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Article — Published Version

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Sveriges Riksbank Economic Review

Suggested Citation: Apel, Mikael; Claussen, Carl Andreas (2012) : Monetary policy, interest rates and risk-taking, Sveriges Riksbank Economic Review, ISSN 0348-6583, Sveriges Riksbank, Stockholm, Iss. 1, pp. 68-83, http://archive.riksbank.se/Documents/Rapporter/POV/2012/rap_pov_artikel_4_120607_eng.pdf

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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.

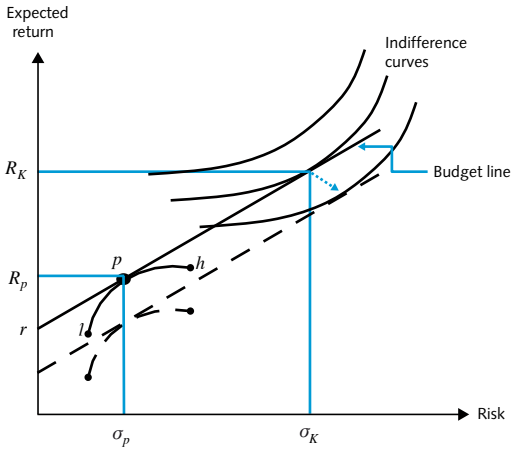
$$R_K = \sigma_K \frac{R_p - r}{\sigma_p} + r$$

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).

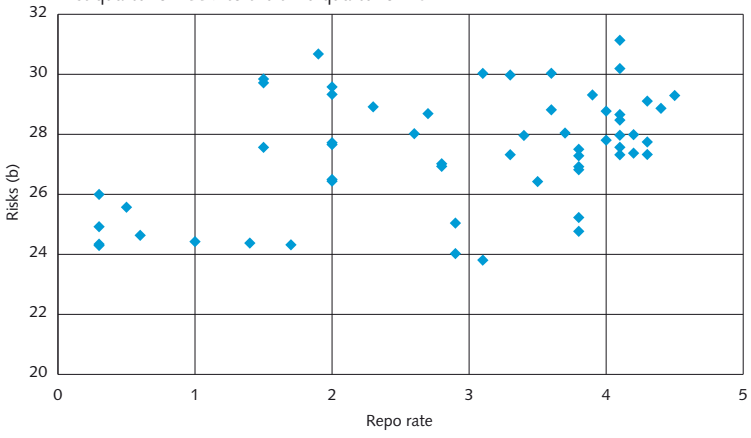
the short run the reduction in the interest rate reduces the risk in the outstanding stock of loans, and probably that the banks take higher risks in their new lending – in accordance with the theory described above.

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

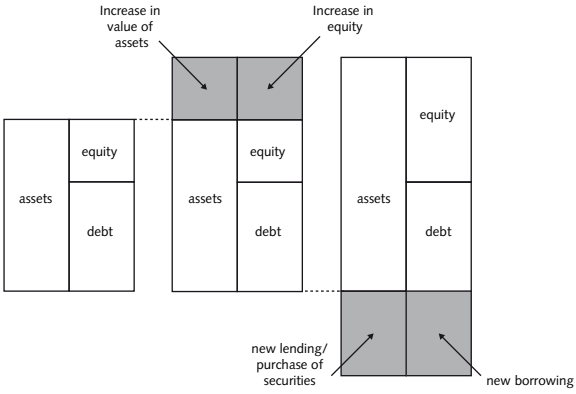
An explanation is to why risks in the financial system as a whole can build up without being detected by micro-prudential supervision relates to the traditional credit channel. But while the focus in the traditional credit channel is on how the amount of credit is affected by the interest rate, the focus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