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Interest Rate Determination and Monetary Policy in Sweden

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Abstract

In this paper, we discuss how a change in the marginal interest rate is transmitted to the credit market interest rates relevant for households and firms. The expectations theory of the yield curve gives the basic relationship between expected future marginal interest rates and the markets rates. We review the theory and some empirical evidence on its validity. Credit institutions set their interest rates given the market interest rates. The behaviour and determinants of the spread between market rates and credit institution rates are analysed. After a short detour about the interest rate structure of private sector debt, the consequences of our findings for monetary policy are discussed.

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1 Introduction

According to the traditional transmission mechanism of monetary policy, an increase in the supply of money lowers the market interest rate, which stimulates consumption and investments. Aggregate demand increases, which eventually leads to higher prices and a lower real money supply. This paper focuses on the first steps of this transmission, from the instrument used by the Riksbank to the interest rates that the private sector meets. We will discuss, in turn, how the Riksbank is able to control the overnight interbank interest rate (section one), how a change in the overnight rate influences other market interest rates, particularly long maturities (section two), how credit market rates are influenced by money and bond market rates (section three) and how the private sector is affected by changes in lending rates (section four). In the final section, the implications of our findings for the ability of monetary policy to influence aggregate demand through this traditional transmission mechanism of monetary policy are discussed.

In a small open economy like Sweden, the transmission of monetary policy via the exchange rate is as important as the effects via interest rates. The Riksbank focuses at the combined effect of interest rates and the exchange rate on the economy. Under a floating exchange rate regime, changes in the interest rate affects the exchange rate. Although this part of the transmission mechanism is of crucial importance for the conduct of Swedish monetary policy, it is not discussed in the present paper.

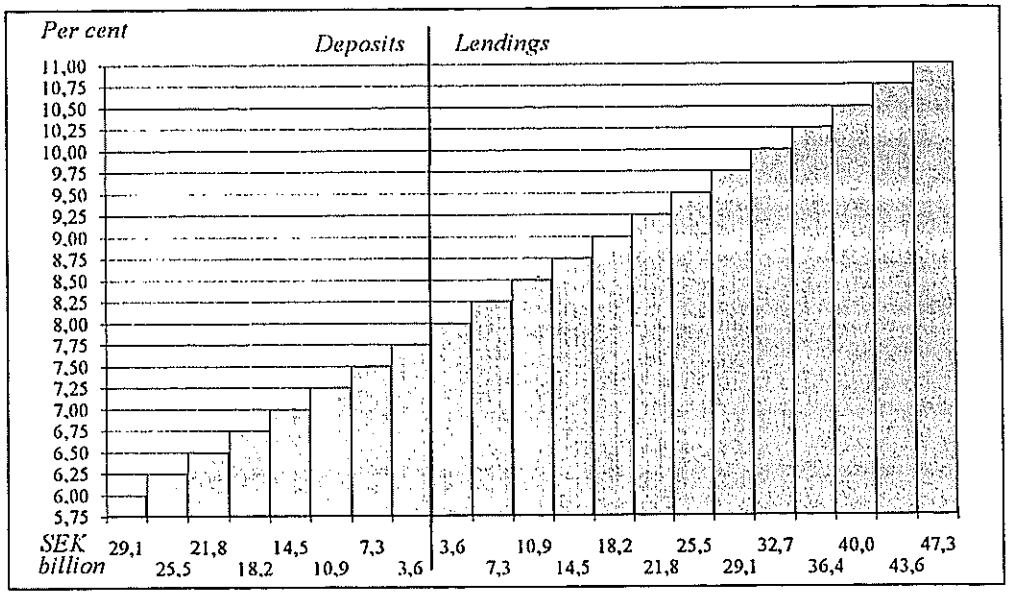
2 From the Riksbank's instrument to the interbank overnight interest rate

With terms for access to borrowed reserves predetermined, the Riksbank is able to control the overnight interbank interest rate by managing the supply of non-borrowed reserves. The very short end of the yield curve is thus under the direct control of the Riksbank.

The terms for day-to-day deposits in and borrowings from the Riksbank are predetermined in the interest rate scale, a supply function of borrowed reserves. The interest rate charged by the Riksbank, the marginal rate, rises with the amount borrowed. In the same way, the rate for deposits with the Riksbank decreases with the amount deposited. An interest scale is defined for each bank, with the size of the steps related to the capital base of the bank. It is however the aggregated supply function, shown in Figure 1, that is of interest for monetary policy.

The scale shows a menu of possible marginal rates the Riksbank can apply by controlling the supply of non-borrowed reserves. If, for example, the desired marginal rate is 8 per cent, the Riksbank has to make sure that the difference between total demand for reserves and supply of non-borrowed reserves is in the range from 0 to 3.6 billion kronor. A higher interest rate is attained by reducing the supply of non-borrowed reserves. The demand for borrowed

Figure 1. The interest rate scale



reserves thus increases and the system ends up at a higher step in the supply function.

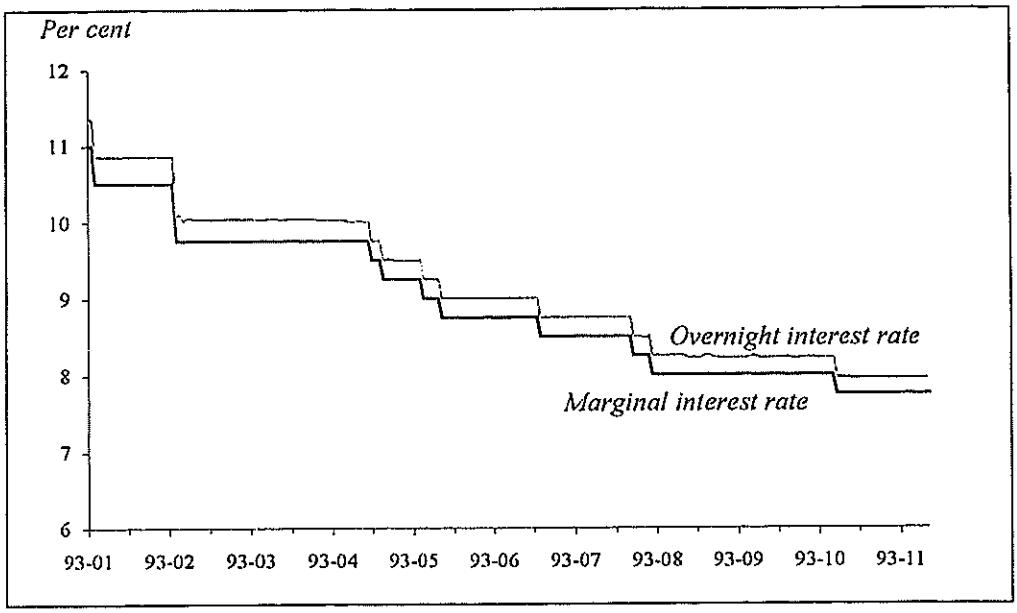
A daily forecast of the components of its balance sheet informs the Riksbank about the liquidity situation in the market. Should the forecast show a deviation between the autonomous supply of non-borrowed reserves and the level required to hit the target interest rate, the Riksbank must undertake open market operations. The most important instrument for short-term control of the non-borrowed reserves is repurchase and reverse repurchase agreements. Should liquidity in the banking sector be too low, resulting in too high an interest rate, the Riksbank announces a repurchase agreement, buying securities and thereby providing liquidity to the market. A reverse repurchase agreement is announced if liquidity is too high.

Although total liquidity is adjusted to place the system as a whole on a certain step, each bank does not automatically end up on the same step in their individual scales, as the initial liquidity situation may differ between banks. A bank with excess liquidity gains by borrowing additional funds from the Riksbank up to the prevailing marginal rate and lend the surplus at a higher rate to a bank with funding needs. The latter thus avoids borrowing from the Riksbank at a higher marginal rate. Interbank arbitrage will eliminate relative differences in bank borrowing and make sure that all individual banks borrow, or deposit, at the same step in their individual interest scales at the end of the day. The marginal rate thus has a direct effect on the overnight interbank rate as it affects the commercial banks' financing costs.

As Figure 2 shows, there is a spread between the marginal and the overnight interest rate. However, since the spread is roughly constant, it does not alter the Riksbanks influence over the overnight rate.

The spread between the two rates is a reflection of the fact that lenders, that are holders of excess liquidity, want to receive a margin between what they pay the central bank for borrowing up to the prevailing marginal rate and what they receive from their borrowers. Thus as in all trading there is a profit margin between the purchasing-price and the selling-price. The fact that the number of agents in the overnight market is limited may however imply a somewhat larger spread than what is explained by the difference between purchasing- and selling-prices.

Figure 2. Marginal and overnight interest rates



3 The relation between the marginal interest rate and market rates

In this section, we will discuss how a change in the marginal rate affects market interest rates – the yield curve. The main determinant of the yield curve is expected future overnight interest rates, which means that expectations about future monetary policy and inflation are of prime importance. Since monetary policy interacts with fiscal policy in influencing aggregate demand, interest rates and inflation, the yield curve also depends on expected future fiscal policy. Although the determination of interest rates is a complex matter, the relationship between the marginal interest rate and market rates can be analysed in a simpler context: the yield curve.

The expectations theory of the yield curve links the marginal interest rate to market rates, expected inflation and expected real interest rates. In the following, we will review some theory and evidence on this issue and discuss the consequences for Swedish monetary policy. In particular, given that the expectations theory of the yield curve seems to be an appropriate model, we are interested in what this theory implies for the ability of the Riksbank to control long term interest rates.

First, we need to clarify the assumptions behind the expectations theory of the yield curve and how the model relates to the real world. The model is based on following assumptions:

- Investors are homogenous. Thus, their behaviour may be analysed in terms of a single representative investor.
- Investors maximise expected utility. In particular, there is no principal-agent problem involving owners of capital as one part and employed professional portfolio managers as the other.
- Investors optimise over an infinite horizon.
- Investors have rational expectations.

In the real world, most investments are made by heterogeneous professional portfolio managers who may have short planning horizons and follow rules of thumb or in some other way not form their expectations fully rationally. Models making the rather restrictive assumptions above have not been very successful in explaining the behaviour of asset prices. However, we still think that the standard asset pricing framework is a useful tool that helps us to understand the mechanisms at work.

The marginal interest rate, i.e. the rate banks pay or receive for loans or deposits in the Riksbank, could be said to have two effects on market interest

rates, a signalling effect by influencing expectations about future marginal interest rates as well as an effect via the bank's cost of financing securities in their portfolios. The expectations theory of the yield curve, discussed in the following sections, covers the first effect. Should the signal be misinterpreted by the market, the Riksbank has the possibility to emphasise the marginal rate change with direct interventions in the market. The fact that banks finance their holdings of securities with loans at the marginal interest rate may under certain conditions influence their willingness to hold long term bonds with low interest rates.[1]

We will discuss, in turn, four questions concerning the yield curve:

- How are short term interest rates (say, six months) linked to future very short term rates (say, one month)?
- How are long term interest rates linked to future short term interest rates?
- What is the relationship between long term interest rates, future inflation and future real interest rates?
- What does this imply for the ability of the Riksbank to influence long term interest rates?

(i) The expectations theory of the yield curve

The basic idea behind the expectations theory of the yield curve is that profitable arbitrage should not be possible in a well-functioning market. The returns from holding two equivalent assets must be equal. For instance, if investing in a two month T-bill or two consecutive one month T-bills are equivalent operations, the returns must be identical. This non-arbitrage condition uniquely determines the relationship between the two month interest rate and the one month interest rates: The average of the one month interest rates must equal the two month interest rate (effective interest rates). If simple returns are used instead of effective interest rates, the two month return equals the sum of the two monthly returns.[2] This principle can be used to find the relationship between any two points on the yield curve.

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1 If the interest rate on a long term security is below the marginal interest rate, capital gains must be large enough to compensate the investor. If the assumptions behind the expectations theory of the yield curve are fulfilled, capital gains will indeed exactly offset the lower interest rate on the long term security. However, if there are many investors with short planning horizons, expectations about interest rates several years ahead may not affect bond prices today as much as the theory predicts. In that case, investors holding long term securities, financed at the marginal interest rate, may demand a higher interest rate than the theory predicts to compensate them for the financing cost effect.

2 This is a first order approximation. The exact formula is $1+r_0^T = \prod_{t=1}^{T}\left(1+r_{t-1}^t\right)$. The first order approximation is appropriate if r is close to zero and T is not too large.

However, it is not evident that holding a two month T-bill and two one month T-bills actually are equivalent operations. Both assets are Government backed, so the risk of default is the same, but they bear different interest rate risks. Should an investor want to invest in T-bills for a period of two months, the two month return on holding the longer paper to maturity is certain, while the return from holding the two shorter papers is uncertain since the interest rate on the second one month T-bill is not known with certainty.

The expected returns on Government bonds of different maturities are thus not necessarily equal, since a risk premium, in this context usually called a term premium may be included to compensate investors for interest rate risk. The perceived risk differs between securities of different maturities, depending on the planning horizon of the investors. However, many models assume that investors have long horizons, which means that they are concerned with the profitability of their investments several years ahead. In that case, short term papers are perceived as riskier than long term papers and ought to have a higher expected return if investors are risk averse.

In the following, we will first derive the non-arbitrage condition under perfect certainty, then discuss the term premium and finally discuss empirical studies of the expectations theory of the yield curve. Several tests on Swedish data have been made at the Riksbank.

If future interest rates are known with certainty, the return from investing in Government securities must be the same for all maturities. In this case, there is no interest rate risk and hence no grounds for demanding a term premium. This non-arbitrage condition can be used to derive the entire yield curve from the overnight interest rates. Let r_j^i be the rate of return for the time period i at the time j. r_0^2 will then be the two month interest rate today, r_0^1 is the one month interest rate today and fr_j^i is the one month forward interest rate one month ahead. The non-arbitrage condition is that r_0^2 is equal to r_0^1 plus fr_j^i.

A forward interest rate fr_j^i is the implicit contract, written today, to buy or sell a security with time to maturity i at the time j. It is equivalent to a forward contract on the currency market. The forward rate fr_1^1 is then the implicit contract to buy or sell a one month T-bill one month ahead. It is equal to the two month interest rate minus the one month interest rate. Such forward rates as fr_1^1 can be derived between any two points on the yield curve according to the formula in equation 1.

(1) $$fr_j^i = r_0^{(j+i)} - r_0^j$$

The non-arbitrage condition will be:

(2) $r_0^{(j+i)} = r_0^j + fr_j^i$

Intuitively, this means that the interest rate on a longer paper is equal to the sum of the shorter interest rates during the holding period. We use formulas with holding period yields since they are simpler than formulas with effective interest rates. With effective interest rates (annualised returns), the one month interest rate is the average of the overnight interest rates during the month and the five year interest rate is the average one month interest rate during the five years. Combining the last two statements yields the desired result: *The five year interest rate (or any other interest rate) is the average of the expected overnight interest rates during the period.* If holding period yields are used instead of effective interest rates, the five year interest rate is the sum of the overnight interest rates.

When uncertainty about future interest rates is introduced in this setting, assets of different maturities are no longer necessarily perfect substitutes. A term premium (tp) may be included in the expected returns to compensate investors for interest rate risk. Equation (2) is replaced by equation (3) as the non-arbitrage condition.

(3) $f r_j^i = r_0^{(j+i)} - r_0^j - tp$

Equation (3) can be tested empirically in order to find out whether there is a term premium and, if there is, what sign and size it has. If no term premium is found, the yield curve is determined solely by the expected future overnight interest rates. We will return to the implications of this for the ability of monetary policy to control market interest rates. If a predictable term premium exists, the yield curve is determined by expected future overnight interest rates and the model of the term premium. Finally, if a term premium exists but we are unable to explain its behaviour over time, the expectations theory of the yield curve is rejected by the empirical evidence. In that case, it is difficult to draw conclusions about how the overnight interest rate affects market interest rates since we have insufficient knowledge about what determines them.

(ii) Links between different short term interest rates

The expectations theory of the yield curve is usually tested jointly with the hypothesis of rational expectations. Several tests of variants of equation (2) have been carried out. The most common structure of the test is shown in equation (4). If β differs from zero, the slope of the yield curve or the

forward rate[3] does contain some information about future spot rates. β equal to one means that the slope of the yield curve is an unbiased predictor or that the expectations theory of the yield curve holds. The term α has to do with the term premium. If α is equal to zero, so is the average term premium.

$$(4) \quad r_{t+1}^{1} - r_t^{1} = \alpha + \beta\left(fr_{t+1}^{1} - r_t^{1}\right) + \varepsilon_t$$

Fama (1984) and Fama and Bliss (1987) find evidence in US data that the difference between forward rates and spot rates has predictive ability for future spot rates, especially at short horizons. They are not able to reject that β is equal to one.

In a recent paper, Dahlquist and Jonsson (1993) perform essentially the same test on Swedish Government bills with maturities up to six months. Their results are rather strong: Not only are the β-coefficients significantly different from zero but they are also not significantly different from one, which means that the forward-spot differential is an unbiased estimator of the future spot rate and the term premium is zero. They are troubled by parameter instability, however, and the standard errors are high which means that the power of the test is low. The tentative conclusion is that the expectations theory of the yield curve is not rejected for the short end of the Swedish yield curve.

Hördahl (1993) investigates holding period yields on 90 day T-bills versus three consecutive 30 day T-bills and for 360 day T-bills versus four consecutive 90 day T-bills. He finds that the average yield on the 90 day bill was 11.44 percent compared to 11.55 percent for the 30 day bills. The difference between them is significant at the 5 percent level, suggesting that there was a negative term premium on the longer bills. This result is unchanged by subsequent developments of the testing procedure. We conclude that there may exist a small negative term premium on longer T-bills.

Thus, the tentative conclusion is that short term interest rates (up to twelve months) is related to very short interest rates as the expectations theory of the yield curve predicts.

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[3] Since the forward rate is the difference between two spot rates, it is obviously related to the slope of the yield curve. It would in fact be equal to the linearized slope of the yield curve if returns had not been annualised. With effective interest rates, a few simple algebraic manipulations are necessary to derive the relationship between the slope of the yield curve and the forward rate implicit in it.

(iii) The relationship between short term and long term rates

The expectations theory of the yield curve links long term rates to short term rates exactly in the same manner that it links short term rates to very short term rates. The annualised return on a five year bond is the average of the expected interest rates on short term bills minus a term premium. Equivalently, the simple return on a five year bond is the sum of the simple returns on shorter papers of any maturity[4]. The reason for treating the relationship between long term and short term rates in a separate section is solely that the subject has been treated separately in the empirical literature.

Mishkin and Jorion (1991) investigate the relationship between the spot-forward differential and future spot rates for horizons up to five years in the United States, Germany, Britain and Switzerland. They focus on the difference between long term rates and one year rates, not at the implicit one year forward rates for each year. That is, instead of taking the difference between the five year rate and the four year rate to derive the one year forward rate for 1997, they look at the forward rate for the years 1994-1997. This means that they are not using all the information in the yield curve.

Mishkin and Jorion find weak evidence in support of the expectations theory of the yield curve. In the cases of Switzerland and Germany, the coefficients are significant at horizons of five years and almost significant for horizons of four years. For the United Kingdom and the United States, no coefficient is significant but the coefficients for five year horizons are much better than for shorter horizons. R^2 is about 0,45 for the five year horizons in Switzerland and Germany.

No empirical research on the expectations theory of the yield curve on long term interest rates has been conducted on Swedish data. The behaviour of the ex post term premium has been studied in a paper by Lindborg and Torstenson (1992). The average term premium on five year bonds amounted to -0.03 percentage points. Although this is close to zero, the term premium varied from positive to negative over the sample period 1987 to 1991. The highest values were recorded during 1987, when the return on five year bonds exceeded the return on three month T-bills by 2.4 percentage points. However, ex post returns cannot be expected to be equal – that would be the result only if agents had perfect information.

A related vein of empirical research has focused on the profitability of a strategy called "riding the yield curve". Whenever long term rates are higher

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[4] This is a first order approximation. The real formula is that $1+r_0^T = \prod_{t=1}^{T}\left(1+r_{t-1}^t\right)$. The first order approximation holds if r is close to zero and T is not too large.

than short term rates and are expected to stay higher, it is potentially profitable to invest in long term bonds and sell them later on as they have become short term bonds. If such operations are profitable, the non-arbitrage condition in equation two is violated. Therefore, evidence that riding the yield curve is profitable is evidence against the pure expectations theory of the yield curve (with rational expectations and risk neutral agents): Most (but far from all) empirical studies indicate that the gap between long rates and short rates can be profitably exploited. However, this is consistent with theories including a term premium since in that case, investors are merely collecting the term premium on long term bonds. Only the assumption of risk neutrality in combination with rational expectations is empirically falsified by these results. Studies of the profitability of "riding the yield curve-strategies" have mainly been performed on American data. There are no tests on Swedish data.

To sum up, the empirical evidence on the relationship between long interest rates and short interest rates is mixed but several tests are not able to reject the expectations theory of the yield curve. We will return to the implications of this for monetary policy. First, the role of expected inflation needs to be clarified.

(iv) Long term interest rates, inflation and real interest rates

The nominal interest rate can be decomposed into the real interest rate plus the rate of inflation. Equivalently, the expected nominal interest rate can be decomposed into expected real interest rate and expected inflation. Expected nominal interest rates can be deduced from the yield curve via the forward rates defined in equation one. We will use this for two purposes: Firstly, empirical results on the ability of the yield curve to forecast future inflation provide additional information on the validity of the expectations theory of the yield curve. Secondly, the fact that long term rates can be decomposed into expected inflation and expected real interest rates has some rather strong implications for the ability of the central bank to control long term interest rates.

Expected future inflation is believed to have a larger influence on long term interest rates than on short term rates. According to Mishkin (1990), the term structure of interest rates provides almost no information about future inflation for maturities of six months or less. Concerning the short term interest rates, attention therefore focuses on the market expectations about the future development of the marginal interest rate. In the short run, inflation can be assumed to be approximately constant and a (unexpected) change in the nominal interest rate will result in a change in the real interest rate. As inflation responds to the new nominal interest rate, the real interest

approaches the value that it would have had if nominal interest rates had stayed unchanged. Monetary policy is generally not assumed to be able to influence real interest rates in the long run. In this framework, it only affects the rate of inflation. The results of Mishkin (1989) indicate that real and nominal interest rates move one to one in the short run, which means that a change in the nominal interest rate leaves inflation unchanged in the very short run, affecting only real interest rates.

Given that we can insert a value for the expected real interest rate, the expected rate of inflation can be deduced from the expected nominal interest rate: It is the nominal interest minus the real interest rate. The problem is that the real interest rate is neither observable nor necessarily constant. The United Kingdom is the only country that has a well developed market for index bonds or real interest bonds. In the United Kingdom, therefore, the expected real interest (plus a risk premium) is observable. This is not the case in other countries. If we do not know the expected real interest rate, we cannot deduce the expected rate of inflation.

The results of Mishkin (1988) and others are interesting in this context. If the hypothesis that β equals one is not rejected, then neither is the hypothesis that the term structure of real interest rates is constant. That is, the real interest rate on a one year bond seems to be equal to the real interest rate on a five year bond. If this is the case, any difference in the expected nominal interest rate between one year and five year papers must be due to differences in expected inflation.

The information in the yield curve about (realized) future inflation has been investigated empirically in a number of papers. The short maturities contain little or no information, which means that the real interest varies in the short run since short term interest rates do contain information about future very short term rates. The evidence on longer term rates, from twelve months and up is somewhat mixed. Fama (1989) and Mishkin (1989) find evidence that the slope of the yield curve at long maturities contains a great deal of information about the future path of inflation. 40-50 percent of the variance of inflation could be forecasted by the information in long term interest rates (maturities of more than three years). Other authors have found evidence against the expectations theory of the yield curve. For instance, Browne and Manasse (1989) find that the forecasting ability in the yield curve deteriorated with the time to maturity.

Very little work has been done on Swedish data. In a study at the Riksbank by Nilsson and Nilsson (1992) a negative β-coefficient was found. This is incompatible with the theory. However, the sample period is short (1986-92) and was characterized by several unusual events (the sharp increase in

inflation at the end of the 1980s and the sharp decrease in inflation in 1991-92). The authors of the paper do not consider their results a rejection of the model. Much more empirical research is needed on this issue.

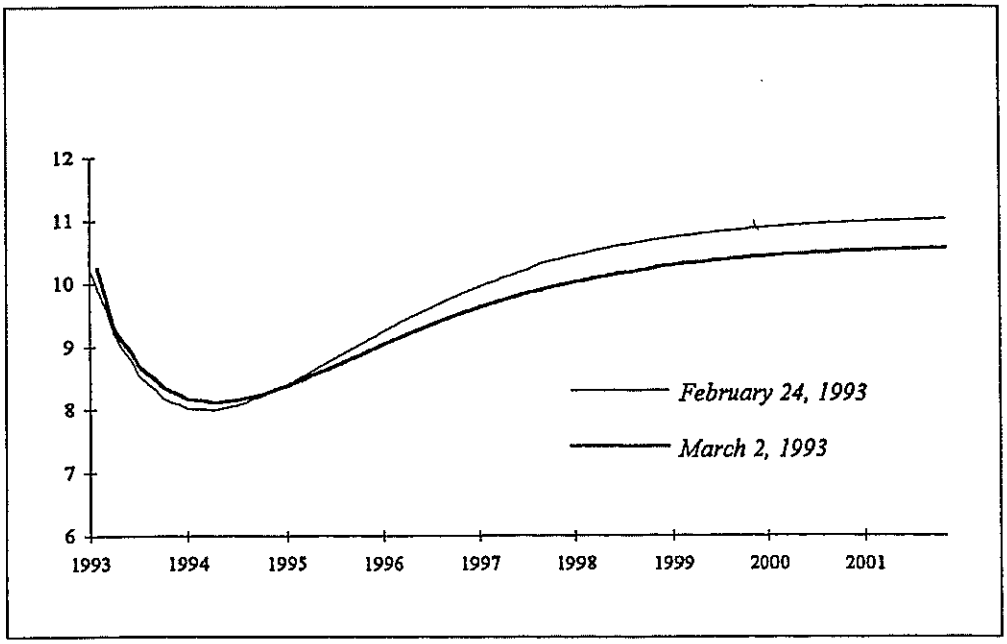
Since the nominal interest rate is the sum of the real interest rate and expected inflation, the latter can be deduced from the forward rates curve given an assumption about the expected real interest rate.

(v) Expected inflation and the forward rates in practice

If the term premium is small, the forward rates implicit in the yield curve can be interpreted as the expected future path of overnight interest rates. Thus, the market's current expectations about future monetary policy can be elicited. If expected real interest rates are constant, changes in expected nominal interest rates can be interpreted as changes in expected inflation. The information in the forward interest rates is therefore an important indicator of the expected rate of inflation.

Figure 3 shows two forward rate curves. The thin line refers to February 24th 1993. According to the expectations theory of the yield curve, the line is interpreted as the expected future path of the marginal interest rate. The market expected the Riksbank to decrease the marginal interest rate rapidly

Figure 3. Swedish forward rates
Annually compounded rate, per cent per year



until 1994, after which it would begin to increase again, presumably in response to increasing inflation created by an easy monetary policy.

Six days later, the forward rates had changed to the thick line. The Riksbank had intervened in the market for short term T-bills and pushed up the short term interest rates in order to signal its intent not to relax monetary policy as fast as the market expected. As a result of these interventions, future monetary policy was now expected to be tighter – and future inflation expected to be a little lower. Thus, an increase (or a non-realized expected decrease) in the short interest rates may result in lower long term interest rates. This counterintuitive effect stems from the fact that tighter monetary policy today means lower inflation and hence lower nominal interest rates tomorrow.

Long term rates are difficult to influence as they depend on expectations about economic policy and inflation several years ahead. There may exist situations where the Riksbank cannot exercise any influence on long term rates. For instance, if the market expects a more expansionary economic policy in the future for some reason outside the control of the Riksbank, this may result in higher expected inflation and long term interest rates.

The credibility of the monetary policy commitment to price stability is of crucial importance for the determination of the long term interest rates. A central bank that has a reputation for not letting inflation increase may have more room for manoeuvre in the short run. If short term interest rates are lowered in an attempt to stimulate demand, the market may expect inflation to rise in the long run. Alternatively the market may expect the easy monetary policy to be temporary and still believe that the central bank will hold back inflation. In the first case, long term rates will rise while in the second, they will not. A major concern for monetary policy is to acquire and maintain credibility for the anti-inflationary policy.

4 From market interest rates to the credit institutions' interest rates

The main question to be answered in this section is to what extent the Riksbank can influence the interest rates of Swedish credit institutions. We start by presuming a given yield curve of market rates and we then analyse how these market rates are transmitted to the interest rates of banks and mortgage institutions. To do this we first define the components of the spread. The spread is defined as the difference between the lending/deposit rate and the benchmark rate, which we define as the interest rate on a risk-free financial instrument. The following subsections outline some major events in the Swedish credit market which have influenced the formation of deposit/lending rates. Banks and mortgage institutions are treated separately since they differ in some fundamental respects. The purpose of this analysis is to answer the following questions:

- To what extent are credit market rates linked to the development of money market rates (which the Riksbank can influence directly) and to what extent are they linked to long term bond rates (which are more difficult to influence directly by monetary policy)?
- How quickly do credit market rates respond to changes in market rates?
- What are the major reasons behind the variations in the spreads between market rates and deposit/lending rates? Can the Riksbank influence these spreads?

(i) The components of the spread

Before discussing the specific conditions prevailing in the Swedish credit market it may be valuable to define the components of the spread. To do this we study the transmission of market interest rates to lending rates set by mortgage institutions; a process which can be described in a simpler model than the corresponding transmission in banks. Unlike banks, mortgage institutions fund themselves exclusively by issuing securities in the financial market. Furthermore, the mortgage institutions only act as lenders to the public. The spread between a mortgage lending rate, i_l, and a market rate of a risk-free financial investment, i_g, may thus be defined as follows:

The interest rate on a Government financial instrument, i_g
+ credit risk premium, rp_1
+ liquidity premium
= *the rate of funding for the financial institution, i_f*
+ credit risk premium, rp_2
+ administrative costs

+ return on capital
= *mortgage lending rate,* i_l

The total spread (i_l-i_g) can be decomposed into an external spread ,(i_f-i_g) , and an internal spread , (i_l-i_f). The *external* spread is the premium an investor demands for choosing mortgage securities instead of Government securities. The credit risk premium, which is the first component of this spread, compensates the investor for the higher credit risk of mortgage securities compared to Government securities. As the mortgage paper market in Sweden is less liquid than the Government paper market investors also demand a liquidity premium to invest in mortgage securities.

The *internal* spread is explained by another credit risk premium, rp_2, together with administrative costs and the return on capital. This second risk premium arises at the institutions' lending side to cover the potential risks of credit losses. The two types of risk premiums, rp_1 at the funding side and rp_2 at the lending side, may vary over time as a consequence of the risk level in the financial institutions and the creditworthiness of the institutions' clients.

(ii) Deregulation, turbulence and imperfect competition in the Swedish credit market

During the period 1978-86 there was a gradual deregulation of the Swedish credit market. These measures were important for the formation of credit market interest rates in several ways. Deregulation thus implied that the administrative control of bank interest rates ceased. Furthermore, liquidity requirements were abolished. Banks had earlier been compelled to hold Government and mortgage bonds. This had lowered the funding costs for mortgage institutions while giving banks additional costs. Credit ceilings were also abolished which increased competition between credit institutions. Finally, deregulation was a prerequisite for the creation of the money market, which is an important source of funding for the credit institutions.

The period which followed deregulation has been rather exceptional in the Swedish credit market. Compared to a competitive long-run equilibrium situation, the transmission of market rates to credit market rates has been affected in two major ways. Firstly, the substantial turbulence in the years which followed deregulation has weakened the transmission process from market rates to credit market rates. Secondly, competition is still far from perfect. These issues will be further discussed in this section.

The substantial turbulence in the credit market after deregulation was due to several factors. First, deregulation made it possible for credit institutions to increase their lending. Second, the tax system in force at the time of

deregulation encouraged households to increase their debt burden since interest costs were fully deductible at the same time as marginal tax rates were high. Together these two factors accelerated credit financed demand. This, coupled with a general economic expansion and an expansive fiscal policy accelerated inflation. In particular, real estate prices soared.

The expansion of credit volume came to an end in 1990 with the onset of the economic recession and as borrowers adjusted to the implementation of the new tax reform, which took effect in 1991. Real estate prices fell sharply, which resulted in severe credit losses for credit institutions. To safeguard the stability of the payments system, a State guarantee for banks and mortgage institutions was introduced in 1992.

The turbulence in the credit market had important effects on the formation of deposit and lending rates. The spreads widened substantially, due to a combination of increasing risk and liquidity premiums as well as compensation for credit losses, implying a weaker impact of market rates on deposit/lending rates.

Under the condition of perfect competition, equilibrium credit market rates imply that the credit institutions' rate of return on capital is normal. However, Swedish credit institutions need a higher profit margin to cover the losses incurred during the turbulent years. This seems to be the major reason for the widening of the spreads. A pricing policy which compensates historical credit losses would not have been possible in a competitive market since new market participants, without such credit losses, would have found it profitable to start operations.

Competition is better on the credit institutions' funding side than between credit market institutions. The Swedish security market is both broad and deep; the whole range of maturities is available and turnover is high. We can therefore assume that the external spread of a credit market instrument reflects an investor's assessment of the instrument's greater risk and inferior liquidity compared to a similar Government security.

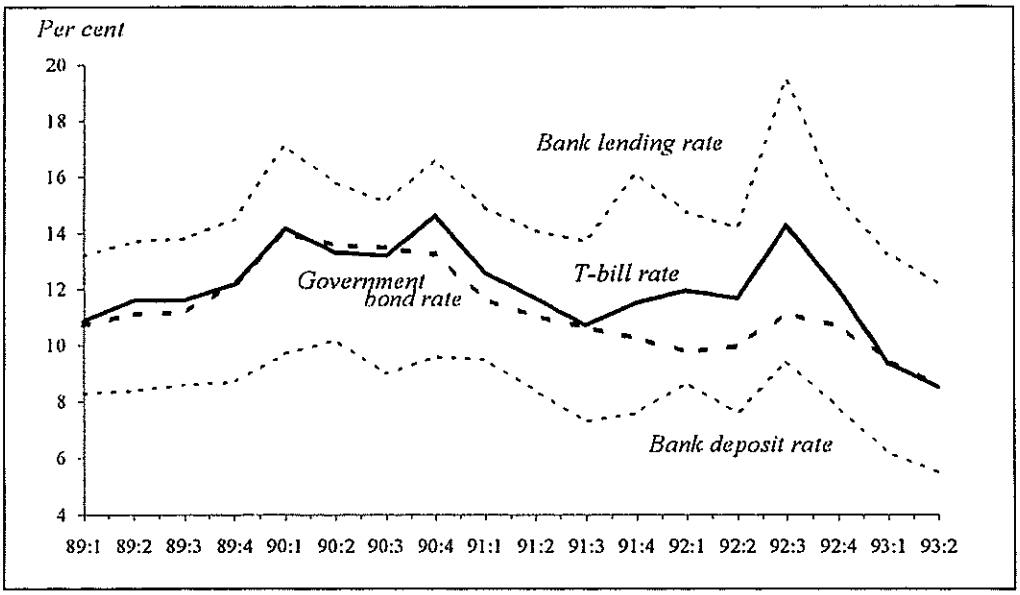
(iii) The determinants of bank interest rates

The formation of bank interest rates differs from that of mortgage institutions. The major difference is that banks are less dependent on funding their operations by issuing their own securities as they also have access to deposits. Bank lending and deposit rates are closely related to developments in the money market. In figure 4 we compare the variations in lending/deposit rates with the six-month T-bill rate and the five-year Government bond rate. It is easy to conclude by visual inspection that the

money market rate is a more important determinant of bank interest rates than long-term rates. More formally, the regression explains 86 per cent of the variance in bank lending rates when six-months' T-bills are used as explanatory variable but only 51 per cent when the Government bond rate is used.

Figure 4 shows no evidence of a time lag between a change in money market rates and bank rates. Unfortunately, monthly data on bank interest rates are not available. The only conclusion we can draw on the basis of available data is that bank interest rates seem to respond within the same quarter as the change has occurred in market rates. However, experience has shown that this time lag is rather a question of days than of weeks or months.

Figure 4. Bank lending and deposit rates in relation to market rates
Per cent



The close linkage between bank and money market rates is explained by the high substitutability between these markets. Firstly, the money market offers alternatives to bank lending/deposits for the banks' clients. Instead of a bank loan, corporate clients are able to issue certificates on the money market. Furthermore, for households the market share of privately-held certificates and bonds – issued by banks and mortgage institutions – has grown during the last few years. The banks also offer several unit trust funds. Secondly, banks also use the money market for their own marginal lending/funding to meet variations in their ordinary bank operations.

Normally, banks define their benchmark rate – or reference rate – as their marginal cost of funding. Lending from the central office of a bank to its branch offices is usually priced accordingly. The marginal cost of funding is calculated as the rate on a representative interbank loan in the deposit market (STIBOR). As we have seen earlier, the development of interbank rates reflects the expected path of the marginal interest rate offered by the Riksbank. This is explained by the fact that a loan from the Riksbank is always the marginal funding alternative for a bank.

Given the benchmark rate, the banks vary in their method of transmitting these rates to clients. One bank does in fact systematically adjust its lending and deposit rates to changes in STIBOR on a monthly basis. The actual lending and deposit rates are thus cost-priced as STIBOR plus/minus a certain margin. Most banks, however, use a less formalized approach, based more on judgement.

In figures 5 and 6 the six-months' T-bill-rate is compared to the bank deposit/lending spreads. Two important observations can be made. Firstly, the spreads widened until the third quarter of 1992. Secondly, the turning-points in the deposit/lending rate spreads and the corresponding turning-points in money market rates usually coincide. Thus, banks increase their spreads in response to a higher money market rate and decrease them in response to a lower money market rate, thus reinforcing monetary policy.[5]

There seem to be two major reasons to the widening of the spread up to the end of 1992. Firstly, spreads were widened to compensate for credit losses. Secondly, there was an increase of expected credit risks. However, as both these factors stem from the banks' lending side they do not *a priori* explain the widening of the deposit rate spread. On the contrary it would have been expected that bank depositors would have demanded a risk-premium due to the instability of the Swedish bank sector during the period. Such a risk premium would instead have reduced the deposit rate spread. Here, other mechanisms appear to have been decisive. Bank clients do not seem to have considered bank deposits as an investment implying any risk. Furthermore, imperfect competition may have opened up the way for cross-subsidisation from banks' deposit accounts to other bank services, including lending.

There are three possible explanations to why bank increase their spreads in response to a higher money market rate and decrease them in response to a

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5 This conclusion is confirmed by a formal regression. An increase in the lending rate by 1 percentage point increases the spread by 0,2 percentage points. However, the t-values is only 1,74 and R^2 is 0,15.

Figure 5. Bank deposit rate spread and average six-months' Treasury bill rate

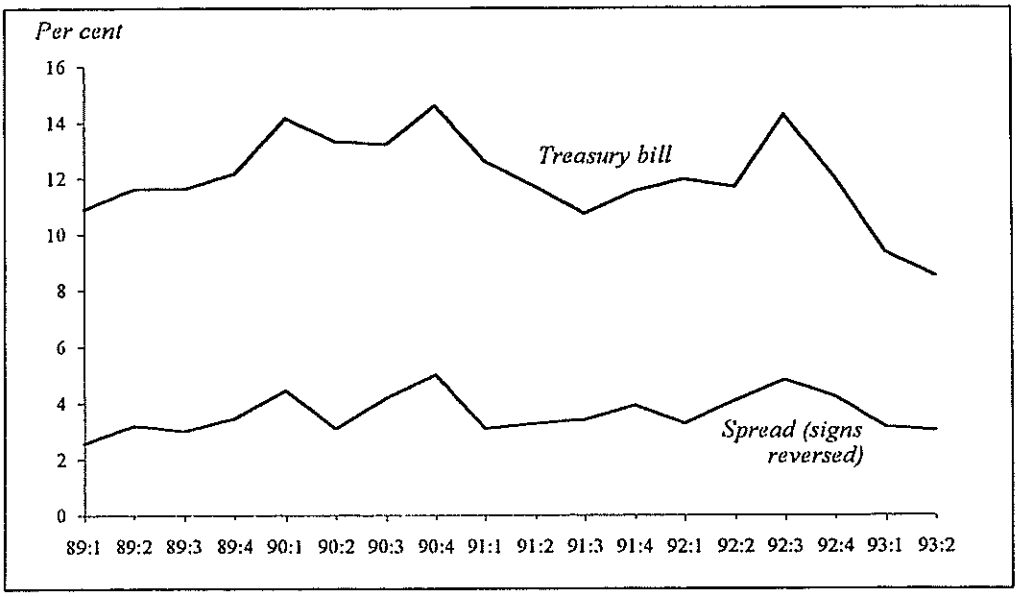
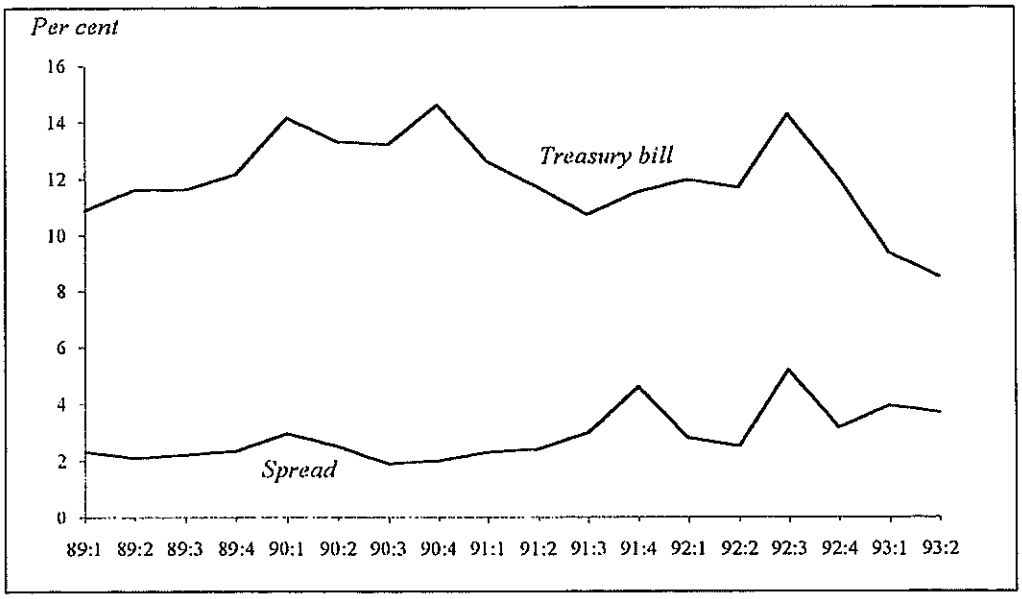


Figure 6. Bank lending rate spread and average six-months' Treasury bill rate



lower money market rate, thereby reinforcing monetary policy. Firstly, higher market rates imply a tighter squeeze on indebted bank clients, thereby increasing the banks' credit risk premium at the lending side. Secondly, it may be easier for banks to improve profit margins when market rates rise rather than in a situation with stable or falling interest rates. A third explanation, elaborated below, is the cost-based motive, namely the asymmetric effect of a given change of market rates on a bank's net interest income.

Net interest income represents the most important component of total earnings for Swedish banks. A change of market interest rates does not have a neutral effect on the bank's net interest income since its assets and liabilities do not have the same average maturity. On average the maturity is longer for a bank's assets (due to the bank's holding of fixed-rate securities in its balance sheet) than for its liabilities. Falling market rates thereby result in a positive effect on net interest income while a rise in interest rates results in a corresponding negative effect. This means that a bank – in the short-term perspective – not only has a motive but also the opportunity to increase its spread when market rates increase since all its competitors have a similar asset/liability maturity structure. However, in the long run this motive does not exist as the interest rates for both bank assets and liabilities can be adjusted.

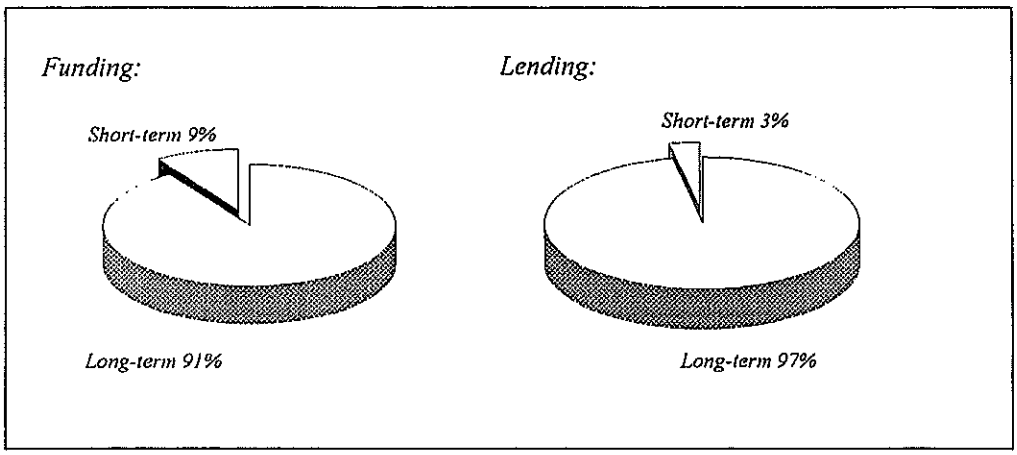
To sum up, some major explanations to the variations in the deposit/lending spreads may be insufficient competition, variations in risk premiums and the assymetric effect of a given change of market rates on banks' net interest income. Consequently, the variations in the deposit/lending spreads cannot be controlled by the Riksbank.

(iv) The determinants of mortgage lending rates

The major part of the mortgage institutions' funding and lending has a long term maturity, see figure 7. Not all long-term lending is made at fixed-rate terms, even if fixed-rate lending dominates. The outstanding amount of lending on variable terms is estimated to correspond 8-10 per cent of total mortgage lending.

The mortgage institutions' mix of lending to fixed-rate and variable-rate terms may change according to their clients' preferences. The dominance of fixed-rate lending is explained by the fact that mortgage institutions normally recommend their clients to opt for a fixed-rate loan due to the lower risk of causing clients unexpected costs upon the possibility of higher future interest rates. Housing loans at variable rates are mostly used by clients as a temporary source of finance while enabling them to choose a suitable time to go into a fixed rate loan.

Figure 7. Maturity structure of mortgage funding and lending



The benchmark rate for fixed-term lending is the corresponding long-term market rate, as can be seen in figure 8. Regressions of mortgage lending rates against five year bond rates and six-months' T-bill rate indicate that the bond rate is decisive[6]. In figure 9 we see that there is a corresponding relationship between the adjustable mortgage lending rate and the Treasury bill rate. In both cases the benchmark rates represent the institution's risk-free funding alternatives in terms of interest-rate exposure. According to their statutes, mortgage institutions are required to match their mix of maturity and interest rate terms on the lending side by a corresponding mix on the funding side. This risk-reducing stategy is reflected in the composition of their funding portfolio. As can been seen in figure 7, the funding and lending mix widely match each other, provided that the lending mix is revised to take long-term lending at adjustable terms into account. However the mortgage institutions also use swaps to adjust their direct funding mix. Hence they are able to meet variations in their lending mix and/or take advantage of differences between expected long and short term interest rates.

Regarding the time-lag between a change in market rates and the responding change in housing lending rates, the available monthly data only show that adjustments normally take place within the same month. However, by experience we know that the actual time-lags are much shorter. The mortgage funding rates are adjusted almost immediately, as mortgage certificates/bonds are issued in a very competitive market. The transmission

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6 R^2 falls from 0,81 to 0,61 when bond rates are replaced by money market rates at the independent variable. The coefficient is 0,79 for bond rates, implying that a 1 percentage point increase in the five year bond rate results in a 0,78 percentage point increase in the mortgage lending rate. The t-value is 11,78.

of a given change in market rates to housing lending rates is only a question of days, provided that the institutions consider the new level as sustainable.

Figure 8. Fixed mortgage funding/lending in relation to the five-years' Government bond rate

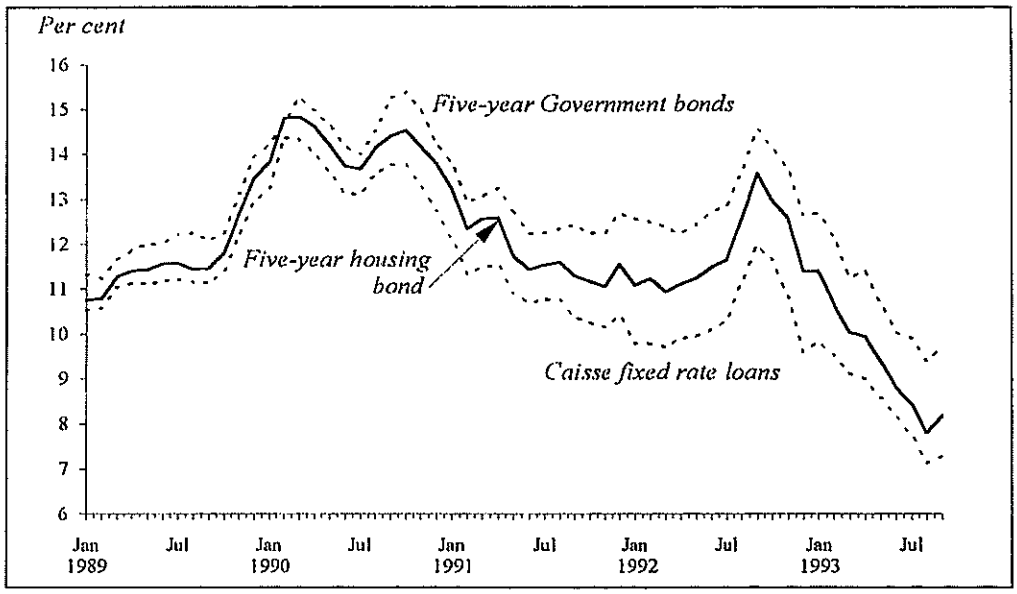
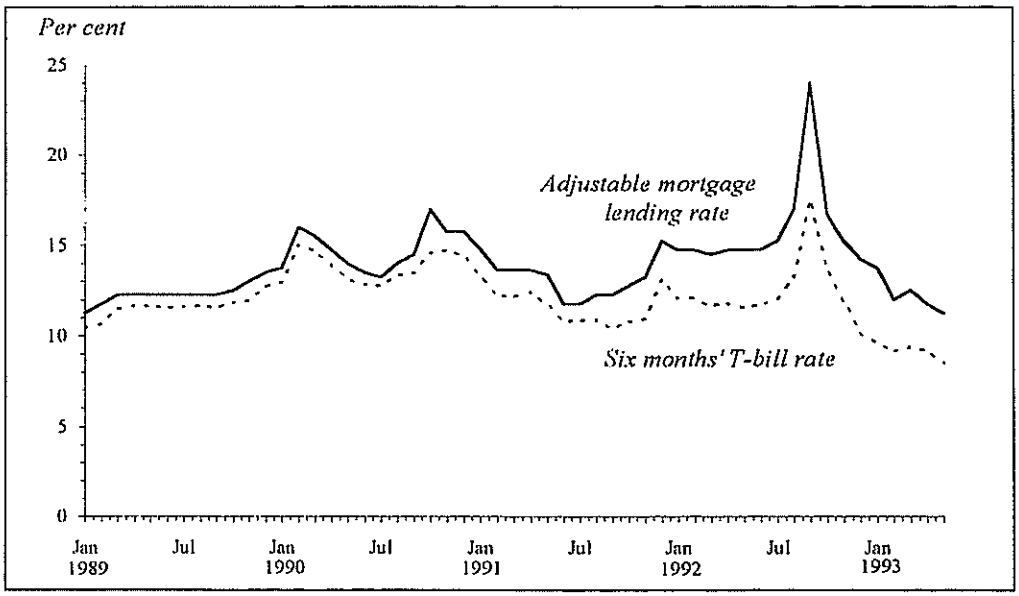
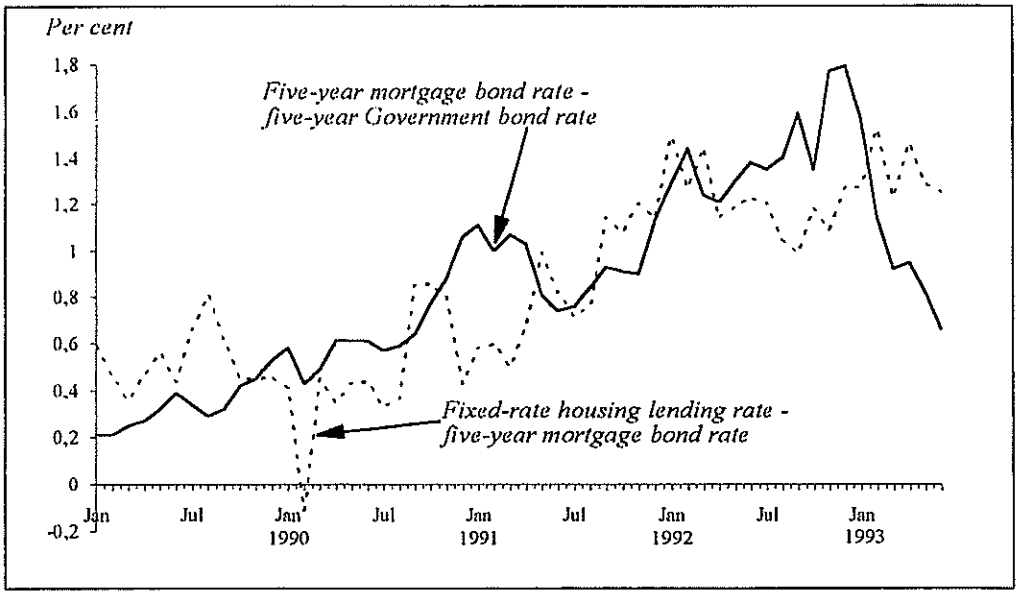


Figure 9. Variable mortgage lending rate and Treasury bill rate



Although there is a close relationship between the changes in market rates and the corresponding change in mortgage lending rates, the changes are not uniform. In figure 10 the variations in the external and internal spread can be studied for the major mortgage institutions. We can observe that the external spread has widened considerably up to the end of 1992, when a marked reduction occurred. The internal spread has continuously widened during the observation period. As was the case for banks, spreads increase when interest rates increase[7].

Figure 10. The external and internal spread for fixed housing lending rates



Mortgage institutions are free to set their own lending rates while taking the competition in the market into account, primarily from other mortgage institutions. The most important type of mortgage institutions is housing institutions, representing 87 per cent of the balance sheet total. In Sweden, a few housing institutions dominate the market. The two major housing institutions are thus responsible for 59 per cent of all housing loans. Banks also offer housing loans, but do not normally compete with mortgage institutions, not least because most of them have mortgage institutions as subsidiaries. Mortgage institutions provide the lowest-priced housing finance against the right to demand priority of repayment if insolvency occurs. Banks, on the contrary, may provide supplementary housing finance against non-preferential collaterals.

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7 Regressing mortgage lending spreads on mortgage interest rates gives a positive but statistically insignificant coefficient.

As was the case for banks, mortgage institutions have been able to widen their internal spreads considerably during the period, probably to a large extent to compensate for credit losses on the historical loan stock. Possibly, the internal spread may also have been below its equilibrium level at the end of the 1980s due to an underestimation of risks. Another factor, which has also contributed to the widening of the internal spread, is the recent requirement on mortgage institutions to comply with the same capital adequacy requirement that applies to banks.

The widening of the external spread is partly due to the increase of the risk premium for funding, rp_l. This risk premium has increased as a result of extensive losses and bankruptcies in the real estate sector. However, when the Government, in the autumn of 1992, introduced a State guarantee for banks and mortgage institutions, the spread consequently fell. The liquidity premium has probably also increased during the period, as a result of turbulence in the market. Higher market rates thus seem to imply that investors in housing bonds demand a higher relative yield in relation to a risk-free asset as they are afraid not to be able to liquidate them. It is, however, hard to distinguish between the contribution to the external spread from the risk premium, r_l, and the liquidity premium, as both most probably have changed during the period.

(v) Conclusions

In this section we have studied three different aspects of the Riksbank's possibility to influence the interest rates of Swedish credit market institutions; their linkage to changes in market rates (especially money market rates), their time-lag of response to changes in market rates and the explanations of the variations in the spread between market rates and bank/ mortgage rates.

Concerning the first aspect we have seen that the development of bank interest rates as well as short-term/variable mortgage rates is closely tied to the development of money market rates. Consequently, these credit market rates can be directly influenced by monetary policy. However, fixed-term mortgage lending rates are closely related to bond-rates and can thus only be influenced if the Riksbank can affect the long term interest rates. The second aspect refers to how quickly credit market rates respond to changes in market rates. The non-availability of daily statistics makes detailed conclusions difficult but by experience we know that lending and deposit rates are usually adjusted within days, provided that the change in market-rates is considered to be sustainable.

Finally, we have studied possible explanations to the variations in the spread between market rates and bank/deposit rates. We have seen that variations in risk and liquidity premiums are important explanatory factors as well as the imperfect competition among Swedish credit institutions. This latter factor has contributed to the variations in the spread by making a mark-up pricing behaviour possible.

The Riksbank can, to a certain extent, influence the *level* of the spread. Consequently, by pursuing a monetary policy which promotes general economic stability the Riksbank can reduce risk premiums. Furthermore, the recent introduction of a repurchase agreement facility for mortgage bonds is one example of how the Riksbank can act to reduce the liquidity premium of the spread. However, it is clear that most of the factors which contribute to the *variation* of the spread cannot be controlled by the Riksbank.

5 The influence of credit market rates on the private sector

The last step of the transmission mechanism of monetary policy that will be discussed in this paper is how business and households are influenced by a change in the credit market rates. Two important factors in this context are private indebtedness and the interest structure of private debt. If households are net lenders, the income effect of an increase in bank rates is positive (as in Italy). In that case, the income effect of a higher interest rate will work in direction of an increase household consumption and aggregate demand. If firms and households are net borrowers, an increase in bank rates has a negative income effect.

Heavily indebted households who wish to reduce their debt/income or debt/wealth ratio are less prone to increase their consumption when interest rates are reduced than households with equilibrium indebtedness. In 1989, the debt/disposable income ratio peaked at 130 per cent – and household saving was negative. Since then, changes in the tax system and higher real interest rates have permanently increased the real after tax cost of borrowing, with the consequence that households had to adapt their indebtedness. This adjustment to a new equilibrium level of indebtedness is probably not yet complete. Although the debt/disposable income ratio is back to its previous level, the debt/wealth ratio is still above its previous level. We may also expect the new equilibrium level of debt/wealth to be lower than previously, due to the permanently higher real post tax interest rates. Also the interest rate expenditure/disposable income ratio is still higher than before the deregulation, although interest rates have come down quickly. Households can therefore be expected to save a larger share of additional income than they would have in equilibrium.

To the extent that the interest rate on private debt is fixed in the short run, a change in the bank lending rate has an effect on the borrowing cost on existing debt only as loans mature. For instance, in the United Kingdom, a large share of household debt is raised on variable terms. A change in bank lending rates then affects the cost of borrowing immediately. In Sweden, 70 per cent of the loans have fixed interest rates, while 30 per cent are subject to variable rates. Approximately 2 per cent of the fixed interest loans are renewed each month, which means that only about one fourth of the fixed loans and 35 per cent of all loans are affected by a change in the lending rate within one year. Thus, the effect of a change in bank lending rates on household interest rate expenditure appears to be rather small in the short run.

Due to the prevalence of fixed interest loans, a decrease in market interest rates will lower interest rate payments of Swedish households relatively little in the short run. The effect on consumption will be smaller than it would have been if lending rates had gone down immediately. However, many households are net lenders or have mainly adjustable interest loans. A decrease in the interest rate still increases aggregate consumption although the short run effect may be smaller in Sweden than elsewhere.[8]

The average ratio of debt to capital is approximately 2 for Swedish enterprises. Most OECD countries have debt/capital ratios between 1,3 and 1,8. Only Japan has a higher ratio than Sweden.[9] However, differences in financial systems, industrial structures and tax systems make international comparisons difficult. A high debt ratio for Swedish enterprises cannot readily be interpreted as evidence of excess indebtedness. The debt ratio has stayed fairly constant since 1980. The enterprises have had plenty of time to change their indebtedness, had this ratio been out of equilibrium. Instead, the last few years have seen the financial savings of non-financial enterprises turning positive.[10] Our conclusion is therefore that there is no evidence of an aggregate business debt crisis. However, individual companies or even industries may still suffer from excessive indebtedness, particularly in the real estate sector.

Around 60 to 65 per cent of the private enterprise debt has fixed interest rate, usually five year loans. Thus, a lower bank rate influences the cost of existing debt only with a substantial time lag as debt matures. However, the effect on aggregate demand from enterprises is primarily via investment. A decrease in the lending rate immediately decreases the financing cost of new investment projects. Studies indicate that an interest rate change reaches its maximum effect on investment only after five years – and that the elasticity of investment with respect to changes in the interest rate is low compared to the elasticity with respect to output.[11] Effects on investment are thus likely to be small in the short run.

The possibility of credit crunches as a driving force behind business cycles has been discussed by Kiyotaki and others. Given that some enterprises are credit constrained, asset prices and credit constraints interact in such a way that cycles are produced from a disturbance even if it is limited to a particular sector of the economy. The mechanism is that the initial shock reduces asset demand and asset prices fall. Since assets are held as collateral for loans, this

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8 The semielasticity of consumption with respect to post tax real interest changes was estimated to 0,85 in a study by Alexius in "Monetary Policy Indicators", (1993).

9 Non-financial Enterprises Financial Statements, OECD Financial Statistics Part 3, 1992.

10 This has often been the case immediately after sharp declines in the value of the Swedish krona, when profit margins have increased but investment have not yet picked up.

11 See for instance Bergström and Södersten (1990).

tightens the credit constraints, which reduces investment demand. In turn, the reduced investment demand pushes asset prices down even further and so on. The mechanism that ends this process is demand from the non-constrained enterprises. When asset prices have fallen to a certain level, the non-constrained firms will find it profitable to increase their investment, which causes asset prices to rise. The higher asset prices increase the value of the collateral and ease credit constraints. Investment demand increases and prices follow suit.

To the extent that monetary policy is able to influence credit conditions, this constitutes a potentially powerful transmission to aggregate demand and the business cycle. Also, the channel from interest rates to the exchange rate and therefrom to aggregate demand is very powerful in the small, open Swedish economy. Several studies at the Riksbank indicate that a 2-4 per cent exchange rate depreciation increases aggregate demand by the same amount as an interest rate decrease of one per centage point.[12]

However, this paper's focus is on the internal transmission mechanism. Household consumption reacts with a time lag to changes is credit market rates due to the large share of fixed interest loans. Effects on new investments via the cost of capital in the absence of credit constraints is independent of the firms debt structure and therefore immediate. However, long lags and low elasticities of investment demand to changes in interest rates have been observed in other studies. We conclude that effects on consumption and investment through the traditional transmission mechanism are likely to be smaller in the short run in Sweden than in many other countries, due to the greater prevalence of fixed interest loans.

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[12] See for instance Hansson (1993) and Alexius (1993) in "Monetary Policy Indicators", Sveriges Riksbank.

6 Conclusions: The transmission of monetary policy

We have discussed how the Riksbank is able to control the interbank overnight interest rate, how it in turn affects market interest rates, the responsiveness of bank rates to market rates and, finally, to what extent a change in the bank rates affects private firms and households.

The Riksbank is able to exercise good control on the overnight interbank interest rate. Short market rates follow the expected path of the marginal interest rate closely and respond well to changes in the policy stance. However, the longer maturities are linked to expected developments further ahead in time. Influencing expectations about future economic policy is difficult. The longer the maturity gets, the more distant are the events that determine long rates and the more difficult is it to influence expectations.

Credibility is the keyword in this context. Given that the Riksbank is unable to control real interest rates five or ten years ahead, the only way to influence long interest rates is through the expectations about the future rate of inflation. If the commitment to price stability is credible in the long run, expectations about future inflation will be low – and so will the long term interest rates. Consequently, the Riksbank has little ability to either lower or raise long term interest rates at will. In a hypothetical situation where expectations about the development a few years ahead are completely dominated by factors outside the control of the Riksbank, long term rates cannot be influenced at all.

Principally, flexible lending rates follow the short term interest rates and fixed lending rates follow the long term market interest rates. About 65 per cent of household debt and 60 per cent of private business debt runs to fixed interest rates that do not change within a year if lending rates change. It takes several years for a change in lending rates to affect the interest rates that the bulk of the private sector meets. This is the major reason why the traditional transmission mechanism of monetary policy may be less effective in Sweden than elsewhere. Flexible lending rates respond to a change in the monetary policy stance with a negligible time lag, but most lending rates to the private sector are fixed and respond only as debt matures. The response of household consumption may therefore be slow.

Although new business investment ought to respond to changes in the cost of capital independently of interest rates on existing debt, investment always responds with long time lags. This makes the traditional transmission mechanism of monetary policy via investment to aggregate demand weak in the short run (less than a year). If the interest rate change is expected to be permanent, investment will pick up after a few years.

There are many channels other than the traditional ones through which interest rates influence demand. Lower interest rates mean higher asset prices, higher wealth, less severe credit crunch and higher consumption and investment. Expectations about a higher level of economic activity may by themselves increase consumption and investment. Even if the prevalence of fixed interest rates and the difficulties in influencing long terms rates makes the traditional transmission mechanism less efficient in the short run, interest changes may still have a large influence on demand and the price level through other channels.

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