Staff Memo

The neutral real interest rate

by

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❀NB❀   NORGES BANK

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1. Introduction

The topic for this paper is the so called neutral real interest rate. This is frequently defined as the level of the real interest rate consistent with stable inflation and production equal to potential production. Hence the neutral real interest rate is a benchmark for evaluating monetary policy. While the real interest rate should be set above the neutral real interest rate in cyclical upturns, it should take a level below in recessions.

In principle then, to be able to assess the degree of policy accommodation, knowing the level of the neutral real interest rate is as important as knowing the real interest rate. Moreover, the neutral real interest rate is not constant over time. In contrast, it depends on the structure of the economy. A decline in the neutral real interest rate implies that, for a given real interest rate, monetary policy is less expansionary. In isolation, a decline in the neutral real interest rate demands a lower nominal interest rate to maintain the monetary policy stance.

The concept of a neutral real interest rate dates back to the Swedish economist Knut Wicksell.[2] The definition above is basically reflecting his view, only put into a modern economic language. The topic has gained attraction in the recent years, both theoretically and empirically. Below, the discussion will be approached along the following lines:

- As a background for the theoretical and empirical discussion, historic developments of real interest rates are considered in chapter 2, both globally and for Norway. The purpose is to show how inflation, nominal interest rates and real interest rates have evolved over the last 50 years. The evolution of monetary policy regimes is reflected in the development of inflation and real interest rates. In particular, going through a transformation from high and volatile inflation to an environment of low and stable inflation has probably contributed to a substantial fall in the inflation risk premium and hence lower real interest rates.

- Chapter 3 presents the theoretic underpinning of the neutral real interest rate notion. Starting with a discussion of the difference between the long-term equilibrium real interest rate and the neutral real interest rate, we proceed to discuss and give a more precise definition of the latter. Moreover, the link between the real interest rate and the real exchange rate and the link between the domestic neutral interest rate and the global neutral interest rate will be discussed. We also look into the mechanisms through which the neutral real interest rate is related to the structure of the economy. Some open economy considerations are here taken into account.

- Chapter 4 concentrates on the literature of empirical estimates of the neutral real interest rate. Estimates for the euro area and the US are considered in particular, taken as a driving force for the global neutral real interest rate. Furthermore, we look at Norwegian interest rate data to assess what would be the appropriate level of the neutral real interest rate for Norway.

- Finally, in chapter 5 focus is on the consequences of a change in the neutral real interest rate. This will be related to the global easing of monetary policy in 2002/03.

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[2] Wicksell (1907, 1936)

Discussed are also consequences of misjudging the level of the neutral real interest rate.

The main conclusions are:

- The global neutral real interest rate seems to have declined over the past few years. For both the euro area and the US most estimates point to a range between 2 and 3 per cent.

- The neutral real interest rate for Norway depends on global developments. Norwegian interest rate data indicate that the neutral real interest rate may have declined over the past few years, in line with global developments.

- Based on the two arguments above, it seems reasonable to reconsider the estimate of the neutral real interest rate for Norway. Based on the assessment in this paper, an estimate in the range of 2.5 to 3.5 per cent seems appropriate now. This range is somewhat lower than previous estimates reported by Norges Bank.

- It should be born in mind that the estimates reported in this paper are subject to a considerably amount of uncertainty and should therefore be interpreted with a great deal of caution.

2. Historic development of inflation and nominal and real interest rates

In this section the historic development of inflation and nominal and real interest rates is discussed, both globally and for Norway. The main message is that both inflation and real rates have declined over time. Moreover, low and stable inflation is in itself an important contribution to the fall in real rates as the inflation risk premium declines. Parts of the following historic analysis draws heavily on Chada and Dimsdale (1999), hereafter CD.

To obtain the broad picture of global developments, figure 1 shows nominal short term rates, inflation and the implied real rates for some sub periods the last 50 years, averaged for the four countries US, UK, France and Germany.[3] In the post-war period of the 1950-1960s both inflation and nominal interest rates were moderate with low real rates. The period was characterized by governments placing ...*greater emphasis on stabilizing output than controlling inflation. They were also concerned about the costs of servicing debt, which led to a preference for low nominal interest rates. Governments were reluctant to relax restrictions on capital markets because of the priority given to financing public borrowing ...*(CD, page 25).

Turning to the 1970s, both nominal rates and inflation rose substantially, while real rates remained low. The higher inflation was a response to ...*the boom conditions of the the late 1960s and early 1970s, the impact of the Vietnam war and the first oil price shock of 1973-4... ...There was little evidence of monetary tightening being sufficient to force up real rates. For the most part nominal rates were raised in line with inflation...*(CD, page 31 and 33).

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[3] Except for the latest period 1998-2004, all data is taken from table 3 in CD.

The 1980s were characterized by higher real rates globally, a correction to the period of high inflation and low real rates in the previous decade. In US and UK governments became more concerned about controlling inflation. Moreover, as capital markets were deregulated, interest rates became more flexible and governments did less to borrow on favourable terms. Furthermore, there was an increase in public debt, which could be financed only by offering investors better conditions and higher real rates (CD, page 34 and 38-40).

Finally, extending the analysis of CD and including the last 7 years, the period 1998-2004 has been characterized by inflation, nominal rates and real rates all being relatively low.

To proceed the analysis of global developments, figure 2 shows inflation and nominal short term interest rates for the G7 countries from 1960. The difference between the two lines reflects the real interest rate. The figure confirms the picture disclosed in the previous chart, with both inflation and nominal rates being low in the post war period and both of them being high with continued low real rates in the 1970s. Continuing with more focus on the last 25 years, the period from the beginning of the 1980s is naturally divided into two sub periods, the period of fighting inflation (beginning of the 1980s and up to mid-1990s) and the period of low and stable inflation (from mid-1990s). In the former period, as governments tightened monetary policy to fight inflation, inflation fell to levels considerably lower than in the 1970s. As inflation turned low and stable in the 1990s, nominal rates continued to decline, leading to lower real rates compared to the 1980s.

The gradual decline in inflation and nominal and real interest rates must be seen against the background of an increasing concern about keeping inflation and output stable, in many countries formulated more or less explicitly as inflation targeting regimes from the beginning of the nineties. This came along with a view that in the long run monetary policy can only influence nominal variables like inflation and the nominal interest rate, leaving the determination of real variables to structural factors in the economy. The lesson for central banks was that monetary policy should aim at keeping inflation and inflation expectations low and stable, creating a nominal anchor for price and wage setters in the economy.

Low and stable inflation expectations contribute in it self to lower real rates. To see this, note that nominal rates can be decomposed into three factors (i) an expected real rate (or the expected real rate of return required by investors), (ii) a compensation for expected inflation, and (iii) an inflation risk premium due to the fact that future inflation and hence real return are uncertain. The inflation risk premium compensates investors for the risk that ex post real return may undershoot the ex ante expected one. Clearly, low and stable inflation expectations would reduce the inflation risk premium and therefore ex ante real rates. In that respect the period from the mid-1990s is historically unique: low and stable inflation expectations create an economic environment contributing to lower real rates and more stable production. Figure 3 shows inflation and the output gap for the G7 countries from the 1960s. As much as output stability is concerned, lower output gap volatility coincides with lower inflation.

Against this background of global developments, figure 4 and 5 show a similar picture for Norway. In the seventies, real rates were virtually zero, as high nominal rates just compensated for inflation. Subsequently, inflation fell gradually over the coming decades and stabilised at a relatively low level of around 2.5 per cent in the beginning of the nineties. The inflation target was introduced in March 2001. It is reasonable to assume that stable and low inflation has contributed to a fall in real rates also in Norway.

3. The theory of the neutral real interest rate

3.1 Long-run equilibrium real interest rate versus neutral real interest rate

In the literature, the notion of 'equilibrium' interest rate is frequently referred to as 'the long-run equilibrium level', 'the natural level' and 'the neutral level'. Some also refer to 'the neutral level in the short run', 'the neutral level in the medium run' and 'the neutral level in the long run'. Obviously, these are overlapping definitions, and different authors have different preferences for how to define the 'equilibrium' real interest rate. Notably, Roger W. Ferguson, Vice Chairman of the Board of Governors of the US Federal Reserve, says that

> ...Economists famously cannot agree on much. In this case, we cannot even agree on the name of the benchmark concept that I have just described. The real interest rate consistent with the eventual full utilization of resources has been called the equilibrium real federal funds rate, the natural rate of interest, and the neutral real rate. I prefer the first name, the equilibrium real federal funds rate, because, by using the word 'equilibrium', it reminds us that it is a concept related to the clearing of markets...[4]

Irrespective of how different 'equilibrium' concepts of real interest rates are labelled, most economists would agree upon the need for at least two definitions. The first one would be one suitable for evaluating monetary policy. Aiming at stabilising inflation and output over the say 1-3 years horizon, the central bank needs to evaluate whether monetary policy is tight or loose. This introduces the concept of real interest rate consistent with production at its potential and stable inflation over a horizon relevant for monetary policy decisions. In this paper, this level of real interest rate will be referred to as the neutral real interest rate. The second concept necessary to introduce is one applying for the very long run, the real interest rate consistent with all parts of the economy being in equilibrium. We will refer to this as the long-run equilibrium real interest rate. Below these two concepts are discussed in more details.

The long run equilibrium real interest rate

The long run equilibrium state of the economy is characterized by a situation in which *...all markets are in equilibrium and there is therefore no pressure for any resources to be redistributed or growth rates for any variables to change...*(Archibald and Hunter, 2001). This means that prices are flexible and production is determined from the supply side of the economy.

In the literature long run equilibrium real interest rates are frequently associated with the Solow and the Ramsey models, where the real interest rate depends on saving and investment decisions determined by productivity, population growth and households time preferences regarding consumption and saving. For example, higher productivity growth increases demand for investments and funding. In order to rise additional saving and supply of loans, savers must be offered more real return, hence the real interest rate must increase. Another example, if for some reason households would like to consume less now and save more for

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[4] See Ferguson (2004), page 2.

the retirement period, they would have to accept a lower real return as lower funding costs would be the only way through which investors would be willing to increase investment.

The long run equilibrium real interest rate is a highly abstract concept related to growth theory and it cannot be observed. Different estimation methods relying on theoretic models and assumptions regarding productivity and time preferences yield volatile and very uncertain estimates (Hammerstrøm and Lønning, 2000). We will not pursue the empirical side of long term equilibrium interest rates here, but note that despite its empirical shortcomings, the concept is useful as a background for the discussion of the neutral real interest rate.

The neutral real interest rate

The neutral real interest rate is normally defined as the level of the real interest rate consistent with output gap equal to zero and stable inflation. At the same time, it is implicitly assumed that also other variables like the real exchange rate neither stimulates nor contracts the economy. In this respect, the neutral real interest rate serves as a benchmark for monetary policy.

An important difference between the neutral real interest rate and the long run equilibrium real interest rate is the time horizon over which the two concepts are relevant and apply. The real interest rate may be neutral with output gap equal to zero and stable inflation in a situation where the economy has not settled at its long run values. In such a situation economic growth could deviate from the long run rate determined by fundamental factors like productivity and population growth. Public and foreign debt, the current account, the level of the real exchange rate, the tax and social benefit system and capital market structures could be in a state not sustainable in the long run. However, they would not have any significant influence on output gap and inflation and therefore monetary policy over the short and medium term horizon.

Hence the difference between the two concepts lies in the degree of flexibility required for the real interest rates to take their respective levels. For the real interest rate to settle at the long run equilibrium level the economy must be flexible with flexible prices, no distortions and no pressure to redistribute resources. However, for the real rate to take the neutral level the economy only needs to be in a state with output gap expected to be zero and inflation expected to be stable over the horizon relevant for monetary policy. In some sense the conditions under which the real interest rate will take the neutral level are 'weaker' than the conditions under which it will take the long run equilibrium level.

It is a general perception in the literature that the neutral real interest rate varies around the long run equilibrium real interest rate, and in absence of any shock to the economy, the neutral rate approaches the long run equilibrium rate. Hence determinants of the long run equilibrium rate pointed to above, like productivity and households saving decisions, will also be important determinants of the neutral rate. However, in addition the neutral real interest rate depends on other factors like the level of public debt, inflation and exchange rate risk and structures of financial markets.

Having established a kind of conceptual difference between the long run equilibrium real interest rate and the neutral real interest rate, we proceed with a more detailed analysis of the neutral rate, as this is the one most useful for monetary policy.

3.2 The link between the real interest rate, the neutral real interest and the real exchange rate

Though we introduced some basic ideas about the neutral real interest rate above, the concept will be discussed in more details in this section. Focus will be on the neutral real interest rate, its relation to the real interest rate in the short-run and long-run and how domestic real interest rate is linked to the foreign real interest rate.

Note that from now on, short, medium and long run is defined in terms of the horizon relevant for monetary policy decisions. While 'short run' and 'medium run' is defined as the horizon over which monetary policy is expected to be tight or lose, 'long-run' is defined as the horizon at which production settles at its potential level and inflation at its target. Hence in the long run real interest rate will be neutral. This long-run definition does not require that the whole economy settles at its long-run equilibrium values, as defined in section 3.1 above. To better understand these issues we start with two equations, the Taylor-rule and risk adjusted real interest rate parity.

The Taylor-rule

The Taylor rule provides a framework to discuss both the neutral real interest rate and the 'long run' concept relevant for monetary policy. The rule prescribes that nominal short term interest rate should be set according to

(1) $i = \pi^* + r^* + 1.5(\pi - \pi^*) + 0.5Y$,

where π, π^*, r^* and Y are inflation, the inflation target, the neutral real interest rate and the output gap, respectively. The output gap is defined as the level of production minus potential production.

Definition of 'long run' in the Taylor-rule

- In terms of the Taylor rule, 'long run' is defined as a state of the economy where output gap approaches zero and inflation its target, e.g., $(\pi - \pi^*) = Y = 0$.

Definition of the neutral real interest rate in the Taylor rule

- In terms of the Taylor rule, r^* defines the neutral real interest rate. When output gap is equal to zero and inflation on target, the nominal interest rate should be set equal to the neutral real interest rate plus inflation expectations, the latter assumed to coincide with the inflation target (hence the Taylor rule is reduced to the Fisher-equation).

- The real interest rate gap – the difference between the real interest rate and its neutral level $(r - r^*)$ – provides a measure of the stance of monetary policy. In cyclical upturns, to calm down and stabilise the economy over time, monetary policy should be tight

and the real interest rate should take a value above the neutral level. Hence the real interest rate gap should be positive. Similarly, in recessions the real interest rate gap should be negative.

- Note that the neutral real interest rate is both a short-term and a long term concept. *In the long run*, as both the inflation gap and the output gap will be zero, the real interest rate will be <u>equal to</u> the neutral level. *In the short run*, the real interest rate will <u>deviate from</u> the neutral level to the extent that the inflation gap and the output gap deviate from zero.

- While the real interest rate gap depends on the state of the business cycle, i.e., the size of the inflation gap and the output gap, the neutral real interest rate depends on the structure of the economy, to be further discussed below.

Risk adjusted real interest rate parity

According to risk adjusted real interest rate parity, the domestic real interest rate is equal to the foreign real interest rate plus expected changes of the real exchange rate and a risk premium,

(2) $r = r_g + (q^e - q) + rp,$

where r is the domestic real interest rate, r_g is the foreign – or global - real interest rate, q^e is the log of the expected long term real exchange rate (the equilibrium real exchange rate), q is the log of the real exchange rate and rp is a risk premium. An increase in q indicates a real depreciation of the domestic currency. Note that the term $(q^e - q)$ expresses the expected change of the real exchange rate. Real interest rate parity is a real term extension of the familiar uncovered interest rate parity, the latter saying that nominal interest rate differentials compensate for expected nominal exchange rate changes.[5] The rationale for both nominal and real interest rate parity is free movements of capital across countries. If expected domestic real return deviates sufficiently from expected real return globally, capital movements would arise and equalize expected real return home and abroad. However, due to uncertain exchange rate and price developments, ex post real return is uncertain at the time of investment. This may lead to a risk premium.

Risk adjusted real interest rate parity establishes both short-run and long-run relations between the domestic real interest rate, the global real interest rate and the real exchange rate. We first consider long-run relations, thereafter short-run relations.

Lon-run considerations

In the long run, defined in the Taylor-rule as a situation where the economy has settled with inflation on target and output gap equal to zero, it is reasonable to assume that the real exchange rate equals its long run value. Expected changes of the real exchange rate will be zero and risk adjusted real interest rate parity is reduced to

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[5] Se MacDonald and Nagayasu (2000) for outline of real interest rate parity.

(3) $r = r_g + rp$,

i.e., the domestic real interest rate is equal to the global real interest rate plus a risk premium. Moreover, in the long-run the real interest rate will equal the neutral rate ($r = r^*$). Assuming similar long run conditions globally ($r_g = r_g^*$), it follows that

(4) $r^* = r_g^* + rp$,

i.e., domestic neutral real interest rate is equal to the global neutral real interest rate (r_g^*) plus a risk premium. As will be discussed below, neutral real interest rate is determined by structural factors. Hence, the domestic neutral real rate is determined by global structural factors plus country specific structural factors, the latter determining the risk premium.

Short-run considerations

In the short run the inflation gap and the output gap normally deviate from zero and monetary policy is oriented towards stabilising the two gaps over time. At the same time, the real exchange rate may deviate from its long-term expected value. According to risk adjusted real interest rate parity as expressed in equation (3), the real interest rate differential is related to expected changes of the real exchange rate. Both of them are endogenous, they influence each other and both depend on other variables in the economy, like fiscal policy.

3.3 What determines the neutral real interest rate?

We now proceed to discuss what determines the neutral real interest rate. In particular, focus will be on mechanisms relating the neutral real interest rate to structural factors in the economy. It turns out to be appropriate to distinguish between closed economy considerations and open economy consideration. We start with the closed economy.

Closed economy considerations

The real interest rate can be regarded as the price equalising saving and investment. Investment, or demand for funding, increases with lower real rate, while saving, supply of loans, increases with the price. This is illustrated in figure 6. Saving and investment conditions and hence the real interest rate are determined by both structural factors and monetary policy. Assuming monetary policy to be neutral, we are left with structural factors determining the neutral real interest rate. Basically, all structural changes which tend to increase investment or reduce saving, lead to higher neutral real interest rate. Similarly, all structural changes which tend to decrease investment or increase saving, lead to a lower neutral level.

Productivity and households saving decisions: As explained above, higher productivity increases demand for investment and leads to an increase in the neutral real interest rate. As higher investments increases aggregate demand, the central bank would need to increase the policy rate to avoid pressure on production and inflation. Hence, the real interest rate would

increase and approach the new and higher neutral level. Moreover, a decision for households to save more for future consumption would tend to reduce the neutral real interest rate. As saving would rise (and consumption and investment would fall), the central bank would have to cut the policy rate to avoid a fall in aggregate demand. The real interest rate would approach the new and lower neutral level.

Public debt: Government borrowing may influence the neutral real rate in that debt issuance need to be matched by higher demand for saving in the private sector. If the private sector decides to save more today to offset a likely increase in taxes in the future (Riqardian equivalence holds), the public deficit may be financed without any increase in the real interest rate. However, if private sector does not fully adjust their savings in response to the larger public deficit, the rate has to increase in order to induce higher savings (the government must offer a higher return).

Inflation risk premia: The more uncertain future inflation is, the more uncertain is the ex-post real return. To compensate for the inflation risk, savers may demand an additional expected return to be willing to postpone consumption. Hence the higher the inflation risk, the higher is the neutral real interest rate. As discussed in chapter (2), inflation risks have probably declined over the past 10-15 years, both globally and in Norway.

Liquidity risk: The less liquid the bonds markets, the higher is the probability that savers will influence the price if they for some reason want to sell the bonds prior to redemption. To offset this potential loss, investors may demand an additional expected real return.

Open economy considerations

The structural factors listed above are typically 'closed economy text-book' determinants of the neutral real interest rate. However, as outlined in equation (4) above, domestic neutral real interest rate is determined by the global neutral interest rate and a country specific risk premium. The global neutral real interest rate is determined by structural factors in the major countries, while the risk premium depends on local structural components.

The country specific risk premium could be determined by exchange rate risk, liquidity risk and by factors related to the structure of financial markets. This could in particular be the case for small economies. Moreover, large international investors may have a preference for large dominant financial markets, for example due to lack of information about smaller markets or simply just because they for some reason feel less safe in peripheral markets. On the other hand, domestic savers may for some reason have a home-bias, preferring the small domestic market.

Moreover, some of the 'traditional' closed-economy determinants listed above could be less relevant for small open economies. For example, in a global capital market it may be possible to finance higher domestic investments without creating more domestic saving. Hence it is not necessary to offer domestic savers additional real return. The same apply for an increase in public debt, in as much as the public deficit may be financed abroad.

Finally, what is the rationale behind the claim that the degree of tightness of monetary policy in Norway depends on say productivity in the US? According to equation (4), domestic

neutral real interest rate depends on global neutral real interest rate, the latter determined by structural factors in the big economies.

Suppose that the US faces higher productivity and higher investment demand.

- Higher US productivity and investment demand increases the US neutral real interest rate. The US central bank would normally respond to higher demand by increasing the real interest rate. Hence in US the real interest rate approaches the new and higher neutral level.

- Domestically, the higher US real interest rate creates a depreciation of the currency (because savers want to save less domestically and more in US). The weaker real exchange rate puts pressure on domestic resources and inflation, hence the domestic central bank must respond with higher interest rate. The real interest rate will approach the neutral real interest rate.[6]

4. Estimates of the neutral real interest rate, globally and in Norway

In this section focus will be on empirical estimates of the neutral real interest rate, both globally and for Norway. As the concept of neutral real interest rate is rather abstract, a great deal of uncertainty is attached to the estimates. In the literature a variety of methods to estimate the neutral real interest rate exists and they all have their advantages and shortcomings. Giammarioli and Valla (2004) provide a survey on the different methods, which briefly could be categorised in the following groups:

Simple average of historic interest rate series
- If the neutral real interest rate could be assumed to be constant over time, the real interest rate, averaged over the whole business cycle, should approximate the neutral real interest rate (by the argument that positive and negative real interest rate gaps cancel out). The problem is (in ascending order of importance) that (i) inflation expectations and hence real interest rates are unobservable, (ii) it is not always clear when the business cycle starts and ends, and (iii) the neutral real interest is by nature not constant. Still, average methods could provide information about the neutral real interest rate and are widespread in the literature.

- Furthermore, some measures rely on inflation-indexed bonds or implied long-term forward nominal rates, the latter deflated by long-term inflation expectations. Though implied long-term forward rates in principle solve the problem of a time varying neutral rate, one can question to what extent they are independent of the current level of the business cycle.

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[6] The exact development of economic variables, whether the exchange rate and the real exchange rate under- or overshoot new equilibrium values depend on the model specification.

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- Some measure the neutral real interest rate by estimating monetary policy rules, like the Taylor-rule, where the constant term normally reflects the nominal neutral rate (given an inflation target). While academic appealing, it also suffers under the constant neutral rate assumption.

SDGE model-based estimates
- Stochastic Dynamic General Equilibrium (SDGE) models define the neutral real interest rates as the level that would prevail when all prices and wages are flexible. This concept allows for a time-varying neutral real interest rate that depends on structural factors and is frequently referred to as the 'flex price' neutral real interest rate. To estimate it, the parameters of the model must be either estimated or calibrated. While theoretic appealing, in practice the estimates turn out to be sensitive to choices regarding the detailed specification of the model and parameter values. Details on the issue can be found in Gali (2002) and Giammarioli and Valla (2004). With respect to the interpretation of neutral interest rate, Amato (2005) discusses some differences between SDGE models and the more 'traditional' approach emphasised in this study.

The Kalman-Filter method
- By applying the so-called Kalman Filter on a small-scale macroeconomic model, one can de-trend data to estimate unobservable variables like the neutral real interest rate and potential output simultaneously. The 'reference paper' on the method is Laubach and Williams (2003), to be further discussed below. The method relates the neutral real interest rate to real economy factors and allows for a time varying estimate of the neutral rate. However, the estimates frequently turn out to be highly volatile and are associated with a great amount of uncertainty. Ferguson (2004), referring to estimates and corresponding confidence intervals provided by Laubach and Williams, claims that *...clearly, this estimate is not measured sufficiently precisely to be a useful guide to policy...* Still, however, Laubach and Williams' study has obtained much attention in the empirical literature on neutral real interest rates because it strikes a compromise between the theoretically coherent SDGE approach and pure statistical approaches.

Overall, all methods used to estimate the neutral real interest rate have some shortcomings. It is useful to recall Blinder (1998), expressing *...the neutral real rate of interest is difficult to estimate and impossible to know with precision. It is therefore most usefully thought of as a concept rather than as a number, as a way of thinking about monetary policy rather than as the basis for a mechanical rule...*Hence the estimates referred to below should not only be treated with great caution, but also sound scepticism. That said, as the neutral real interest rate provides a benchmark for evaluating monetary policy, it seems useful to go through a process of trying to estimate it.

Estimates of the global neutral real interest rate

Starting with estimates for the euro area, the European Central Bank (ECB, 2004) argues that the neutral real interest rate may have declined over the past 10-15 years. It points to slowdown of productivity and population growth in the euro area, disappearance of inter-euro area exchange risk premiums, the process of fiscal consolidation in the euro area before the

start of Stage Three of EMU and a fall in the inflation risk premium. They indicate that most estimates point to a range between 2 and 3 per cent for the neutral real interest rate in the euro area at present. However, they also point to the high degree of uncertainty attached to these estimates, hence they should be interpreted with a great deal of caution.

Giammarioli and Valla (2003), based on a SDGE, argue that the neutral real interest rate for the euro area has gradually declined from mid-1990s, from around 4 to around 3 per cent in 2000. Cuaresma, Gnan and Ritzberger-Gruenwald (2003) indicate that the neutral real interest rate for the euro area fell somewhat after 2000 and suggest a level of around 2 per cent at the end of 2002. Garnier and Wilhelmsen (2004) also find that the neutral real interest rate has fallen in the last years, both for euro area and Germany. Goldman Sachs (2004) argues that the neutral real interest rate for the euro area has decreased over the past 15 years and estimates it to be close to 2 per cent in October 2004.

Turning to studies on US data, Laubach and Williams (2003), one of the most-quoted recent papers in the literature, estimate the neutral real interest from the beginning of 1960s and up to 2002. The estimates are uncertain and depend on the exact method used. In general, the neutral real interest rate seems to have fallen gradually over time. One reason for this could be a fall in the inflation risk premium as discussed in chapter 2. Moreover, while the neutral real interest rate was temporarily low in mid-nineties, it rose towards the end of the decade, after which it has been fallen. As productivity is one of the forces driving the neutral real interest rate in the Laubach-Williams methodology, this could be seen against the background of the new-economy wave in the second part of the 1990s and the decline in stock market prices in 2000 and the following US recession. In mid-2002 Laubach and Williams estimate the neutral real interest rate for the US to be around 3 percent. OECD (2004), updating the Laubach-Williams' estimates, argues that the neutral real interest rate was slightly above 2 per cent at the end of 2004.

In a speech held in October 2004, Roger W. Ferguson, Vice-Chairman of the Board of Governors of the US Federal Reserve System, focuses on the significant fall in estimates of the US neutral real interest in the last years.[7] He refers to the cut in interest rates from the high level at the beginning of 2001 to the low level in 2003/2004 and emphasizes that even though the real federal funds rate was pushed below zero the policy accommodation was less exceptional as the neutral real rate had declined, too. He points out that *...an unusual hesitancy on the part of businesses to hire and spend emerged in 2001 after the collapse of equity prices*...and that *...the restraint imposed on domestic consumers from an increase in the cost of energy...* contributed to the fall in the neutral real interest rate.

Manrique and Manuel Marques (2004) estimate the neutral real interest rate for US and Germany from mid-1960s and up to end-2001. For US the pattern of the neutral rate since the beginning of the nineties is similar to that reported by Laubach and Williams. While the neutral real interest rate in US increased towards the millennium, it declined thereafter. Late 2001 the estimate was around 2.5 per cent. Amato (2005) estimates the neutral real interest rate for both the euro area and the US to be around 2 ½ - 2 ¾ per cent. This is also the view taken by BIS (2005).

Turning to less academic, though not necessarily less correct, information regarding the neutral real interest rate in the US, Financial Times (2005) refers to a neutral nominal federal

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[7] Ferguson (2004)

funds rate ...*generally seen as a range centred around 4¼ per cent*..., and ...*the central bank's presumed 1-2 per cent comfort range based on the core personal consumption expenditure measure*..., implying a neutral real federal funds rate of around 2.75 per cent. In an earlier note from 12 July 2004 the same newspaper referred to Robert Parry, outgoing president of the San Francisco Fed, who had suggested ...*using the average for the real federal funds since the 1960s of 2.5-3.5 percent*...Taking into account the general perception of a falling neutral real interest rate for US in the recent years, the lower bound of Parry's interval would probably be appropriate. Furthermore, Goldman Sachs (2005), referring to average real interest rates since the sixties, argue that the real neutral interest rate for US could be around 2.5 per cent.

Having a closer look at other countries, Björksten and Karagedikli (2003) and Lam and Tkacz (2004) report that the neutral real interest rate has also declined for New Zealand and Canada, respectively. Moreover, according to OECD (2004), ...*estimates for Poland put the neutral rate at around 4 per cent in 2003, down somewhat from its average level in earlier years, but clearly above euro area levels*...

Summary of the view on global neutral real interest rate:

- Estimating the neutral real interest rate is a very tricky business. Not only is the real rate unobservable, in addition the concept of neutral real interest rate is abstract. Still, on a theoretic level it provides an important benchmark for evaluating monetary policy and some empirical literature also exists.

- First, it seems to be a general perception in the literature that lower and stable inflation has contributed to a fall in the inflation risk premium and the neutral real interest rate.

- Second, several studies indicate that from the beginning of the 1990s, the pattern of the neutral real interest rate in US differs somewhat from that in the euro area. While the neutral real interest rate for the euro area has gradually declined, for the US it rose from mid-nineties and up to the millennium. Following the stock market crash, the recession and the 11 September attack, most estimates indicate that it has declined in the last few years.

- Third, estimates point to a level in the range of 2-3 per cent for both the euro are and US. For both countries some estimates are close to the lower bound, while other estimates are close to the upper bound.

Estimates of the neutral real interest rate for Norway

Turning to the neutral real interest rate for Norway, we recall that for a small open economy the neutral real interest rate is likely to be affected by the global neutral rate plus a country specific risk premium. Thus, the neutral real interest rate for Norway should be judged partly on the basis of global developments. In addition, Norwegian market interest rate data may also provide some information about the level of the neutral real rate.

Looking at Norwegian market rates data, figure 7 shows implied long-term forward rates adjusted for long-term inflation expectations from 1996 (red line). Nominal implied long term forward rates are calculated on the basis of government (benchmark) bonds with five and ten years maturity, hence the implied rates are five years forward in five years. Inflation expectations are set to 2 per cent from 1996 and up to the first quarter of 2001, after which it is assumed to be 2.5 per cent (the inflation target of 2.5 per cent was introduced in March 2001). The figure also shows that consumer prices (blue line) vary around the assumed long-term expectations, indicating that our measure of those is not that far fetched.[8] In principle, long-term implied forward rates are determined by market's future interest rate expectations and should – at least in theory – be independent of the current business cycle. Hence the real rate deduced from them should be close to market's estimate of the neutral real interest rate.

While it remains questionable to what degree the implied long-term forward rates are really independent of the current business cycle, at least they are less dependent than money market rates and bond rates. In the period 1998-2003 this measure of the real neutral interest rate varied roughly between 3 and 4 per cent. However, from mid-2002 it has been trending downwards, and from mid-2003 it has taken values lower than 3 percent. This development is consistent with the view of a decline in global neutral real interest rates.

Figure 8 shows short term real money market rates from the beginning of the 1970s (deflated by current headline consumer prices) and a smoothed series based on a HP-filter, the latter sometimes taken as a simple statistical measure of the level of the neutral real interest rate (see for example OECD, 2004). Though the HP-filter may reflect the stage of the business cycle, it could provide some insight in studying it. In the second half of the nineties the filtered rate has been broadly in the range of 3-4 per cent, after which it has declined. At present it is around 2 percent, probably lower than the neutral real interest rate.

In the last years, up to late 2004, the neutral real interest rate in Norway was estimated to be in the range between 3 and 4 per cent, partly based on the study by Hammerstrøm and Lønning (2000). Based on the developments of the global neutral real interest rate in the recent years and the broad picture given by the Norwegian interest rate data, it seems reasonable to reconsider the estimate of the neutral real interest rate for Norway. A somewhat lower estimate in the range between 2.5 and 3.5 per cent would probably be appropriate.[9] Note, however, as already mentioned above, that a great deal of uncertainty is attached to such estimates.

This range is slightly higher than the interval suggested for the global neutral real interest rate, implying a risk premium of around ½ percentage point. As mentioned above, this difference could reflect exchange risk premia or a perception among international investors that Norwegian financial markets are relatively small and peripheral. In fact, it seems to be a general tendency that estimates of the neutral real interest rate for smaller economies are larger than those for the big countries.

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[8] If we recall figure 5 in chapter 2, showing inflation in Norway since the 1960s, it would be reasonable to assume that from mid-nineties inflation expectations have settled at a fairly low level.

[9] Note that in Inflation Report 3/2004, in the monetary policy rules discussed in chapter 5, the neutral real interest rate (constant term in the rules) was set to 3 per cent, the mid-point of the suggested interval above.

Björksten og Karagedikli (2003) indicate that estimates of the neutral real interest rate for New Zealand, UK, Australia, Sweden and Canada (though not Switzerland) are higher than the estimate for US. For all countries - US included – it has declined in recent years. Moreover, in a small model of the Australian economy the neutral real interest rate is set to be 3.5 per cent (Beechey et al., 2000), higher than most estimates for the euro area and the US. Furthermore, Amato (2005) indicates that the neutral real interest rate for UK is higher than the rates for US and the euro area. Larsen and McKeown (2004) indicate that the neutral real interest rate for UK is around 3 per cent. Hence, estimates of the neutral real interest rate seem to be higher for small economies than for the big countries.

Summary of the neutral real interest rate for Norway

- The global neutral real interest rate seems to have fallen over the past few years. The neutral real interest rate for Norway is probably influenced by the global rate.

- Norwegian market interest rate data suggests that the neutral real interest rate for Norway may have declined.

- Overall, it seems therefore reasonable to reconsider the estimate of neutral real interest rate for Norway. While previous estimates pointed to a neutral real interest rate in the range between 3 and 4 per cent, this range has probably declined somewhat. At present we estimate the neutral real interest rate to be in the range between 2.5 and 3.5 per cent. This is somewhat higher than the estimates of the euro area and the US, in line with estimates for other small countries.

5. Implications of a change in the neutral real interest rate

We now proceed to consider the implications of a fall in the neutral real interest rate. Given the stage of the business cycle, the lower the neutral real interest rate is, the lower should the real interest rate be. This means that if the neutral real interest rate declines, the economy can take a lower real interest rate without booming. Hence, as noted by Ferguson (2004), even though real rates may be historical low, the degree of policy accommodation may be less exceptional if the neutral real interest rate has declined, too.

Against this background, and assuming that the neutral real interest rate for Norway has declined over the past few years, we shall have a closer look at the interest rate cuts in Norway starting late 2002. Figure 9 shows nominal short term money market rate, core inflation and the corresponding real rate. The fall in nominal rates can be assessed in light of three components:

- First, as inflation fell, but for a given estimate of the neutral real interest rate, the nominal rate had to be cut to maintain the same policy accommodation, i.e., the same real interest rate gap.

- Second, as the neutral real interest rate was probably declining somewhat at the time, the real rate had to be lower to maintain the same level of policy accommodation (This would have occurred also without the fall in inflation).

- Third, as inflation fell under the inflation targeting regime, lower inflation and inflation expectations implied a more accommodative monetary policy, i.e., a lower real interest rate gap.

Finally, as estimates of the neutral real interest rate are highly uncertain, it seems appropriate to discuss implications of misjudging the level of it. If estimates of the neutral real interest rate are incorrect, monetary policy would be unintentionally tight or lose. Consequences of misjudging the level of the neutral real interest rate are illustrated in figure 10 and 11, showing different paths for inflation and the output gap.

In the reference scenario the neutral real interest rate is assumed to be 3 per cent, and, at the same time, the central bank is assumed to know the true level (red lines). The reference paths in figure 10 and 11 are technically constructed only with the purpose of showing implications of misjudging the correct level of the real exchange rate.

The blue and black lines show paths for inflation and the output gap given that the central bank incorrectly estimates the neutral real interest rate to be 3 per cent, when in fact the true level is 2-2.5 per cent, alternatively 3.5-4 per cent. For all paths it is assumed that the central bank misjudges the true level from the first quarter of 2005 until the last quarter of 2008, after which the neutral real rate takes the true value. The paths are based on a small model for the Norwegian economy (Husebø et. al., 2004).

If the neutral real interest rate is incorrectly estimated to be 3 per cent, when in fact the true level is 2- 2.5 per cent, monetary policy would be unintentionally tight. Hence inflation and the output gap would be lower than in the reference scenario (black lines). In the period up to around 2010 inflation would be around ¼ - ¾ percentage points lower and the output gap would be ½ - 1¼ percentage points lower than in the reference path. Similarly, if the neutral real interest rate is incorrectly estimated to be 3 per cent, when the true value is 3.5 – 4 per cent, monetary policy would be unintentionally expansionary. Inflation and the output gap would be higher than in the reference path.

The figures illustrate that the neutral real interest rate may be important for the conduct of monetary policy.

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# 1. Nominal and real interest rates and inflation

Average of US, UK, France and Germany

■ Mean 3m. nom. rate ■ Mean inflation ■ Mean real rate
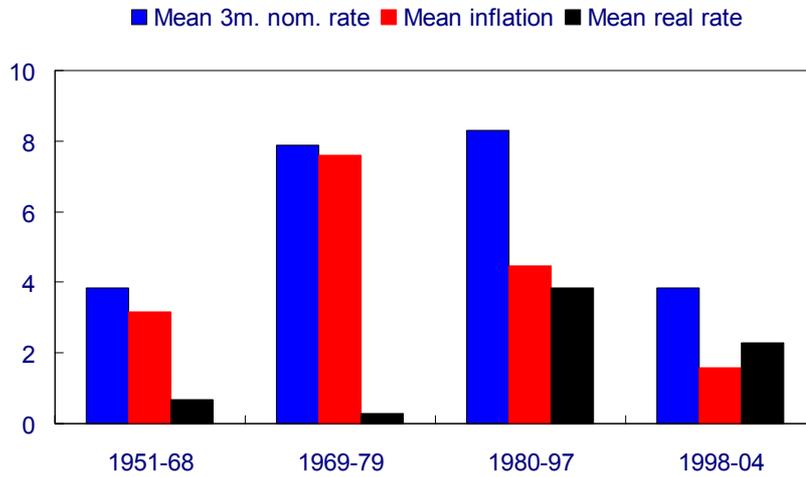
Source: Chada and Dimsdale (1999) and own calculations (EcoWin)   1

# 2. Inflation and short term nominal interest rates for the G7 countries

Short term nominal rates, G7

Inflation, G7 countries
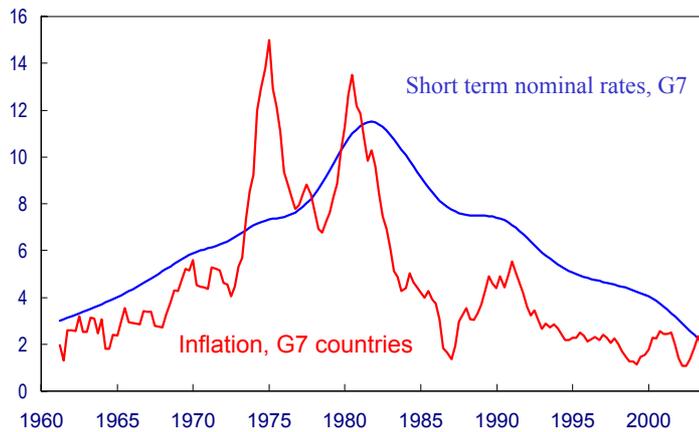
Source: OECD

2

3. Inflation and output gap for the G7 countries

Inflation, G7

Inflation and production more stable since the 1990s

Output gap, G7
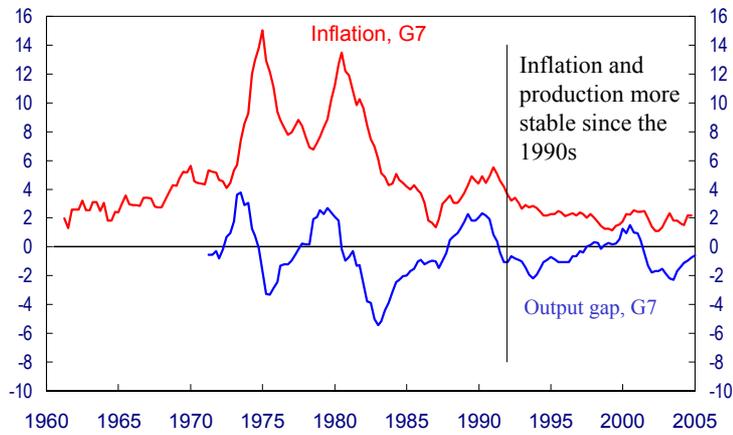
Source: OECD

3

4. Nominal and real interest rates and inflation Norway

■ Nominal rate ■ Inflation ■ Real rate

1971-79   1980-89   1990-94   1995-04
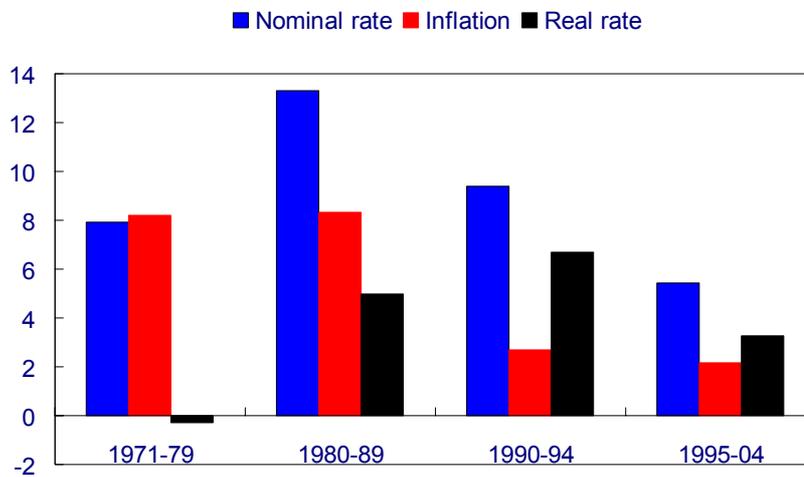
4

5. Inflation and nominal short term interest rates in Norway

Inflation, headline, Norway

3m. nom. rate, Norway

2.5 %   **2.5 %**

1960   1965   1970   1975   1980   1985   1990   1995   2000   2005

Source: Norges Bank

Real interest rate   Supply of loans/saving

r*

Demand for funding/
investments

Production
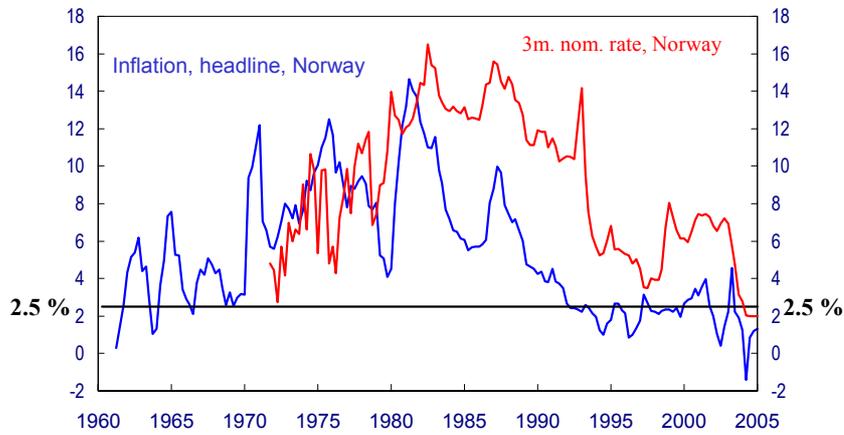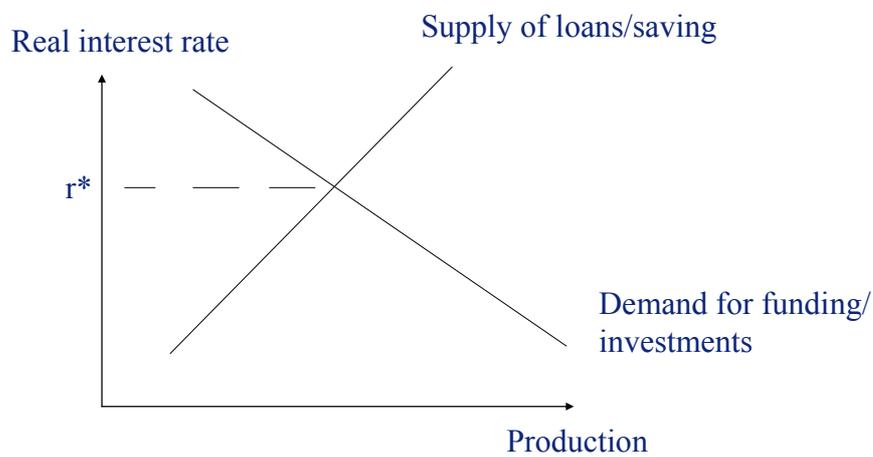
7. Long-term implied forward rates (five years in five years) minus long-term inflation expectations
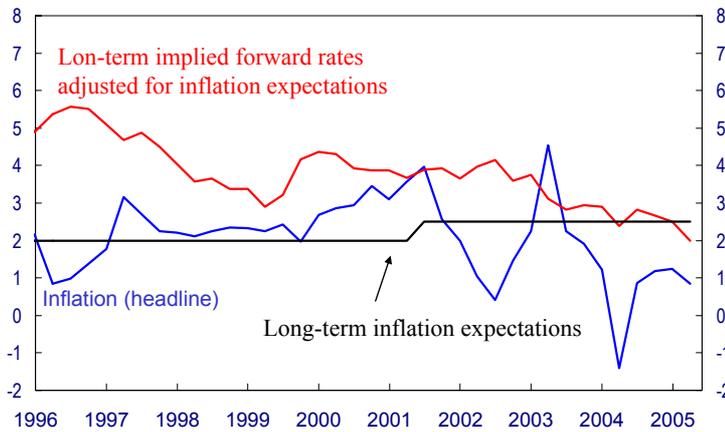

Source: Norges Bank

7

8. Short-term real interest rate deflated by consumer prices and HP-filtered short-term real rates
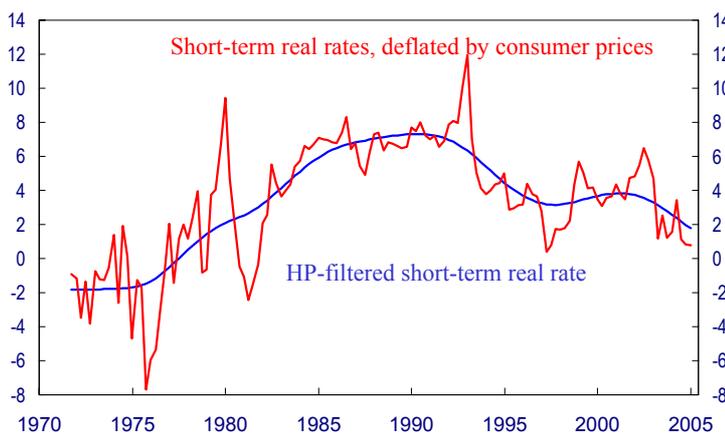

Source: Norges Bank

8

9. The interest rate cut in Norway from 2002
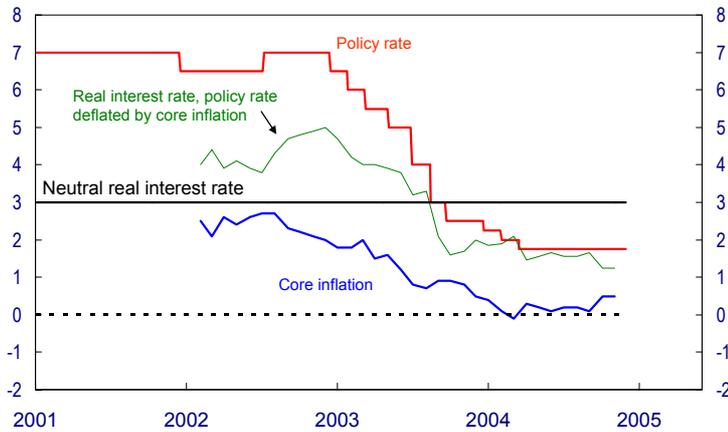

Source: Norges Bank

9

10. Inflation given different values of the neutral real interest rate, when the central bank all the time believes it is 3 per cent
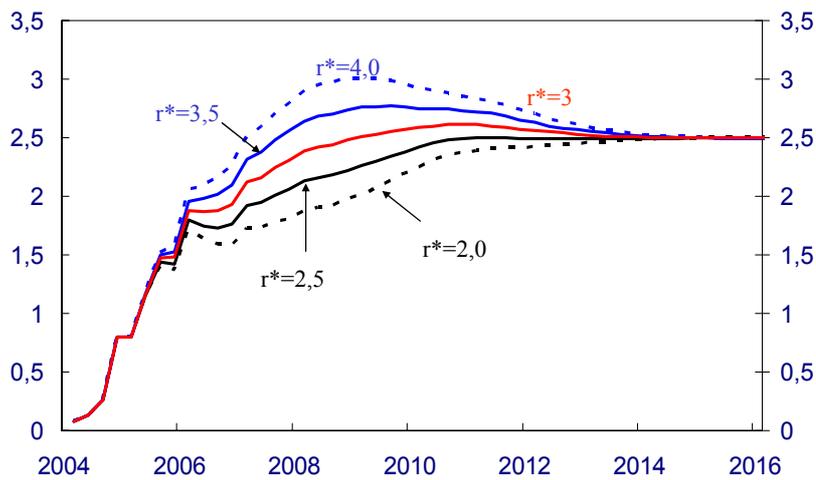
Source: Norges Bank

10

11. Output gap given different values of the neutral real interest rate, when the central bank all the time believes it is 3 per cent