risk-taking when the interest rate falls. Thus, an empirical link between low interest rates and risk-taking is not remarkable in itself and is not necessarily a sign that the banks are acting irrationally or in a more irresponsible manner. We have also stated that the

15 The concept of 'balance sheet recession' was coined a few years ago to explain the development in Japan and its 'lost decade', see Koo (2003). For an analysis of the significance of household debts to the recovery (in the USA), see, for example, Mian, Rao and Sufi (2011).

literature on the risk-taking channel does not always state whether the higher risk-taking is a result of an expansionary monetary policy or a low general level of interest rates. If we are to say that the risk-taking channel is part of the monetary policy's transmission mechanism, this distinction is crucial.

Finally we discussed the lesson from the global financial crisis that there is perhaps most agreement on; i.e. that there were risks built up at the macro- and systemic-level that the micro-prudential supervision was not able to detect. We noted that it is not that simple to link this to the hypothesis that the risk-taking channel played a central role. The risk-taking channel is essentially a micro-based theory in which individual banks increase their risk-taking when the interest rate is low. If the crisis was due to individual banks taking excessively high risks, the micro-prudential supervision should have noticed this. However, low interest rates could still have contributed to the crisis by triggering a process in which the banks expanded their balance sheets, thereby making the banking system sensitive to shocks.

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