

Projections, uncertainty and choice of interest rate assumption in monetary policy

Speech by Deputy Governor Jarle Berge at a Seminar by the Association of Norwegian Economists at Sanderstølen on 27 January 2006

Please note that the text below may differ slightly from the actual presentation. The speech does not contain new assessments of the economic situation or of current interest rate setting.

Introduction

First of all, I would like to thank you for inviting me to this seminar. Participants at this and other seminars have occasionally shown some interest in Norges Bank's views on future interest rate developments. For a long period, our analyses were based on the assumption that the interest rate would move in line with market expectations, and the discussion was usually about whether the bank agreed with this interest rate outlook or had a different interest rate path in mind. In *Inflation Report 3/05*, projections were based on the Bank's own projected path for future interest rates for the first time. In other words, from using technical assumptions and others' assessments of our future monetary stance, we have now in a sense "assumed ownership" ourselves of the interest rate path in our projections.

This seminar would therefore seem to give me an appropriate opportunity to provide some background on this issue and on the assessments underlying our forecasting.

When we make forecasts for variables such as output and inflation, we must at the same time have formed an opinion of the future interest rate path. Interest rate developments, in turn, must be considered in the context of other forecasts.

The choice of interest rate path in forecasting is important because monetary policy influences developments in the economy primarily through expectations. I will come back to this later on in my speech. First I will focus on the role of the interest rate in Norges Bank's projections. I will then move on to describe the analytical tools used by the Bank to arrive at a projection for future interest rates. Finally, I will discuss the uncertainty inherent in the projections.

Choice of interest rate assumptions in forecasting

Norges Bank seeks to achieve an interest rate path that provides a reasonable balance between the objective of bringing inflation up to target and the objective of stabilising developments in output and employment. This means we have to judge how these variables will develop in the period ahead and how they are affected by the interest rate. Hence, in order to make forecasts for inflation and output, we must also judge how interest rates will develop in the future.

The interest rate can be approached in various ways in forecasting. There might be arguments in favour of basing the interest rate assumption on external factors, as an exogenous assumption, either by assuming that the interest rate will remain constant through the projection period or that it will develop in line with market expectations. The projections that result from such technical interest rate assumptions do not necessarily provide a reasonable balance between the different objectives of monetary policy. In some cases, both the interest rate assumption and the projections may seem unreasonable. This may raise the question of the purpose of forecasting. However, it provides a starting-point for discussions about how the interest rate path might be adjusted to produce more acceptable results.

Alternatively, the interest rate can be treated in the same way as other variables forecast by the Bank. We would then have to try to make projections for inflation, output and the interest rate simultaneously, with the aim of arriving at an interest rate path that provides a reasonable balance between the different objectives of monetary policy. If the central bank has the intention of adhering to this interest rate path, this might be regarded as an interest rate forecast rather than a technical assumption.

Establishing such an interest rate path is not a straightforward matter. Flexible inflation targeting, which is the system we use, means that the deviation from the inflation target and the output gap are both taken into account. There is considerable uncertainty surrounding the calculation of the output gap, and there is no simple relationship between developments in the output gap and developments in inflation. It cannot therefore be claimed with any great certainty that it is possible to identify one particular interest rate forecast that provides the indisputably "best" trade-off in monetary policy. More often than not, there will be a number of possible interest rate paths that might be said to provide a reasonable balance, in view of the uncertainty involved.

Norges Bank's treatment of the interest rate in forecasting has changed over time. In 1999 and 2000, forecasting was based on the assumption that the interest rate would develop in line with market expectations as indicated by forward interest rates. In 2001 and 2002, the Bank based its forecasting on the assumption that the interest rate would remain constant to the end of the projection period. The constant level of the interest rate was calculated on the basis of historical averages, although the historical period on which the calculations were based could vary from one period to the next. On some occasions, the interest rate assumption reflected the average for the interest rate over the previous three months, on other occasions, the average for the previous month. From mid-2003, the interest rate assumption was again linked to market expectations, and in autumn 2005 we published our own interest rate forecast.¹

In addition to these changes in choice of interest rate assumption, Norges Bank has on some occasions commented on market expectations. In December 2000, the Bank stated in its editorial in the *Inflation Report* that market participants had a different view of the future interest rate. Communication following monetary policy meetings sometimes contained information concerning probable interest rate developments in the near future. After the inflation target was introduced in March 2001, monetary policy assessments had a more prominent position in the *Inflation Report*.

In some cases, the Bank has indicated that it would prefer an interest rate path that differed from the path on which the projections were based. For example, *Inflation Report 2/04* stated that "the most appropriate alternative now seems to be that the interest rate should be kept unchanged for a longer period than indicated by market expectations". In other words, the interest rate considered by the Bank to provide a better balance was lower than the rate factored in by market participants.

The chart illustrates what happened in summer 2004. The broken blue line shows the interest rate path underlying the projections. The line was consistent with interest rate expectations in the market as measured by forward rates. Norges Bank indicated in the *Inflation Report* that a lower interest rate than expected by the market would provide a better balance. What the appropriate interest rate level should be, however, was not stated explicitly, but the shaded area can perhaps provide an illustration. In the period following the publication of the *Inflation Report*, market expectations fell in the desired direction, as shown by the broken red line. Market participants did not, however, find any answers in the Report that would enable them to assess whether the new level, in the opinion of Norges Bank, would provide a reasonable balance.

The answer did not appear until the following *Inflation Report* in autumn 2004, when the Bank stated that market interest rates at that time provided a good balance between the various objectives of monetary policy. Against this background, the question might be raised of whether Norges Bank's guidance to the market in summer 2004 could have been even better.

In the first and second issues of the *Inflation Report* in 2005, the interest rate assumption was based on forward interest rates. However, the curve was adjusted upwards in the last part of the projection period. The Report pointed to extraordinary factors that might imply that forward rates underestimated actual expectations. The adjusted interest rate path - the baseline scenario - was considered to provide a reasonable balance between the different monetary policy objectives.

Over time, Norges Bank has chosen different interest rate assumptions. This is partly because the Bank has assessed whether the interest rate assumption is reasonable and has not based its decision on a purely mechanical application of certain technical assumptions.

As from *Inflation Report 3/02*, the Bank has published a recommended interval for the sight deposit rate over the following four months. To begin with, the interval was published at the end of the period to which it applied. Since *Inflation Report 2/04*, it has been published ahead of the period. The interval reflects the Bank's sight deposit rate projection for the following four months, conditional on economic developments that are approximately as projected. The interval is an important part of the Bank's communication strategy. Since we now also publish an interest rate projection for the entire projection period and not only for the next four months, economic agents gain broader insight into the analytical base, the assessments made and the Bank's response pattern.

Possible advantages of an explicit interest rate projection

In forecasting inflation and output, there may be a number of advantages to basing forecasts on an interest rate projection that in the Bank's opinion provides a reasonable balance between the different monetary policy objectives.²

A communication such as this makes it clear which interest rate path, in the Bank's opinion, provides a balance between monetary policy objectives. Given the information at the Bank's disposal and the assessments made by the Bank at the time the projections are made, the interest rate forecast in the *Inflation Report* will reflect a monetary policy that provides a reasonable balance between the objectives of stabilising inflation at target and stabilising output and employment. This forecast might in many cases be close to market expectations, but this will not necessarily be the case.

When the interest rate forecast reflects a monetary policy that provides a reasonable balance, it contributes to monetary policy predictability. With a predictable monetary policy, market participants can react to new information in a way that contributes to stabilising developments in output and inflation. This makes monetary policy more effective, especially if market participants share the central bank's analyses and assessments. To be successful, monetary policy must be capable of influencing expectations. This is essential to effective monetary policy.

The essence of this argument is that it is primarily through the expectations channel that the central bank can influence economic developments. The expectations channel is the most important channel for monetary policy transmission.³ The central bank determines the shortest money market rates via the key rate. The shortest rates, however, are of limited importance to economic agents' consumption and investment decisions. These decisions depend more on agents' expectations with regard to future developments in the key rate.

The key rate is primarily effective because it influences market expectations concerning future interest rates. Economic agents therefore need to understand the central bank's intentions in its interest-rate setting. Otherwise, agents might perceive future interest rate developments as unnecessarily uncertain. Decisions on consumption and investment will then be more difficult to make. This might lead to greater instability both in terms of variables in the real economy and in inflation. As I mentioned earlier, Norges Bank only influences the shortest money market rates. Open communication concerning our future response pattern will probably also allow us to have more influence over somewhat longer-term interest rates and thereby conduct a more effective monetary policy.

Many agents outside the Bank place considerable emphasis on Norges Bank's projections when they make their decisions. The projections are also evaluated by agents outside the Bank and by Norges Bank itself. The interpretation and evaluation of these projections will be more difficult if they are based on an interest rate assumption that is not consistent with the rate Norges Bank considers most realistic. If the forecasts for inflation and output are to reflect the Bank's best estimates, the underlying interest rate assumption must be a rate the Bank believes to be realistic.

If the Bank's interest rate forecast is different from market expectations, then this is useful information, not only for market participants, but also for the central bank. This may indicate that the central bank and market participants have a differing perception of future economic developments. It may also reflect differing views concerning the trade-offs in monetary policy. Market expectations, as reflected in forward rates, will be a way of cross-checking the Bank's interest rate forecast. If Norges Bank's interest rate forecast deviates from market expectations, the Bank should be able to explain this satisfactorily in order to influence interest rates in the money market.

In *Inflation Report 3/05*, there were only minor differences between Norges Bank's interest rate path and calculated forward rates up to 2007. Forward rates indicated that interest rates would then level off, while our forecast indicated a continued gradual rise up towards a more normal level. After the publication of the Report and up to end-January, market expectations have fallen. This shows that the interest rate path envisaged by the Bank and the path expected by the market can differ. There may be several reasons for this.

Calculated forward rates will usually reflect market expectations concerning the future interest rate path. Market interest rates may, however, be influenced by extraordinary supply and demand factors that do not have a bearing on the outlook for underlying economic developments or monetary policy. But market participants may also have a different perception of the interest rate path that is required to stabilise inflation at target. The difference can also be ascribed to the downward pressure exerted on long-term interest rates in many countries by extraordinary conditions in international capital flows.

Possible challenges of an explicit forecast of future interest rates

To what extent a central bank should publish an interest rate forecast has been the subject of discussion in international economic literature.⁴ The discussion has arisen as a result of the different solutions chosen by different central banks for different reasons.

It has been argued that the central bank might feel too bound by a previously announced interest rate path. Publication of the Bank's interest rate forecast might impose constraints on monetary policy, making it more difficult to adjust the interest rate to changes in economic developments. The interest rate path may be perceived as a straightjacket, preventing the central bank from pursuing the policy it considers to be appropriate at any given time. In addition, if the central bank should deviate from the previously published interest rate forecast, the Bank might be accused of misleading the market. Confidence in the central bank may thereby be undermined.

Some economists stress that a published interest rate forecast may create problems in the practical implementation of monetary policy. Results published in the literature, however, seem to point in a different direction. First, any constraints a published interest rate forecast might entail are not necessarily a disadvantage; on the contrary, they may be an advantage. Indeed, if interest rate expectations can be influenced, a response pattern that is binding for a shorter or longer period will in many cases be useful for a central bank. By being committed to a response pattern, the need for interest rate changes today may be reduced. From mid-2003 to mid-2004, for example, the Federal Reserve was concerned that inflation

might fall too low. The Fed therefore indicated that market participants should expect an expansionary monetary policy for longer than usual in periods of increasing activity.⁵ Norges Bank has made similar statements about the future interest rate. For example, from mid-2004 to the beginning of 2005, the Bank stated that "the prospect of continued low inflation in Norway also implies that we should lag behind other countries in setting interest rates at a more normal level". Statements such as this are intended to influence market expectations. Similarly, there may be advantages of publishing an explicit interest rate forecast. This may lead to commitments that increase the credibility of consistent interest-rate setting by the central bank. Nevertheless, statements related to the interest rate path can still be useful as they can provide information about why a particular path has been chosen. In addition, such statements can provide some information about our response to conditions outside the Bank's control.

Second, when the central bank deviates from the original projection for future interest rates, an explanation has to be provided. The interest rate forecast is based on incomplete information about the current situation and the functioning of the economy. If the economy is exposed to disturbances, the central bank's assessment of these disturbances must be communicated. The same applies if the central bank should change its view of the functioning of the economy. Professional financial market participants and other economic agents will have little difficulty in understanding that the interest rate will occasionally have to deviate from the forecast.

Basis for the interest rate forecast

In forecasting economic variables, Norges Bank uses an approach that captures and juxtaposes many different elements. The chart provides an illustration of the structure of forecasting. One important source of information on the current situation is current statistics. In addition to official statistics, information from our regional network plays an important role. In the course of a year, around 1400 interviews are held with leaders from various parts of the corporate and public sectors about economic developments in their enterprises and institutions. In our forecasting, we seek to build a bridge between our assessments of the current situation and the knowledge we have about long-term relationships in the economy. As a tool in this work, the Bank uses several macroeconomic models: one core model and a number of smaller models.

Central to this process is the use of judgment. The macroeconomic models provide a very simplified description of the economy and only serve as a forecasting tool. The forecasts for inflation, output, the interest rate and other variables in the economy must be perceived as a result of the Bank's best judgment. There is no mechanical relationship between the models the Bank uses and its forecasts.

Nevertheless, the models are a very useful tool in the conduct of monetary policy. In the process of arriving at an interest rate forecast that in the Bank's opinion provides a reasonable balance, a model system is needed where the interest rate and other variables in the economy are interdependent. The core model has this property.⁶

The core model includes relationships that describe the demand and supply side of the economy and a relationship that describes interest-rate setting. The interest rate is set on the basis of a long-term normal interest rate level in addition to information on inflation and output. Disturbances to the economy that influence developments in inflation, output or the exchange rate also trigger interest rate changes. Interest rate changes in turn affect inflation, output and the exchange rate in such a way that these variables stabilise over time around their equilibrium values. The model thus also embodies assumptions concerning long-term developments. In the literature, an interest rate path determined in this way is often referred to as an endogenous interest rate path. This means that the interest rate is simultaneously determined within the model with other variables such as inflation, output and the exchange rate - the interest rate is not taken as a given outside the model.

Economists with experience of other Norwegian macromodels may perhaps argue that the model I have just described seems too small to describe a complicated reality. The strength of such a small model is primarily that it isolates the mechanisms we are particularly interested in. At the same time, we also want to focus on a larger set of variables. In addition to the core model itself, the Bank therefore also uses a number of smaller additional models in its forecasting. This is illustrated in the chart, where the core model is represented by the yellow boxes at the top. The additional models are represented by the blue boxes, while the red boxes represent exogenous factors. The additional models are smaller models used to forecast variables such as wage growth, private consumption, investment and imports. We also look at conditions related to financial stability. The results produced by the core model and the additional models are tested against each other, and by means of an iteration process based on judgment we arrive at forecasts we believe are reasonable.

The forecasts that result from the models can be referred to as model-consistent. These forecasts will not necessarily be consistent with the Bank's perception of realistic economic developments. This is because the models are too simple to describe the real world, and as a rule, judgment will need to be applied to adjust the forecasts. Judgment is used to ensure that the forecasts for the different variables are economically consistent.

The work on models at Norges Bank has partly been focused on describing the role of the interest rate in the economy and partly on developing models that may be useful to decision-makers. A central element of the core model is that agents are forward-looking, reacting to expected economic developments. In recent years, a number of central banks have developed models of this type. However, it must be stressed that our core model and the models we develop only provide a very simplified description of reality. The Bank's forecasts are based on a broad range of different sources of information, with judgment as a substantial component.

Important elements in the assessment of what a good interest rate path is - and which underline the judgment component in this assessment - are reflected in six criteria that should be satisfied.⁷

The criteria emphasise that if monetary policy is to anchor inflation expectations around the target, the interest rate must be set so that inflation moves towards the target. Inflation should be stabilised near the target within a reasonable time horizon, normally 1-3 years. Assuming that inflation expectations are anchored around the target, the inflation gap and

the output gap should be in reasonable proportion to each other until they close. The inflation gap and the output gap should normally not be positive or negative at the same time further ahead. In addition, interest rate developments, particularly in the next few months, should result in acceptable developments in inflation and output also under alternative, albeit not unrealistic assumptions concerning economic developments and the functioning of the economy. The interest rate should normally be changed gradually so that we can assess the effects of interest rate changes and other new information about economic developments. Interest-rate setting must also be assessed in the light of developments in property prices and credit. It may also be useful to assess interest-rate setting in the light of some simple monetary policy rules. If the interest rate deviates systematically and substantially from simple rules, it should be possible to explain the reasons for this.

These criteria are important guidelines in forecasting an interest rate that provides a reasonable balance in monetary policy. Of course, the criteria cannot provide a precise instruction as to how the interest rate should be set, but points to factors we should have taken into account and assessed. In some contexts, the various criteria may be in conflict. In these situations, it is particularly important to exercise judgment in the trade-off between the different objectives of monetary policy.

Uncertainty surrounding future interest rate developments

What I have said so far about interest rate forecasts have perhaps left the impression of an exaggerated belief in control. This was not my intention. Our recent history underscores that economic developments involve a great deal of uncertainty. Even if the Bank publishes a forecast for the interest rate, this does not mean that the interest rate will follow the forecast throughout the projection period. Forecasts for inflation, output, the interest rate and other variables are based on an assessment of the current situation and a perception of how the economy functions. Disturbances to the economy may result in changes in the forecasts. Our ambition must be to reduce uncertainty with regard to our own response pattern. That actual interest rate developments will deviate somewhat from Norges Bank's forecast must be expected to be the rule rather than the exception. There is, in other words, substantial uncertainty associated with future interest rates. I would draw your attention to the fact that the Executive Board, when providing a more precise indication of where the interest rate level should lie over the coming four month period, operates with an interval of around one percentage point. Uncertainty does not of course diminish as we look further ahead.

This is a familiar situation for financial market participants, who are constantly changing their expectations concerning future interest rates as the economy is exposed to disturbances. Market participants' interest rate expectations can be calculated on the basis of observed money market rates. The deviation between market expectations and the actual interest rate has been substantial in periods. One important reason for this is that the Norwegian economy has been exposed to unexpected disturbances, often originating in the global economy. As a result, market participants have constantly had to change their assessments of future interest rate developments. There is no reason to believe that Norges

Bank will not also have to reassess its interest rate forecasts as new information emerges about economic developments.

While Norges Bank now publishes forecasts for inflation, output and the interest rate, we also try to provide information about the uncertainty in these variables. The charts show the forecasts in the most recent *Inflation Report*. Uncertainty is illustrated by fan charts. The broader the fans are, the more uncertain are the forecasts. For example, our calculations indicate that there is a 90 per cent probability that the interest rate towards the end of 2008 will lie in the interval 2 - 7¼ per cent. Uncertainty with regard to the interest rate reflects uncertainty in inflation, output and the exchange rate when the central bank's response pattern is taken into account. In other words, uncertainty with regard to the interest rate reflects the monetary policy response to unexpected disturbances in inflation, output and the exchange rate.

There is considerable uncertainty associated with constructing these fan charts. Not only are the forecasts themselves uncertain, but the forecasts' uncertainty is also uncertain. The core model, described above, serves as a useful tool in constructing fan charts. The fan charts are of course only indicative and depend on a number of model-based technical assumptions. The model incorporates relationships for the demand and supply side of the economy. In addition, a relationship for interest-rate setting is included. Within the framework of the model, we have sought to quantify uncertainty in key variables such as inflation, output, the interest rate and the exchange rate, based on the disturbances in the Norwegian economy in the period 1993-2005. Within the structure of the model, we have exposed the economy to similar disturbances ahead through Monte Carlo simulations of add factors. This gives an indication of uncertainty surrounding the different variables based on historical disturbances. Monetary policy responds to disturbances to the other variables. This increases uncertainty about the future interest rate, but at the same time reduces uncertainty in the other variables.

In other words, there are strict, model-based technical assumptions behind the fan charts we use to illustrate uncertainty in our forecasts. It goes without saying that it is difficult to be very precise as to exactly how great the uncertainty will be. Nevertheless - in spite of these strict model-based technical assumptions - the fan charts illustrate an important point: that the forecasts are very uncertain.

Norges Bank seeks to achieve an interest rate path that provides a reasonable balance between the objective of stabilising inflation at target and the objective of stabilising developments in output and employment. Monetary policy influences the economy with a lag; when the interest rate has been set, a period of time elapses before the effects on inflation and the real economy can be observed. In periods, inflation will deviate from the target while output will also deviate from potential output. A successful monetary policy provides the economy with a nominal anchor and contributes to stabilising the economy. This reduces the uncertainty associated with future inflation.

Conclusion

Assessing uncertainty is an important part of the central bank's communication strategy. An explicit forecast for inflation, output and the interest rate, in addition to assessing uncertainty in the forecasts, is intended to enable economic agents to better understand the central bank's intentions in its interest-rate setting. When the economy is exposed to disturbances, agents will have a basis for predicting the central bank's interest rate response and helping to ensure that market interest rates move in the right direction, thereby increasing the effectiveness of monetary policy.

Norges Bank has in recent years taken a number of steps towards greater transparency in monetary policy. The strategy intervals are published at the beginning of the period to which they apply. Each monetary policy meeting is followed by a broad review of the most important factors underlying the interest rate decision. The use of the Bank's own forecasts for the interest rate path in the *Inflation Report* can be viewed as a further step towards increased transparency with regard to the basis for monetary policy.

Thank you for your attention.

Footnotes

¹ For a more detailed description of how Norges Bank calculates market participants' interest rate expectations, measured by forward rates, see Kloster, A. (2000): "[Estimating and interpreting interest rate expectations](#)", Economic Bulletin 3/2000, Norges Bank, and Myklebust, G. (2005): "[Documentation of the method used by Norges Bank for estimating implied forward rates](#)", Staff Memo 2005/11, Norges Bank. Both articles are available on www.norges-bank.no.

² Arguments in favour of the publication of an interest rate forecast by the central bank are discussed in more detail in some of the papers presented at the conference hosted by Sveriges Riksbank entitled: "Inflation Targeting: implementation, communication and effectiveness". Reference is made in particular to Archer, D. (2005): "Central-bank communication and the publication of interest rate projections", Faust, J. and E. Leeper (2005): "Forecasts and inflation reports: An evaluation", Svensson, L.E.O. (2005): "Further Developments of Inflation Targeting" and Woodford, M. (2005): "Central-Bank Communication and Policy Effectiveness".

³ This is further discussed by Woodford, M. (2005): "Central-Bank Communication and Policy Effectiveness", see footnote 2.

⁴ Arguments against the publication of an explicit interest rate forecast by the central bank are discussed in more detail in Goodhart, C. (2001): "Monetary Transmission Lags and the Formulation of the Policy Decision on Interest Rates", Federal Reserve Bank of St. Louis Review, July/August 2001 and Mishkin, F. S. (2004): "Can Central Bank Transparency Go Too Far?", NBER working paper no. 10829

⁵"In these circumstances, the Committee believes that policy accommodation can be maintained for a considerable period.", see press release from the Federal Reserve, Board of Governors, 12 August 2003

⁶ See Husebø, T. A., S. McCaw, K. Olsen and Ø. Røisland (2004): "[A small calibrated macro model to support inflation targeting at Norges Bank](#)", Staff Memo 2004/3, Norges Bank, se www.norges-bank.no.

⁷ For more about these criteria, see Qvigstad, J.F.Q. (2005): "[When does an interest rate path look good? Criteria for an appropriate future interest rate path - A practitioner's approach](#)", Staff Memo 2005/6, Norges Bank