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# Norges Bank Watch 2008

An Independent Review of Monetary Policymaking in Norway

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## Foreword

Each year the Centre for Monetary Economics (CME) appoints an independent group of experts to examine monetary policy in Norway. This year the group consists of the following: Steinar Juel, Chief Economist for Norway at Nordea, Krisztina Molnar, Assistant Professor at NHH and Knut Røed, Senior Research Fellow at the Frisch Centre. The committee is solely responsible for the report and the views presented therein. The report does not necessarily represent the views of the CME or its members.

Oslo, 19 February 2008  
Centre for Monetary Economics  
Arne Jon Isachsen

## **Mandate for Norges Bank Watch 2008**

The objective of the Norges Bank Watch report of 2008 is to evaluate Norges Bank's conduct of monetary policy, given the mandate for the monetary policy set by the Government in March 2001. The committee should evaluate if the objectives stated in the monetary policy mandate concur with those expressed by Norges Bank and whether Norges Bank uses its policy instruments efficiently in order to achieve the relevant objectives.

The committee should also address other issues that it may find relevant for the present conduct of monetary policy.

Finally, the committee should evaluate the communication strategy of Norges Bank.

## **Executive summary**

Both economic theory and central bank practice show that it is good to establish an independent central bank in order to maintain low and stable inflation. Independence of central banks at the same time calls for more openness and accountability about their decisions. Only a couple of decades ago central banks were fairly secretive, now there is more demand for central banks to be open and clearly explain their decisions.

There are several reasons why openness is important. Openness enables the general public to better understand what the central bank is doing. This in turn helps the central bank to establish credibility and anchor private expectations better. Openness is also important because it makes it easier to evaluate the central bank.

Norges Bank has gone a long way in being open about its decisions and it is one of the most transparent central banks; this report makes a few recommendations about further improving the bank in this respect. Since Norges Bank already has a history of many years of transparency about its decisions and the principles used to make these decisions, it is possible to make a retrospective analysis and evaluate the bank. We think that evaluating and discussing the monetary policy of Norges Bank should also be an essential part of openness, and the Norges Bank Watch is an ideal forum for this. As monetary policy affects the economy with a time lag, many decisions must be based on forecasts. Therefore an important part of our evaluation will be about the forecasting methodology of Norges Bank. Good forecasts need good data, and given the current lack of reliable real-time data for the Norwegian economy, we would like to urge a solution to this problem even though the responsibility for solving it partly lies outside Norges Bank.

### **Data problems**

With the central role given to monetary policy, the Ministry of Finance should enable Statistics Norway to produce the data necessary to minimise the risk of major policy errors. The wage and labour market statistics should be improved as suggested by NBW 2007 and by the IMF in the 2007 Article IV Consultation for Norway. There is also a need to expand Statistics Norway's business surveys to include other sectors than goods-producing industries.

As other core inflation concepts than CPI-ATE play a more important role in Norges Bank's assessment of the inflationary situation in real time, Statistics Norway should start to publish regularly all the indicators used regularly by Norges Bank.

## **Openness**

It should be clearly shown what principles Norges Bank's decisions are based on and what information is used in the decision-making process. We think there is room for improvement in this respect.

## **Criteria for an appropriate interest rate path**

In 2007 Norges Bank changed the criteria for an appropriate interest rate path. We think the new criteria better reflect the underlying principles of conducting monetary policy and better show that the bank is conducting a flexible inflation targeting regime, caring not only about inflation but also about capacity utilisation. Even though these changes practically reflect how monetary policy was conducted in the past, we think that the bank should be more open when adjusting its operational rules, and explain better to the public why these changes were made. It would increase the credibility of the text and help economic agents understand the implications of the amended rules.

## **Asset prices**

In the current criteria for an appropriate interest rate path the only asset price that is mentioned is the exchange rate. The bank does not refer to asset prices when explaining its interest rate decisions. Even though economic theory is not conclusive about how central banks should take asset prices into account, we find it important that Norges Bank makes it clear how asset prices other than the exchange rate are taken into account in the interest rate setting process. In particular we would strongly recommend more formal feedback from the financial stability assessments to the forecasting process. Norges Bank should take a long-term perspective and consider the risk of excessive asset prices; how turbulence in the asset market can influence aggregate demand and cause instability in output, employment and inflation.

## **Communication**

For a better understanding of interest rate decisions, Norges Bank should consider presenting its assessment of the economic situation by publishing summarised adjusted forecasts after each monetary policy meeting. Also, the bank should be more systematic in its usage of policy phrases, instead of suddenly changing them. One example is the usage of the phrase "Given the inflation target, we will be mindful of the effects of higher interest rates on the NOK exchange

rate when inflation is low” for a long time, then suddenly dropping it without an explanation in January 2008.

### **Fan charts**

Future developments in inflation and other variables are uncertain, therefore Norges Bank put a band around the forecasts that measure uncertainty. These bands make it easier to understand the extent of uncertainty, and also make it easier to communicate alternative scenarios that might arise in the future. Uncertainty partly comes from uncertainty about the appropriate model, partly from the uncertainty about the parameters and also from the uncertainty about the data used in these models. We think that the bands reported by Norges Bank do not reflect all these uncertainties. As a first step to incorporate all these uncertainties we recommend Norges Bank to revise the way they communicate statistical uncertainty, and to a larger extent communicate the actual distribution of past nowcast and forecast errors. Model uncertainty could be better understood if the bank would be more open regarding the roles of formal models and judgment.

### **Evaluating monetary policymaking**

Monetary policy influences the economy only with a lag, therefore good forecasts about the future are extremely important for the success of monetary policy. We think an important aspect of evaluating Norges Bank is to have an open debate about its forecasting performance. This may also encourage exploitation of the cumulative learning process in the scientific community as a whole, by which existing empirical models are improved or (eventually) overtaken by new and better ones.

### **Forecasting performance**

Forecasting performance can be evaluated in many different ways; a central bank might care about being close to the actual data on average, or rather to forecast the turning points in the business cycle with more accuracy, or could care about not revising its forecast too often. In this report we compare the forecasts of Norges Bank with the actual outcomes. One problem related to this is that there are many factors that are not foreseen or very difficult to predict, for example the process of globalisation or the outbreak of a war. When a forecast is bad, it is hard to say whether the forecasting method was responsible or whether it was caused by something unpredictable. Therefore it is common to compare the central bank forecasts to the forecasts of statistical or econometric models.

We find that especially over a short-term horizon, Norges Bank's forecasts did not perform well compared to validated empirical econometric models. Therefore we recommend Norges Bank to consider drawing more on established empirical regularities between key macroeconomic variables, especially for forecasts over a short-term horizon.

### **Modelling**

Regarding longer horizon forecasts, we think that Norges Bank should rely more on empirically validated macroeconometric models as well as on a core model that better fits the characteristics of the Norwegian economy.

We think that the core model could be improved to fit the Norwegian economy more. In particular the high level of unionisation in the Norwegian labour market has important policy implications for the monetary policy; therefore incorporating a unionised market into the core model would be advantageous.

Looking at survey expectations of inflation we also find that in many instances the assumption of rational expectations about private agents is not correct. Therefore we recommend Norges Bank to incorporate alternative expectation formation mechanisms as an alternative next to rational expectations. We find that modelling agents as econometricians, using past data to make their forecasts, can be a promising alternative.

We strongly recommend the estimation of the full core model on Norwegian data. The Swedish Riksbank has already performed this estimation and the forecasting property of their core model is very promising.

### **A special focus on the output gap**

In a flexible inflation targeting regime the central bank pays attention not only to inflation but also to the output gap. The output gap is difficult to measure, and is subject to many revisions for all central banks, but we think that in Norway there are even more problems.

Norway is in a special situation because the potential output itself is also difficult to assess. The Norwegian economy is subject to substantial shocks related to migration, outsourcing and structural labour market reforms. As we mentioned earlier this calls for improvement in the data on immigration flows. Monetary policy might play a role in the development of the potential output because migration flows are sensitive towards labour demand. Structural reforms of the Norwegian labour market may also affect the domestic labour supply and, hence, output capacity. Norges Bank should be aware of this and accommodate reforms that are implemented with the explicit aim of raising output capacity, such as pension and social security reforms.



Given the large difficulties associated with assessing the output gap in real time, we recommend that Norges Bank explores the possibilities of exploiting other and more reliable measures of inflationary pressure instead; in particular more real time data could be used.

The assessment of labour market tightness could be improved through a more systematic exploitation of variations in labour market *flows*; for example, in terms of the six transition rates between employment, unemployment and non-participation. These could be constructed at a quarterly or yearly level on the basis of Statistics Norway's labour force sample survey or on the basis of administrative registers (NAV).

### **Final remarks about monetary policy in 2007**

Based on our evaluation and the interviews conducted for this report we think that the monetary policy of Norges Bank in 2007 was satisfactory. Norges Bank acted as an independent authority with credibility. The bank acted in accordance with its strategy and reacted to the changing environment as indicated in the MPRs. The bank was quick in adjusting its forecasts, and reacting to the changing environment with more frequent interest rate changes.

The report is structured as follows. Chapter 1 assesses the conduct of monetary policy in 2007. Chapter 2 evaluates economic analysis at the bank. We place a special focus on the problems associated with estimating the potential output and the output gap in Chapter 3. Finally, Chapter 4 deals with the new core model NEMO.

## 1. Conduct of monetary policy in 2007

Norges Bank's monetary policy is based on forecasts and monetary policy strategies published in separate reports three times a year (March, June and October/November). Up to 2007 the reports were entitled Inflation Report (IR). With the publication of the first report in 2007 (15 March), the name was changed to Monetary Policy Report (MPR). The justification given in the editorial to the MPR 1-2007 was that *"The new title better reflects the purpose of the Report. The Report presents Norges Bank's strategy for interest rate setting for coming months. Furthermore, Norges Bank's monetary policy assessments are reflected in our forecast for the key policy rate."*

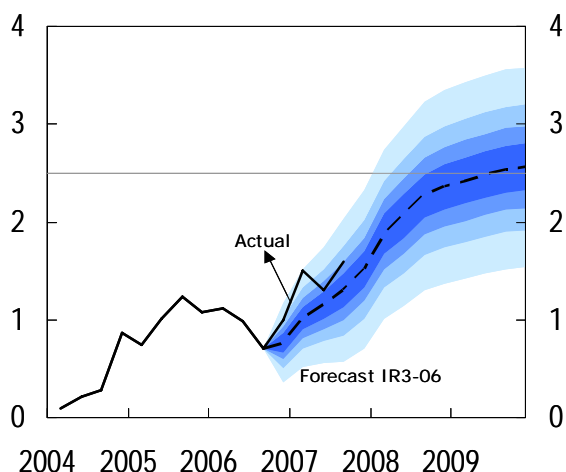
Norges Bank has over the years become very open in publishing its assessments of the economic situation and its policy intentions. A central feature in the development of a monetary policy strategy is the bank's assessment of the output gap, the inflationary situation and exchange rate developments. Norges Bank presents its forecasts for the output gap and inflation with a fan chart indicating the uncertainty to its baseline forecasts. In each MPR the exchange rate for a period close to the time of publication of the report is taken as the basis and the rate is assumed to develop from there in accordance with the theory of uncovered interest rate parity. The exchange rate projections are to be considered as technical assumptions rather than as forecasts. The projections and forecasts are then used to establish a path for Norges Bank's policy rate (the deposit rate) with an uncertainty fan chart. The path is Norges Bank's interest rate forecast for the next three to four years while the monetary policy strategy in the reports only covers the four months up to the next MPR. The strategy is formulated as a range for where Norges Bank expects its deposit rate to be at the end of the strategy period, i.e., when the next MPR is published. The range is typically 100 bp wide. This is understood to mean that the expected deposit rate is in the middle, but it will also be within the strategy to let it deviate from the midpoint by up to +/- 50 bp.

### 1.1. Forecasts and outcomes in 2007

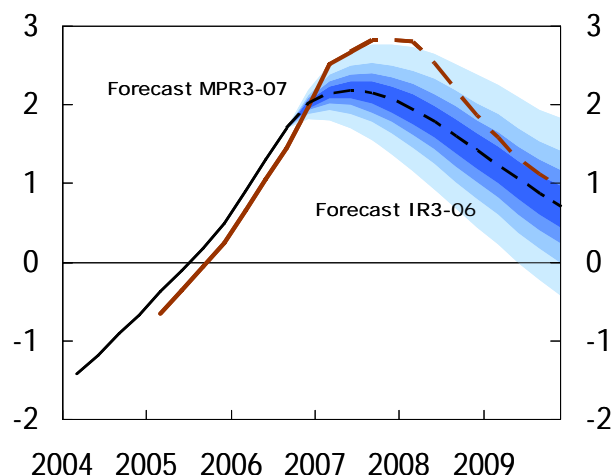
If we take IR 3-2006 as the starting point, the Norwegian economy last year developed significantly different from what was expected. Economic growth became much stronger and the output gap higher than expected, also resulting in somewhat higher-than-expected core inflation as measured by CPI-ATE (consumer price index adjusted for taxes and energy prices). As a reaction, monetary policy was tightened significantly more than indicated in IR 3-2006 through a combination of a stronger NOK and a higher key policy rate (the deposit rate).

In Figure 1.1.a-d the forecasts from IR 3-2006 for the output gap, core inflation, the NOK's import-weighted value and Norges Bank's interest rate path are compared to the outcome, or for the output gap, to the forecast in MPR 3-2007. However, growth in mainland GDP was even stronger than indicated by the trend in the output gap displayed in Figure 1.1.b. The availability of labour was better than expected. Total demand could then be stronger than assumed in IR 3-2006 without creating unwanted inflationary pressure. The participation rate in the labour market increased more than expected and the continued immigration of labour from EU countries was also larger than expected. As data during the year indicated a stronger supply of labour than assumed, Norges Bank adjusted up potential growth from MPR to MPR.

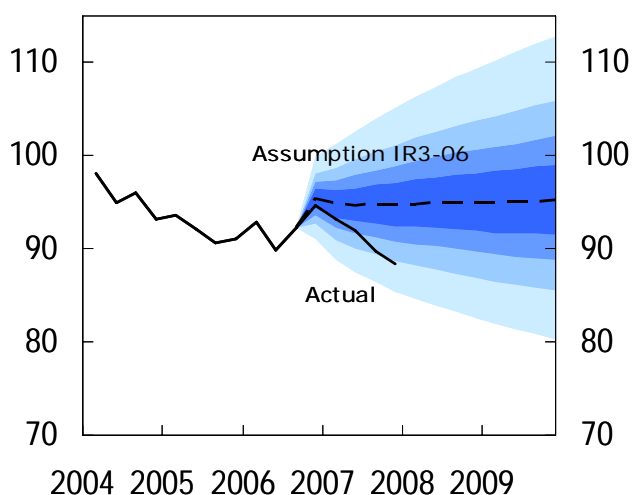
1.1.a. Forecast and actual CPI-ATE inflation



1.1.b. Output gap IR 3-2006 and MPR 3-2007



1.1.c. Import-weighted NOK index



1.1.d. Interest rate path IR 3-2006 and actual

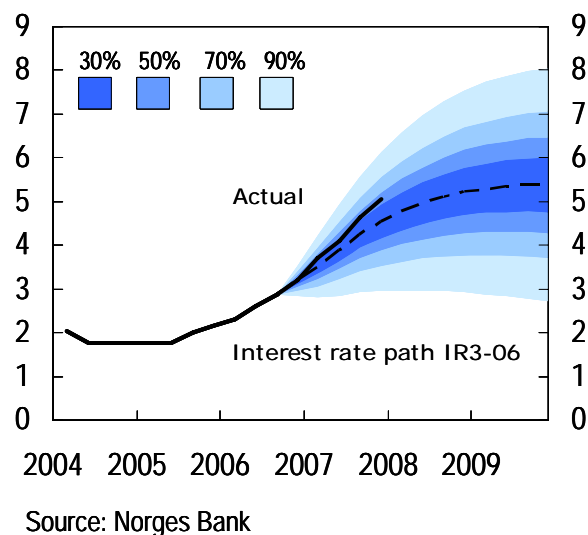


Figure 1.1. Forecasts and outcomes 2007

Source: Norges Bank and NBW

As discussed in Chapter 3 of this report, a structural shift in the economy's capacity is likely to have taken place. Norges Bank took account of this by assuming that potential growth will be higher for a period and then gradually decline towards what has been assumed to be its long-term level of 2½%. Figure 1.2 shows how potential growth was changed from MPR to MPR. In IR 1-2006 potential growth was assumed to be stable at 2½% during the years 2005-2009. Actually, the historical potential growth rate for 2005 was lowered in that report from 2¾% that was the estimate in the two previous 2006 reports. In MPR 1-2007 the bank again rewrote history by assessing that potential growth the previous year (now 2006) had been 3¼%

and not 2½% as assumed as late as in IR 3-2006 published on 1 November 2006. The changes in the forecasts of potential growth rates for the years ahead were significant during 2007.

We concur with Norges Bank's assumption that improved access to labour from abroad created a new situation where the application of a stable long-term potential growth rate when estimating the output gap would have led to policy errors. If Norges Bank had continued to apply the long-term potential growth rate of 2½%, the output gap in 2007 would have been assumed to have been 1½% points higher than was estimated in MPR 3-2007. The bank would consequently probably have hiked the policy rate significantly more than it actually did, curbing demand and growth. As we show in Chapter 2.2., according to its own subsequent revisions, Norges Bank tended to *overestimate* the output gap in previous years, including 2006. Current assessments indicate that this situation was reversed in 2007. Yet, at this juncture it is difficult to assess to what extent the adjustments of the potential growth are correctly measured. That will only be seen later as the inflationary effect of a certain output gap is a lagging variable. We wish to point out, however, that the supply side of the Norwegian economy shows signs of being much more elastic than what could be expected on the basis of previous experience. This issue is further discussed in Chapter 3.

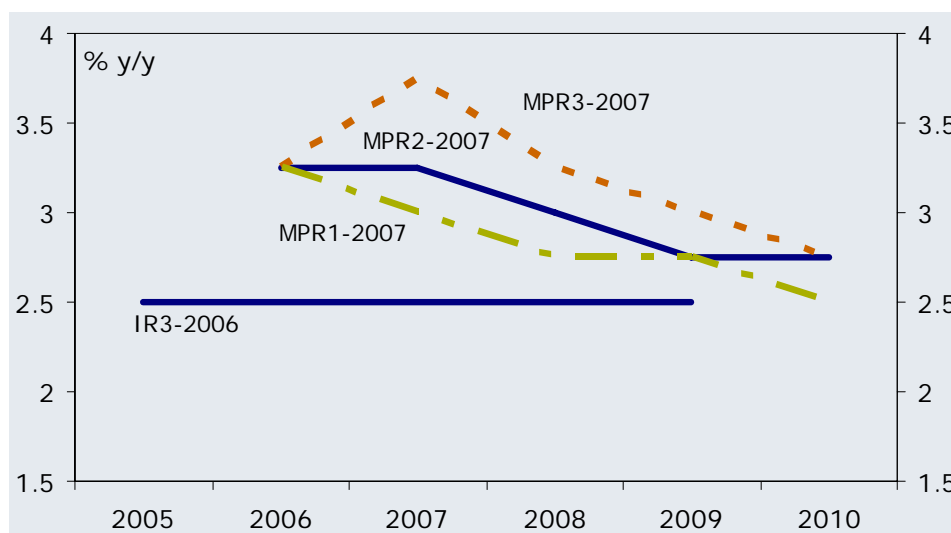


Figure 1.2. Estimated potential growth in inflation/monetary policy reports 3-2006 to 3-2007

Norges Bank is very much aware of the uncertainty in the estimates of potential growth and output gap. In a box in IR 3-2005, reference is made to estimates that the uncertainty range associated with its calculation of the output gap is ½-1½% points, and that the uncertainty range associated with potential growth is 1½-3½% points. The uncertainty is again discussed in a box

in IR 3-2006. There it is said that the uncertainty around the estimated output gap in real time is assumed to be a standard deviation of +/- 1% point. The uncertainty is assumed to be smaller on historical estimates, because of better data, and larger on forecast output gaps. With a view to underlining the uncertainty associated with the estimates of historical and present output gaps, Norges Bank in MPR 1-2007 introduced an uncertainty fan around historical estimates also when graphically presenting the trend in the output gap.

The uncertainty about what the output gap is has probably not decreased the last few years; on the contrary, it may have increased with the shift in the availability of labour from abroad. Figure 1.1.b is an indication of that as the latest estimates of the output gap for 2007/2008 are outside the 90% uncertainty fan used in IR 3-2006.

The output gap is a central concept in Norges Bank's assessment of the inflationary pressure in the economy. An error in the assessment of the present capacity utilisation of +/-1% point would potentially imply a significant policy error. If Norges Bank last year underestimated the output gap by 1% point, then the interest rate would have been set as much as 1½-2% points too low. This estimate is based on calculations in MPR 1-2007 of the isolated effect on the interest rate path of a higher output gap.

The uncertainty about the assessment of the present situation has inspired Norges Bank to commence a project on "nowcasting". The purpose is to improve the bank's assessment of the present situation, recent history and the near future. Not least based on the experiences from 2007 we think it wise of Norges Bank to prioritise this project.

Norges Bank's assessment of the inflationary pressure in real time is hampered by insufficient quality of labour market statistics and a lack of current wage statistics. (This is further discussed in Chapter 2.) This issue was also addressed by NBW last year, and mentioned by the the International Monetary Fund (IMF) in its 2007 Article IV Consultation for Norway. The sample for the Labour Force Survey is small and foreign guest workers with short-term assignments are excluded from the sample. The quarterly wage data are fragmented and do not comprise all sectors of the labour market. We concur with the IMF that the "assessment of labor market conditions would be improved by monthly labour-force survey estimates and an establishment survey for timely data on employment and wages."

Surveys on business trends and consumer confidence are useful instruments to capture changes in a business cycle at an early stage. Statistics Norway conducts quarterly business surveys for manufacturing, mining and quarrying, and investment surveys for the same industries and for the petroleum industry. Surveys covering other industries and also an official consumer confidence survey would enhance the understanding of the economic performance in real time.

**NBW's view:**

**With the central role given to monetary policy, the Ministry of Finance should enable Statistics Norway to produce the data necessary to minimise the risk of major policy errors. The wage and labour market statistics should be improved as suggested by NBW 2007 and by the IMF in the 2007 Article IV Consultation for Norway. There is also a need to expand Statistics Norway's business surveys to include other sectors than goods-producing industries.**

All forecasters underestimated the growth in mainland Norway last year. When comparing the last forecasts for 2007 made in 2006, Norges Bank's growth forecast was the highest of the three public institutions Norges Bank, the Ministry of Finance (MF) and Statistics Norway (SN). Based on the national accounts for the first three quarters of 2007, Norges Bank therefore also seems to have been closest to the actual outcome. Norges Bank's forecast of core inflation in 2007 measured by CPI-ATE was 1¼%, while the MF forecast was 1½% and the SN forecast 1.4%. The outcome was 1.4%.

**NBW's view:**

**As everybody was surprised by the strong growth and Norges Bank's forecasts at the end of 2006 were among the highest, we do not see any reason to criticise the bank for the forecasting errors in 2007. Norges Bank adapted its forecasts quickly to new information, adjusted its strategy and speeded up the rate hiking frequency.**

**1.2. The interest rate setting**

Last year Norges Bank hiked rates by 25 bp at seven out of nine monetary policy meetings (MPMs). The path presented in IR 3-2006 indicated four to five rate hikes. At the same time the bank allowed the NOK to strengthen by 6-7% (import-weighted). The policy adjustments were primarily done after a new forecast and strategy had been published in a new MPR. An exception was an extra hike in the first quarter of 2007. In IR 3-2006, one hike only was scheduled for that quarter. However, new information in late December/early January indicating stronger growth in private consumption and a stronger decline in unemployment than assumed led the bank to hike rates an extra time on 24 January. The strategy period ending on 15 March was the only time last year the deposit rate ended higher than the midpoint of the strategy range.

Norges Bank's intention by being open about its strategy, publishing interest rate paths and by illustrating reactions to new developments is to be predictable. The interest path and the detailed information about the bank's short-term forecasts are a starting point. In the MPRs the bank also presents alternative economic scenarios where it indicates how it will react if the economic performance deviates significantly from the baseline. Each time the interest rate path is changed Norges Bank also shows how much changes in important variables, such as the output gap and the exchange rate, have influenced the adjustment. If market participants digest this information correctly and if Norges Bank acts consistently, the surprise from "unscheduled" rate changes should be minimised. Despite this the market is from time to time surprised. Last year the consensus (according surveys made by Reuters) was surprised three times; the rate hike on 24 January, an unchanged rate on 25 April and the hike on 26 September.

Despite current indicators pointing to stronger growth than expected, the consensus still expected unchanged rates on 24 January, the first MPC meeting last year. The reason seems to have been that Norges Bank concluded at the MPC meeting on 13 December 2006 that developments had been about as expected despite some indicators having been on the stronger side. The market seems to have concluded from this that the threshold for an extra rate hike was high and that the strong numbers coming in between the December and January meetings did not warrant an extra hike either.

In MPR 1-2007 (published 15 March) the strategy indicated two rate hikes of 25 bp over the next three MPC meetings. The interest rate path pointed to a hike on 30 May and 27 June and unchanged rates on 25 April. However, already in April current indicators pointed to stronger demand than forecast in MPR 1-2007. The central wage negotiations in the industrial sector (LO-NHO) that were concluded in early April also indicated higher wage growth in 2007 than forecast by the bank. There were consequently growing expectations of an unscheduled hike on 25 April also. This time the consensus was surprised that Norges Bank left the rate unchanged. The bank hiked as scheduled on 30 May and 27 June, and adjusted up its interest rate path in MPR 2-2007. Norges Bank could have reacted quicker as data already for March/April signalled stronger growth in demand.

MPR 2-2007 indicated a hike at both the August and September MPC meetings. However, the financial market turmoil emerging in July/August led a small majority of analysts to conclude that Norges Bank would leave the rate unchanged at the MPC meeting on 26 September. But the bank hiked rates.

In the press releases after the three above-mentioned meetings where the consensus expectations were wrong, Norges Bank said it had considered alternatives; on 24 January and



26 September to keep the rate unchanged and on 25 April to increase it. This indicates that the decision was more difficult than normal.

Table 1: Overview of Norges Bank's interest rate decisions in 2007

	<b>Decision</b>	<b>Rate after decision</b>	<b>Consensus just before the meeting</b>	<b>Midpoint strategy range at end of strategy period</b>
<b>24 January</b>	+25 bp Considered no hike	3.75%	3.50%	
<b>15 March</b>	+25 bp Considered no hike	4.00%	4.00%	3.75%
<b>25 April</b>	0 Considered 25 bp hike	4.00%	4.25%	
<b>30 May</b>	+25 bp	4.25%	4.25%	
<b>27 June</b>	+25 bp	4.50%	4.50%	4.50%
<b>15 August</b>	+25 bp	4.75%	4.75%	
<b>26 September</b>	+25 bp Considered no hike	5.00%	4.75%	
<b>31 October</b>	0	5.00%	5.00%	5.00%
<b>12 December</b>	+25 bp Considered no hike	5.25%	5.25%	

Source: Norges Bank, Nordea

**NBW's view:**

**Norges Bank's monetary policy last year was generally uncontroversial. The bank acted in accordance with its strategy and reacted in accordance with the indications given in the MPRs when developments deviated from forecasts. This does not preclude that Norges Bank may have misjudged capacity utilisation and the inflationary pressure in the economy. When capacity utilisation is high, even a small underestimation of it may result in significantly higher inflation later on than expected, indicating that rates should have been higher. The inflationary effect of pressure on the capacity limits is a lagging indicator. It is**

**therefore too early to tell whether the uncertainty about the output gap last year has resulted in policy mistakes.**

### ***1.3. Appropriate interest rate path***

Norges Bank has established criteria to be applied for setting an appropriate interest rate path. The criteria are published in each inflation/monetary policy report. A reformulation of the criteria was published in MPR 1-2007. The old and the reformulated criteria are presented on page 20. The changes were claimed to be of a linguistic character. However, three of the changes are also material.

1. The horizon to reach the inflation target was previously stated to be normally one to three years. In the new criteria it is said to be the medium term. The new wording provides room for more flexibility than the previous one.
2. There are now two main criteria; the interest rate should be set to stabilise inflation close to the target in the medium term, and the interest rate path should give a reasonable balance between the inflation path and the capacity utilisation path. The other criteria are made conditional on these two.
3. The wording that the interest rate setting must also be assessed in light of the development in property prices and credit was altered. It is not bulleted anymore as a criterion. The reference to asset prices is now contained in a paragraph between the two main criteria and the conditional ones. The wording has also been altered. It now reads that in the assessment, potential effects of asset prices on the prospects for output, employment and inflation are also taken into account. Property prices and the exchange rate are mentioned as examples of asset prices. There is no reference to credit anymore. In the previous criteria it was stated that asset prices and credit growth may constitute a source of instability in demand and output “in the somewhat longer run”. Probably that meant longer into the future than the one to three years used as the horizon for reaching the inflation target. The new wording does not refer to a longer-run perspective anymore. The reason could be that the horizon for reaching the monetary policy target is more flexible.

The changes in the criteria for an appropriate interest rate path did not signal any major policy changes even if some of the changes were material. The new wording rather seems to adjust the text to how practice has developed. An unspecified horizon gives more flexibility in balancing the objective of bringing inflation back to target against the objective of a stable trend

in output and employment. A loosening up of the horizon might indicate that the bank considers inflation expectations to be more anchored than was the case during the first years of the inflationary targeting regime. It might also be the result of the experience that in practice it has been hard to operate with a specified time horizon. The reformulated criteria are well within the mandate granted to Norges Bank by the Ministry of Finance and contained in the Government Regulation of 29 March 2001.

Norges Bank does not have a habit of explaining and justifying the reformulation of criteria and the horizon for the policy setting. When the bank last time changed the wording about the horizon (July 2004) from “at the two years horizon” to “within a reasonable time horizon, normally 1-3 years”, the change was also claimed not to represent a material change. Prior to the change in the wording, the bank’s practice had also tilted in a more flexible direction than implied by the two years’ horizon.

**NBW’s view:**

**We do not think Norges Bank would have anything to lose by being more open when adjusting its operational rules related to its policy conduct. It would rather increase the credibility of the text and help economic agents understand the implications of the amended rules.**

Old (left) and new (right) criteria for appropriate interest rate path

## Criteria for an appropriate future interest rate path

The following criteria may be useful in assessing whether a future interest rate path appears reasonable compared with the monetary policy objective.

1. 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. For the same reason, inflation should also be moving towards the target well before the end of the three-year period.
2. 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.<sup>1</sup> The inflation gap and the output gap should normally not be positive or negative at the same time further ahead.
3. 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 the economic situation and the functioning of the economy.
4. 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.
5. Interest rate setting must also be assessed in the light of developments in property prices and credit. Wide fluctuations in these variables may in turn constitute a source of instability in demand and output in the somewhat longer run.
6. It may also be useful to cross-check by assessing 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.

<sup>1</sup> The inflation gap is the difference between actual inflation and the inflation target of 2.5%. The output gap measures the percentage difference between actual and projected potential mainland GDP.

## Criteria for an appropriate interest rate path

The operational target of monetary policy is low and stable inflation, with annual consumer price inflation of approximately 2.5 per cent over time. In interest rate setting, the forecast for future interest rate developments should satisfy the following main criteria:

1. The interest rate should be set with a view to stabilising inflation close to the target in the medium term. The horizon will depend on disturbances to which the economy is exposed and the effects on the prospects for the path for inflation and the real economy.
2. The interest rate path should provide a reasonable balance between the path for inflation and the path for capacity utilisation.

In the assessment, potential effects of asset prices, such as property prices, equity prices and the krone exchange rate on the prospects for output, employment and inflation are also taken into account. Assuming the criteria above have been satisfied, the following additional criteria are useful:

3. Interest rate developments should result in acceptable developments in inflation and output also under alternative, albeit not unrealistic assumptions concerning the economic situation and the functioning of the economy.
4. Interest rate adjustments should normally be gradual and consistent with the Bank's previous response pattern.
5. As a cross-check for interest rate setting, it should be possible to explain any substantial and systematic deviations from simple monetary policy rules.

#### **1.4. Asset prices**

The Government Regulation of 29 March 2001 gives the following mission to the monetary policy to be conducted by Norges Bank:

*“Monetary policy shall be aimed at stability in the Norwegian krone’s national and international value, contributing to stable expectations concerning exchange rate developments. At the same time, monetary policy shall underpin fiscal policy by contributing to stable developments in output and employment.”*

As is well known, the Regulation further states that the operational target for monetary policy is an inflation rate of 2.5% over time. Norges Bank’s conduct of monetary policy and the criteria for an appropriate path are based on this mission and operational target. When setting an appropriate interest rate path, the bank balances the path for inflation and capacity utilisation. This is well in line with the mission and operational target contained in the Regulation. Stability in terms of the exchange rate is also a major objective in the Regulation.

Previous Norges Bank Watch groups have discussed the relevance of the wording about the exchange rate in the Regulation, and how to understand it. We have chosen not to take up that discussion again. It is our understanding that the Regulation’s reference to exchange rate stability is a way of bridging the new inflation targeting regime with the previous exchange rate targeting.

The exchange rate is an important input when Norges Bank forecasts inflation, develops an interest rate path and decides on a policy strategy. The trend in other asset prices, such as property prices, may be important for the stability in “developments in output and employment”. We assume that is why other asset prices than the exchange rate are cited in Norges Bank’s criteria for an appropriate interest rate path. However, it is much less transparent how, and to what extent, Norges Bank takes into account the trend in such asset prices.

As early as 3 June 2003, Governor Svein Gjedrem addressed the issue of financial imbalances and asset prices in a speech at a meeting arranged by the Centre for Monetary Economics (CME). He said there are a number of reasons for central banks not taking into account financial imbalances (exaggerated asset prices and debt) as a separate parameter when setting the leading rate. He mentioned in particular the following:

- It may take a long time before a bubble bursts.
- It is often difficult to identify with certainty that imbalances are building up.
- It is difficult to identify the severity of the imbalances and how quickly corrections will come.
- Rate hikes may not to a sufficient degree dampen the emergence of imbalances. Very large rate hikes may be needed, which may have other large negative effects.

In the speech Governor Gjedrem also pointed out that imbalances usually build up during economic upturns and that inflation then also most often is increasing. Then there will not be any conflict between keeping inflation low and using interest rates to dampen emerging imbalances. There are examples from other countries that inflation has been low while imbalances have been building up (Japan during the 1980s), but Governor Gjedrem mentioned that up to 2003 we had not experienced that in Norway.

In the speech the Governor concluded that because imbalances may destabilise the economy later on, it might be necessary to use a somewhat longer period than the normal two years to bring the inflation rate up to the target. However, that requires that the inflation target is well anchored among economic agents.

When discussing the recent financial market turmoil at a seminar arranged by the Association of Norwegian Economists on 1 February 2008, Deputy Governor Jarle Berge repeated that it is very hard for monetary policy to react to exuberant property prices. His main point was that “It is very difficult to establish whether rapidly increasing asset and house prices are bubbles, or whether the price increases are driven primarily by economic fundamentals” But he admitted that “Surely, expansionary monetary policies have contributed to the rise in property prices and debt accumulation. Asset prices generally will react to changes in short-term interest rates, but one would expect such movements to more or less even out over the cycle.” Berge’s main point seems to be that the strong increase in property prices over the last year mainly has been a fundamental economic phenomenon. Lower natural real interest rates worldwide have contributed to that.

The same line of argument is used in a box about household savings in MPR 3-2007. Here the strong improvement in Norway’s terms of trade is mentioned as a possible fundamental economic reason for the strong increase in asset prices.

If real natural interest rates have actually declined permanently, an asset should adjust to that over time. The monetary authorities may, however, influence the speed of the adjustment process. By keeping monetary policy rates very low because of lack of inflation, monetary policy authorities have probably this time accelerated an adjustment in asset prices rather than slowing it down. Large rises in asset prices over short time periods risk creating bubbles even when the price increase initially is fundamentally based. Overshooting often takes place as economic agents adjust expectations to recent developments. It is also highly uncertain whether a lower natural rate will be sustained over time. Research on US data indicates that the natural rate is much more variable over time than generally assumed by central banks. (We will discuss that further in the next subsection.) The same applies if a repricing of assets is based on terms of trade gains.

In the discussion about monetary policy and the recent experiences with strong increases in asset prices, there seems to be two lines of arguments: one is that some central banks lowered rates too much compared to what standard inflation targeting-based reaction functions said was needed, and that rates were kept too low too long during the years 2002-2005. By doing so, they ignited a housing bubble that later burst. Central banks lowered rates because of very low inflation and a risk of deflation. However, since the deflationary effects to a large degree were the result of supply shocks and not of weak demand, it is relevant to question if central banks to a sufficient degree balanced the risk of deflation against the risk of creating asset bubbles. John Taylor (the father of the Taylor rule) argued at the Federal Reserve's annual conference in Jackson Hole in August 2007 that the American central bank kept interest rates low too long. If the Fed funds rate had been set in accordance with the Taylor rule, house prices would not have gone up so strongly and the downturn we now see would have been milder, he argued.

The other line of argument is found in papers published by the Bank for International Settlements (BIS). When asset prices increase strongly, central banks should react by increasing rates (or not decreasing them) even if inflation is low; this is a main conclusion in for instance BIS Working Paper No 114 (2002). The paper also advocates closer cooperation between financial surveillance authorities (FSAs) and central banks in such situations. The Norge Bank Watch report of 25 September 2001 also advocated that central banks should be prepared to act by raising rates when asset prices increase strongly while inflation is low. Monetary policy based on inflation targeting alone may sometimes reinforce asset bubbles, even when rates are set correctly according to an inflation targeting monetary policy rule. Low rates over a longer period, even if justified by low inflation,

may lower economic agents' expectations about future real rates and create an exuberant rise in property prices. Later this may be a source of an abrupt decline in economic growth and employment.

Simple monetary rules like the Taylor rule indicate that also Norges Bank's leading rate may have been kept too low too long. In its MPRs Norges Bank regularly presents graphs comparing the trend in the key policy rate with such standard rules. The graph published in MPR 3-2007 is shown below as Figure 1.3. Very low inflation combined with a risk of a stronger NOK is probably the main reason why rates were kept so low for such a long time. The inflation target regime was quite new, and Norges Bank may have considered it not to be sufficiently anchored to allow a somewhat higher rate and longer time before reaching the inflation target.

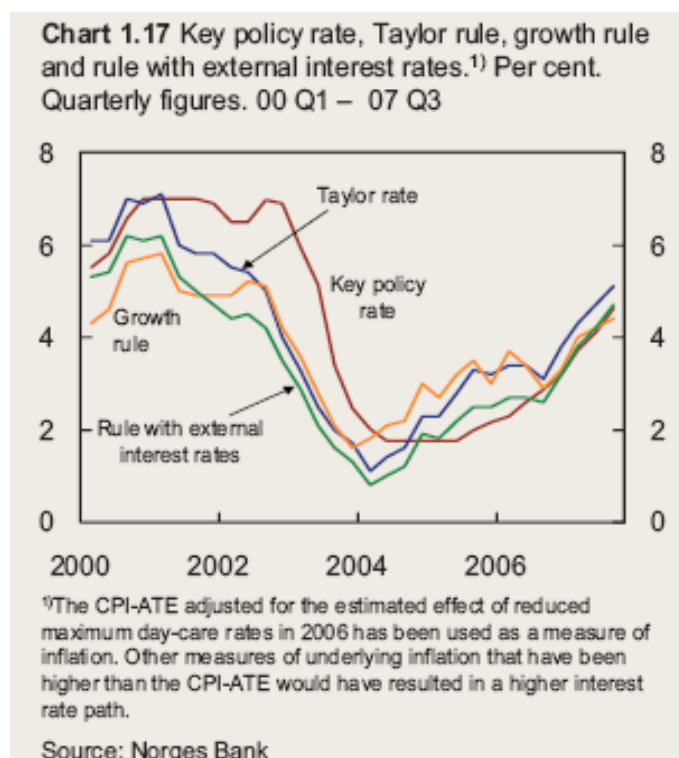


Figure 1.3. Key policy rate and monetary policy rules

Norges Bank has so far said very little about how it balances the effects of asset prices (other than the exchange rate) on the economy as is stated in the criteria for an appropriate interest rate path. From what has been published it is difficult to see that the risk of serious financial imbalances has been considered at all when taking interest rate decisions. The fact that Norges Bank allowed it to take much more than two years before inflation returned to the target could indicate that the bank has taken into account the risk



of stimulating financial imbalances. However, when the two-year horizon was valid, Norges Bank ex ante always aimed at bringing inflation back to 2.5% close to that horizon. This indicates that the bank did not take financial stability considerations into account when using a longer time to reach the inflation target.

The extension of the horizon, first to one to three years and last year to the medium term, may have taken place because Norges Bank became more certain that the inflation target has become well anchored. The bank's more flexible horizon now makes it easier in the future to take into account financial stability considerations when relevant.

Except for the treatment of the exchange rate, it is not clear to us how asset prices are taken into account when setting an interest rate path. From the meetings we have had with Norges Bank and the documentation to which we have had access, we have the following impression:

- There is no specification of asset prices and of their effects on demand and output in the models that are used when setting the interest rate path.
- When changes in the interest rate path are explained in a MPR, no references have been made to asset prices except for the exchange rate.
- In the report on Financial Stability, forecasts from the latest MPR are applied to make a baseline scenario for key financial stability parameters. However, there seems to be no formal feedback from the financial stability scenarios to the forecasting process related to MPRs.

A central bank should not, and probably cannot, manage asset prices. Nor are asset prices (excluding the exchange rate) parameters that should be followed as closely as employment, output and inflation. It usually takes years before serious imbalances are created that later may threaten the stability in output and employment. Norges Bank should in such situations lean against the wind and not reinforce it. It is our understanding that this is also the message contained in the criteria for an appropriate interest rate path. It is hard to see that Norges Bank's forecasting process facilitates balancing the risk of creating exuberant property prices against inflation considerations. It is also our impression that Norges Bank, like many other central banks, rather has resigned to the idea that excess asset prices are hard to identify and that monetary policy is inefficient in dampening them. Hence we perceive it at this point to be a gap between the message in the criteria for an appropriate interest rate path and how asset prices are taken into account in practice.

**NBW's view:**

**Norges Bank should clarify how asset prices other than the exchange rate are taken into account in the interest rate setting process. More formal feedback from the financial stability assessments to the forecasting process leading up to the interest rate path and the monetary policy strategy should be considered, with a view to minimising the risk that excessive asset prices later become a source of instability in output, employment and inflation.**

**1.5. The neutral interest rate**

Corresponding to the role played by potential growth when assessing inflationary pressures, the assumed neutral interest rate is central when assessing the tightness of monetary policy. In the MPRs Norges Bank conveys the message that the long-term neutral real rate has declined in recent years. It says it believes the neutral real rate to be in the lower part of the range in Figure 1.4 (Chart 1.9 from MPR 3-2007). The argument is that the long-term real yields in the capital market have declined internationally and in Norway in recent years.

The neutral real interest rate is a fundamental economic parameter. By using the words of Deputy Governor Jarle Berge, the natural rate can be explained as the following:

*“According to economic theory, in the long term the real interest rate is determined by structural fundamentals such as productivity and population growth and households’ long-term saving preferences. It seems reasonable that there is a long-term relationship between an economy’s potential growth and the real interest rate. If potential growth is higher than the real interest rate, the return on fixed investment will be higher than the cost of investing. This provides an incentive to increase fixed investment. Higher demand for fixed investment normally leads to higher real interest rates.” (Speech at Sanderstølen 26 January 2007)*

If the real monetary policy rate is lower than the neutral (or “normal”) rate, the monetary policy is expansionary. Growth in demand is higher than potential growth in the economy. The monetary policy is restrictive if the real monetary policy rate is higher than the neutral rate. Growth in demand should then be lower than growth in potential output.

It is not easy to identify or measure the neutral rate. However, in a perfect market there should over time be a correspondence between market rates and the return on real investments. Therefore the trend in long-term real yields is often used as a proxy for neutral rates. In the above-mentioned speech Bergo continues:

*“Against the background of historical developments in growth and real interest rates over the past 10-12 years, it may seem reasonable that the normal real interest rate level in Norway is in the range of 2½-3½%. If we add the inflation target to this, a range of around 5-6% may be a reasonably normal level for the nominal interest rate. On an uncertain basis, the normal interest rate for Norway is now estimated to lie in the lower end of this range.”*

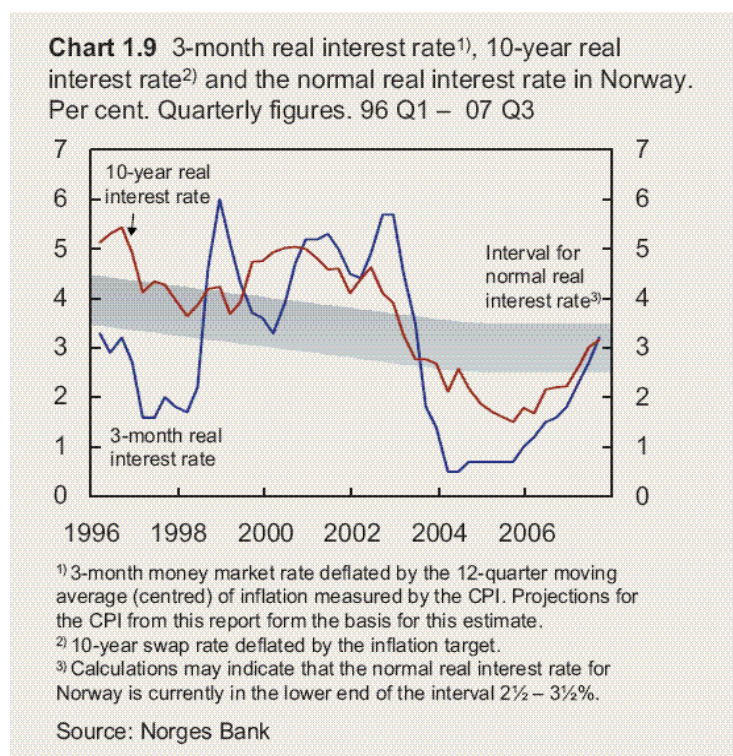


Figure 1.4. Real normal and actual market rates

As discussed in Chapter 1.1, potential growth in Norway is assumed to have increased the last few years. There consequently seems to be an inconsistency between Norges Bank’s assessment of potential growth and the natural rate within the horizon of the monetary policy. Data also show that the profitability of real investments has been extraordinarily high in most western countries. Despite this, real long-term market rates have generally declined. A number of explanations have been given for this. One of the

most frequently used is the emergence of economies such as China with a greater preference for saving than for instance the US. A redistribution of income to oil-producing economies may also lead to higher global savings, since these economies tend to save a larger part of the extra revenue accrued.

It is highly uncertain to what extent the so-called saving glut will persist. The uneven distribution of saving and dissaving may not be sustainable over time. Research by the Federal Reserve (Edge et al., 2007) and Norges Bank (Bjørnland et al., (2007) on US data indicates that the natural rate has varied highly from the mid-1980s and up to 2005.

**NBW's view:**

**We recommend that Norges Bank does more to identify developments in the neutral interest rate in Norway. In an integrated global capital market, the neutral rate will over time tend to be the same in different countries. However, because of different supply-side shocks like large changes in the terms of trade, changes in the supply of labour from abroad etc, there may be periods relevant for the horizon of the monetary policy when the neutral interest rate in Norway may differ significantly from that of other countries.**

### ***1.6. Communication of policy***

Norges Bank's communication with the public is generally good and comprehensive. No major changes have been made in the form or content during the last year. The structure of the press releases where interest rate decisions are published was changed at the final policy meeting last year. The press release was shortened to contain the Board's conclusions only. In a separate document, the bank presents the background and general assessment linked to the decision. This is a more efficient way to present the bank's conclusions than previously when all the information was contained in one long press release.

Good communication and openness do not necessarily mean that many words should be used. Market participants are looking for even small changes in central phrases, changes in the order arguments are presented etc. A few concise sentences where changes in wording are easy to perceive quickly are an efficient way to communicate main conclusions and assessments. The above-mentioned change in the press releases was a step in that direction.

In the press releases after monetary policy meetings (MPMs) Norges Bank has often given some guidance about future intentions. When the interest rate was at 1.75% the bank indicated that it would stay at that level for a longer period by saying that Norges Bank would “not be the frontrunner relative to other countries in setting interest rates at a more normal level”. The wording was repeated and kept more or less unchanged until the bank in early 2005 signalled that a hiking process was about to start. Then the phrase “small, not too frequent steps” was introduced. That wording was kept unchanged also when the hiking frequency was increased. Finally, last year the following wording, with some variations, was iterated in all press releases after MPMs: “Given the inflation target, we will be mindful of the effects of higher interest rates on the NOK exchange rate when inflation is low”. The wording disappeared in the press release after the monetary policy meeting on 23 January 2008.

**NBW’s view:**

**Instead of keeping key messages like the above-mentioned unchanged also when the basis for them changes gradually, and then suddenly leaving them out, Norges Bank should consider changing the phrases more gradually. We assume the bank’s mindfulness of the effects of higher interest rates on the exchange rate is not the same when core inflation is around 1.5%, and the inflationary pressure is increasing, as it is when core inflation is at 1% and the inflationary pressure is moderate. Last year’s NBW group was also critical of the way Norges Bank repeats such policy phrases.**

The document published together with the press releases after the MPMs is called “The Executive Board’s key policy decision – background and general assessment”. It partly overlaps with the press release. In addition it lists changes in economic indicators, domestic and international, since the latest MPM. The bank’s assessment of the consequences relative to its forecast from the latest MPR is with a varying degree of precision summarised verbally.

With effect from last December the Swedish Riksbank started to publish adjusted forecasts for growth, inflation and also an adjusted interest rate path after every MPM. These forecasts are not as detailed as those presented in the Riksbank’s MPRs, but summarise the bank’s overall assessment of the situation at the time when a new interest rate decision is taken.

**NBW's view:**

**Norges Bank should consider presenting its assessment of the economic situation by publishing summarised adjusted forecasts after each MPM. We do not know if the Executive Board is presented with adjusted forecasts at each MPM. If not, we assume it would be useful also for them to have these before taking an interest rate decision.**

When assessing the inflationary situation in real time, Norges Bank uses different indicators for core inflation. From the outset, the bank said it looked at changes in CPI-ATE (consumer price index adjusted for taxes and energy prices). After recommendations from NBW, Norges Bank now also looks at other core inflation concepts (such as weighted median and trimmed mean) for assessing the inflationary situation in real time. Still, CPI-ATE is the only core inflation concept for which the bank makes forecasts. However, when characterising the underlying inflationary situation Norges Bank now more often mentions ranges derived also from the other indicators for core inflation. The other core inflation indicators are, however, not published generally by Statistics Norway when new data are produced.

**NBW's view:**

**As other core inflation concepts than CPI-ATE play a more important role in Norges Bank's assessment of the inflationary situation in real time, Statistics Norway should start to publish regularly all the indicators used regularly by Norges Bank.**

## **2. Economic analysis at Norges Bank and the assessment of current and future macroeconomic conditions**

Since monetary policy under inflation targeting is forward looking, it clearly needs to be based on a reliable assessment of the current macroeconomic conditions as well as their future trend. In the long run, a good track record on economic analysis and forecasting is also crucial for Norges Bank's credibility and, hence, for its ability to anchor inflationary expectations. However, forecasts that turn out to be wrong *ex post* are not necessarily bad forecasts. That depends on whether the errors are due to genuinely unexpected shocks/developments or due to a poor forecasting model or a misjudgment of the monetary policy transmission mechanism. In the former case, there are no reasons to expect inflationary expectations to be affected by past forecast failures. In the latter case, inflationary expectations may respond to past errors. An important success criterion for a central bank is therefore its ability to shelter inflationary expectations from its forecast errors.

### ***2.1. Nowcasting and forecasting at Norges Bank***

Norges Bank presents a thorough assessment of the macroeconomic conditions three times a year in the MPRs. This assessment is partly based on statistical and economic models, and partly on judgment. The current economic situation is evaluated on the basis of available statistical information regarding output, employment, vacant jobs, inflation etc. Since many of these statistics are presented with a substantial time lag, and also subject to later revisions, even the current economic situation is assessed with a substantial element of uncertainty and has to be "nowcasted". To improve its nowcasts and short-term forecasts, Norges Bank exploits its own regional network of approximately 1,300 "early warning" informants. This network consists of firms, organisations and municipalities throughout the country, and provides regular interview-based information (five times a year) on economic trends within different industries and regions; see Kallum et al. (2005).

Economic forecasts are currently made on the basis of a "core model" (Model 1A), which is a four-equation rational expectations model determining the paths of inflation, interest rates, the output gap and the exchange rate; see Husebø et al., (2004). The four equations are:

- i) an aggregate demand equation (IS) capturing the dynamic relationship between real output, the real interest rate, the real exchange rate and world output;
- ii) an aggregate supply or price-setting equation (Phillips curve) characterising the dynamic response of actual inflation to inflation expectations, the output gap and the real exchange rate;
- iii) an uncovered interest rate parity (UIP) equation expressing the dynamic relationship between the exchange rate and the difference between domestic and foreign interest rates;
- iv) a monetary policy rule, describing how the monetary authority sets interest rates in order to balance the short-run trade-off between stabilising inflation around the target and stabilising the real economy.

Since late 2005, all macroeconomic forecasts have been based on Norges Bank's own predictions regarding its interest rate setting behaviour. The core model is used to compute forecasts for up to a 3-4-year horizon, and – given Norges Bank's mandate – the interest rate rule is parameterised so that the predicted inflation rate approaches the target level of 2.5% and the output gap approaches zero within this time frame. Forecasts into the near future (the first few quarters) are typically not based on the core model, but rather on a suite of purely statistical models, such as autoregressive integrated moving average models (ARIMA) and vector autoregressive (VAR) models. Predictions derived from the statistical models are then fed into the core model in order to produce consistent paths for the variables in question. During this process, a number of different statistical models are applied and alternative assumptions are made regarding the development of exogenous variables. This exercise is to some extent iterative, in the sense that the results from one modelling exercise are used as a starting point for other models, which again feed back into the former modelling exercise. The process requires a substantial element of judgment regarding the path of exogenous variables and the weights attached to the different models. The degree of forecast uncertainty is communicated by means of confidence fan charts. These fan charts are based on Monte Carlo simulations constructed from introducing shocks to the residuals appearing in equations i), ii) and iii) in the core model (the demand equation, the Phillips curve and the exchange rate). The shocks are drawn in such a way that their standard deviations match the historical (1995-2006) standard deviations of the residuals.



## **2.2. Assessment of nowcasting and forecasting performance**

Except for 2007, Norges Bank has consistently overestimated the inflationary pressures in the economy since inflation targeting was introduced in Norway; see Figure 2.1. Similar prediction errors have been made by other key forecasters in Norway, such as Statistics Norway, and to a large extent they can be attributed to genuinely unexpected supply shocks related to globalisation and cheaper imports. This is not the whole story, however. Based on the more recent assessments of past output gaps, we find that Norges Bank has also had a tendency to overestimate current domestic inflationary pressures as reflected in the output gap. This is illustrated in Figure 2.2, where we show how the output gap estimates for the years 2002-2004 have been revised over time. The upper left-hand panel, for example, shows that by the end of 2003 (IR 3-2003), Norges Bank considered the output gap in the year before (2002) to have been significantly positive (1.4% of trend GDP). Since then, the output gap for 2002 has been consistently revised downwards, and according to the latest estimates (MR 3-2007) the output gap in 2002 was *negative* (-0.5% of trend GDP). Similar revisions have been made for 2003, 2004 and 2005. It is a well-known fact that it is much easier to disentangle cycles and trends with the knowledge of hindsight than it is to do it in real time. Given the importance of the output gap for the conduct of monetary policies, we nevertheless find the large ex post revisions worrying. A wrong real-time starting point for the output gap will propagate into the core model, and hence cause unreliable medium-term forecasts for all the key macroeconomic variables. This informational problem clearly also entails the risk of making poor policy decisions; see Orphanides (2001). As we return to below, the computation of the output gap is essentially based on historical data. The experiences so far suggest that more real-time information needs to be exploited, particularly regarding developments in labour market tightness. Given the well-known end-point problem associated with disentangling cycles from trends in real time, the output gap concept may also be more useful for historical ex post assessments of cyclical fluctuations than it is for assessment of the current situation and future developments.

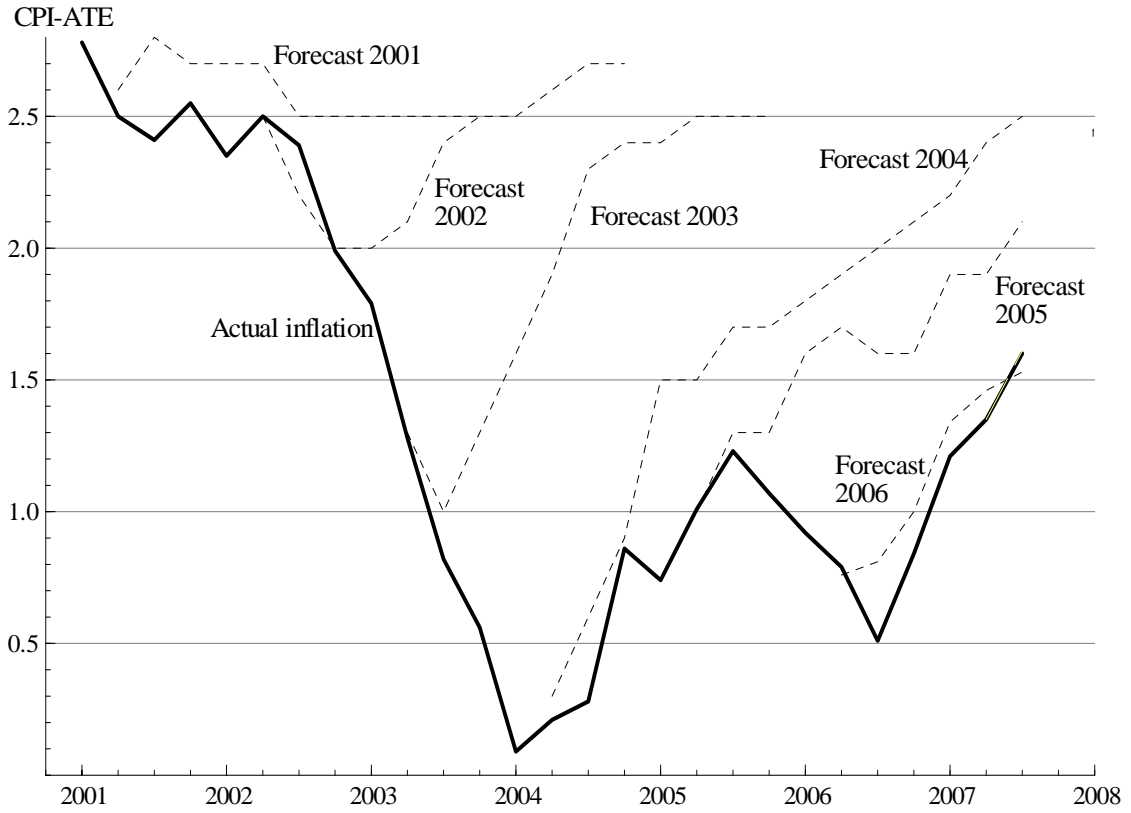


Figure 2.1. CPI-ATE inflation and Norges Bank forecasts made in the second Inflation Report (IR 2) each year

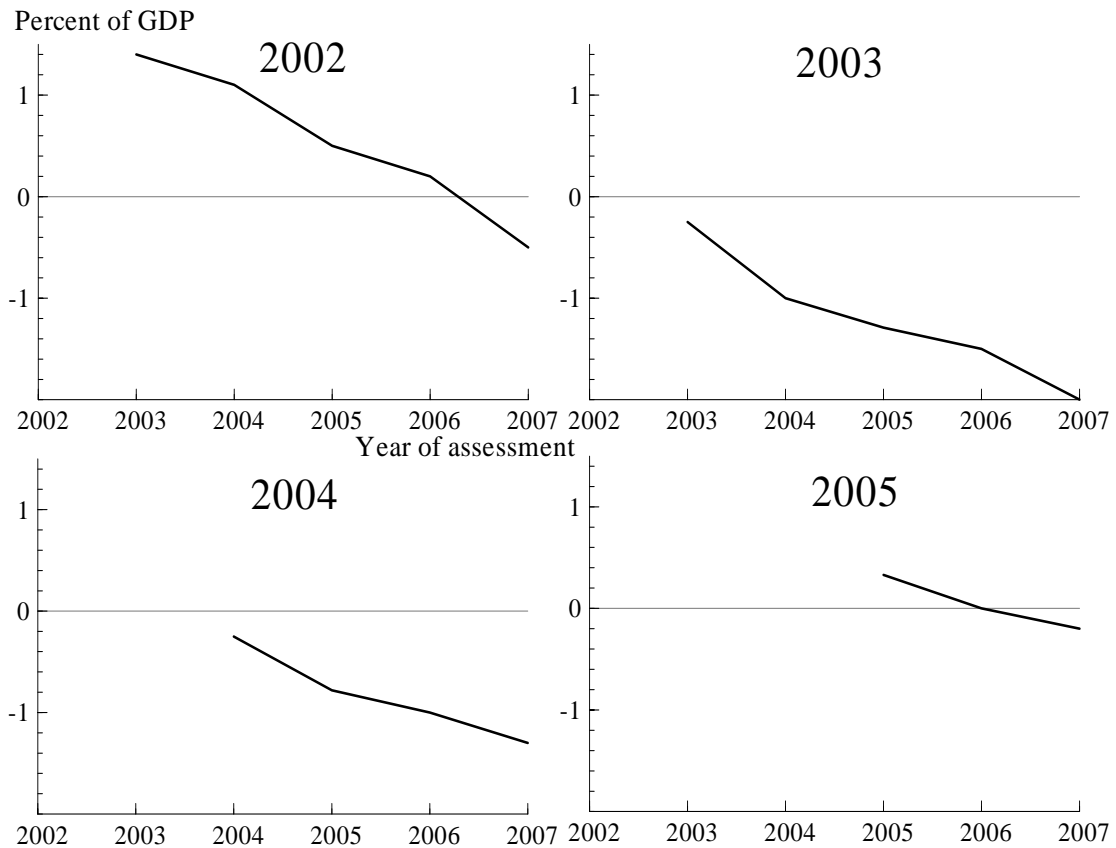


Figure 2.2. Norges Bank assessments of output gap 2002-2005 – assessments made in the last inflation report each year

During 2007, the output gap has been revised upwards in each Monetary Policy Report, and the most recent estimate for the fourth quarter is 2.8%. The key driving force behind these upward revisions is that the forecasts for actual growth in 2007 have also consistently been revised upwards during the year; see Figure 2.3. In real time, actual growth and the output gap are almost by definition revised in the same direction. While this appears reasonable in the current situation, it illustrates a methodological problem in separating supply-driven from demand-driven changes in economic activity.

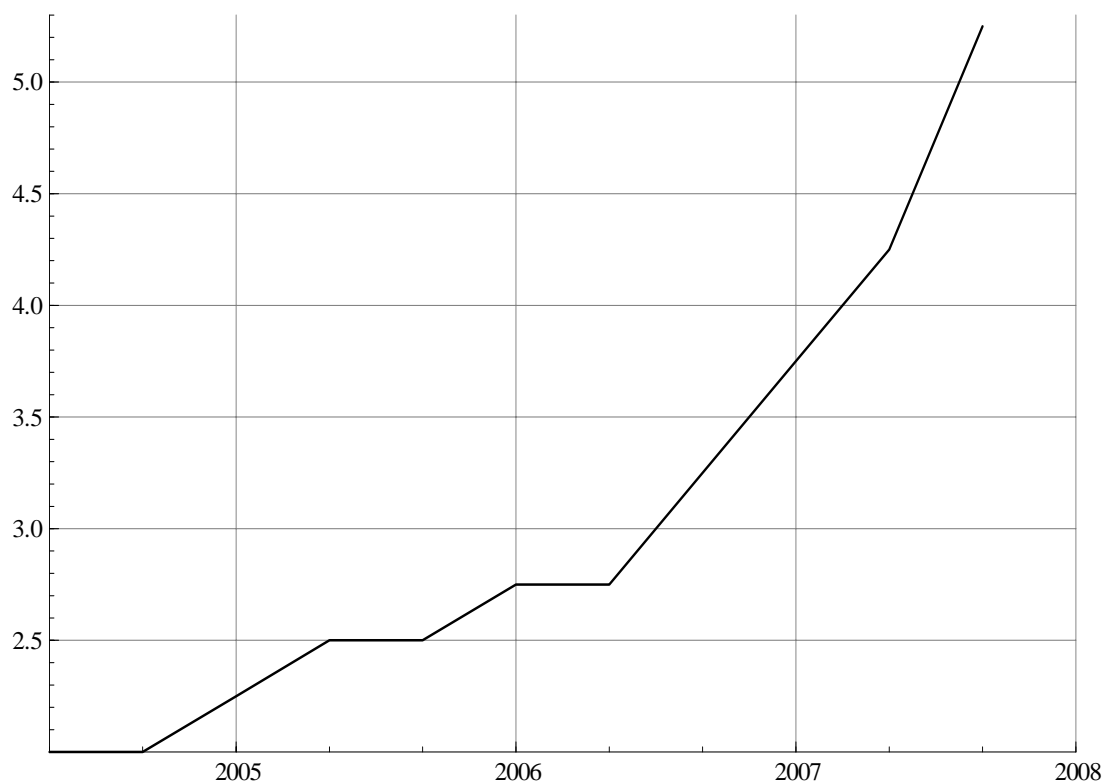


Figure 2.3. Growth forecasts (mainland GDP) for 2007 made in inflation/monetary reports from 2004 (second report) to 2007 (third report)

We suspect that it is possible for Norges Bank to improve the quality of its forecasts of core inflation, particularly over the shorter-term horizon. One indication that there is potential for improvement is that automated forecasts based on empirically validated macroeconomic models seem to have done better than Norges Bank's forecasts during a relatively long period of time; see Nymoén (2005; 2007). The point is illustrated in Figure 2.4, where the performance of Norges Bank's forecasts (from the inflation and monetary policy reports) are compared to the automated real-time inflation forecasts (AIF) regularly published by Professor Nymoén (University of Oslo) for the period from 2004 (second quarter) to 2007 (third quarter).<sup>1</sup> Since virtually all forecast errors in this period have been negative (in the sense that actual inflation has turned out to be lower than predicted), the comparison is simply made in terms of mean forecast errors by the length of the forecast horizon (a comparison of mean squared forecast errors gives a very similar picture). The difference in forecast performance is largest at the one-year

<sup>1</sup> See [http://folk.uio.no/rnymoen/forecast\\_air\\_index.html](http://folk.uio.no/rnymoen/forecast_air_index.html)

horizon, where AIF on average has been more than a quarter of 1% point closer to the true rate of inflation than Norges Bank's forecasts.

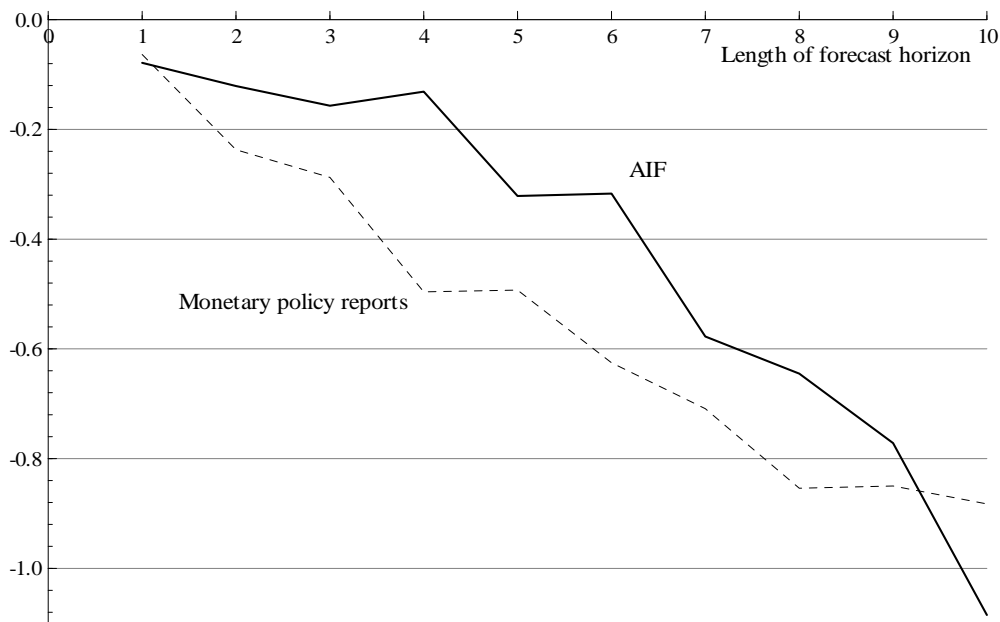


Figure 2.4. Mean forecast errors for core inflation (CPI-ATE) by length of forecast horizon (quarters)

Source: Nymoene (2007)

While the automated econometric forecasts are generated from an *empirically validated* econometric model, Norges Bank's forecasts build on the combination of a suite of time-series models (for the short term) and a structural – i.e., a *theoretically validated* – calibrated model (for the longer term). Norges Bank's inflation forecasts have the inherent property that they approach the inflation target of 2.5% within a given time horizon. In July 2004 the previous two-year horizon was abandoned in favour of a more flexible 1-3-year horizon. This policy shift is clearly mirrored in a structural break in the inflation forecasts reported in Figure 2.1. The fact that Norges Bank's forecasts are partly driven by the policy mandate – in the sense that monetary policy must adjust to *ensure* that the forecast approaches the target within a given time horizon – may suggest that Norges Bank's inflation forecast is not directly comparable to those made by other forecasters. It is also important to bear in mind that until the third Inflation Report of 2005, Norges Bank's inflation forecasts were conditional on an exogenously given interest rate path, implying that they were not meant to be the “best” forecast for actual inflation over the medium- and longer-term horizons (in 2002 and 2003, a constant interest rate was assumed, while in

2004 and 2005, the markets' interest rate expectations were adopted). However, Figure 2.4 indicates that Norges Bank's forecast errors have been unnecessarily large even at relatively short time horizons, where the forecasts should be less affected by the chosen interest rate path and by the "obligation" to bring inflation towards its target.

All inflation forecasters in Norway failed to fully capture the consequences of the negative price shocks due to cheaper imports during 2002 and 2003. Hence, to some extent these forecast errors may be viewed as unavoidable. However, it also appears that it took unnecessarily long to incorporate the consequences of these shocks into the forecasts for future inflation rates. At this point, empirically validated econometric models may have had the advantage that they more quickly could exploit the real-time information embodied in a series of macroeconomic variables and their empirical relation to the inflation process.

We fully support Norges Bank's efforts in terms of building a theoretically consistent model of the Norwegian economy, which is indeed a necessary tool for evaluating monetary policy alternatives in the medium and long term. However, in the process of ensuring theory consistency, Norges Bank may have given too little priority to empirical validation, and perhaps too quickly abandoned the exploitation of knowledge generated from macroeconometric models. As we return to in Chapter 4 of this report, we also believe that it is important to incorporate some key institutional features of the Norwegian economy better into the core model. It is obviously the case that even the most sophisticated theoretical model of a country's economy represents a drastic simplification of the immensely complicated real world. Hence, good forecasting based on a theoretically consistent model somehow needs to take into account that no single model is even close to being a complete description of the economy. The model behind the automated econometric forecasts referred to above does not itself represent a realistic alternative for Norges Bank, since it does not facilitate conditional forecasts and policy analysis. Moreover, it does not even exploit the essential knowledge that Norwegian monetary policy is run according to an inflation target of 2.5% (which perhaps makes its apparent superior forecasting performance all the more worrying).

Norges Bank's forecast errors do not seem to have undermined its credibility in the eyes of economic agents. Figure 2.5 shows how the inflation expectations of different types of agents have developed since the beginning of 2002. Among experts (academics and macro analysts), inflation expectations into the two- and five-year time horizons have remained stable around the inflation target of 2.5%, and, particularly into the five-year horizon, Norges Bank seems to have succeeded in anchoring inflation expectations at the

target, despite having delivered inflation rates well below the target for several years. It may be noted, however, that households still expect inflation rates well above the inflation target.

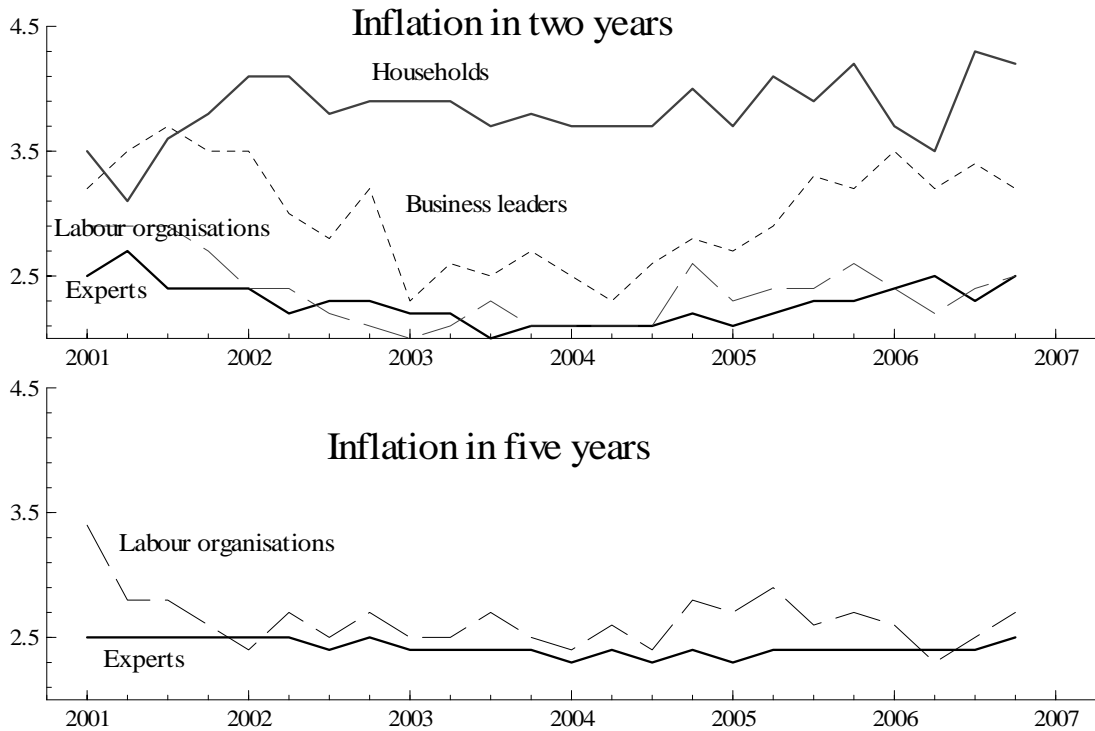


Figure 2.5. Inflation expectations two and five years ahead

Source: TNS Gallup

#### **NBW's view:**

**The errors in Norges Bank's core inflation forecasts during the last few years could to some extent have been avoided with better forecasting models, particularly over the shorter-term horizon. In order to improve future forecasts Norges Bank should consider drawing on empirically validated macroeconomic models as well as a suite of pure time-series models and a theory-consistent structural core model.**

Norges Bank's forecast errors have tended to be somewhat larger than what could be expected on the basis of previously published confidence fan charts. For example, Figure 2.6 shows that realised inflation rates have tended to lie outside the 90% confidence interval more often than it should, particularly for the forecasts made in 2002 and 2003. Since these forecasts were conditional on exogenously given interest rate paths, the excess

number of realised rates outside the fan chart does not necessarily imply that the underlying model is rejected. However, it clearly implies that the fan charts have not communicated the correct degree of uncertainty. As described above, the fan charts are constructed by introducing shocks to the residuals appearing in the core model, so that the standard deviations of the shocks match the historical standard deviations of the model residuals. If the model provides a better fit to the historical data than to future data, the method will indeed tend to underestimate the degree of uncertainty. The fan charts are also by construction symmetrical. While this may be a reasonable forecast property, it is in sharp contrast to the empirical distribution of forecast errors during the past years. An alternative or supplementary way of computing confidence fan charts could indeed be to base them more directly on past forecast errors, perhaps with higher weights on more recent errors. In that case, tight and symmetrical fan charts could only be achieved through – and would actually reflect – a consistently good forecasting performance.

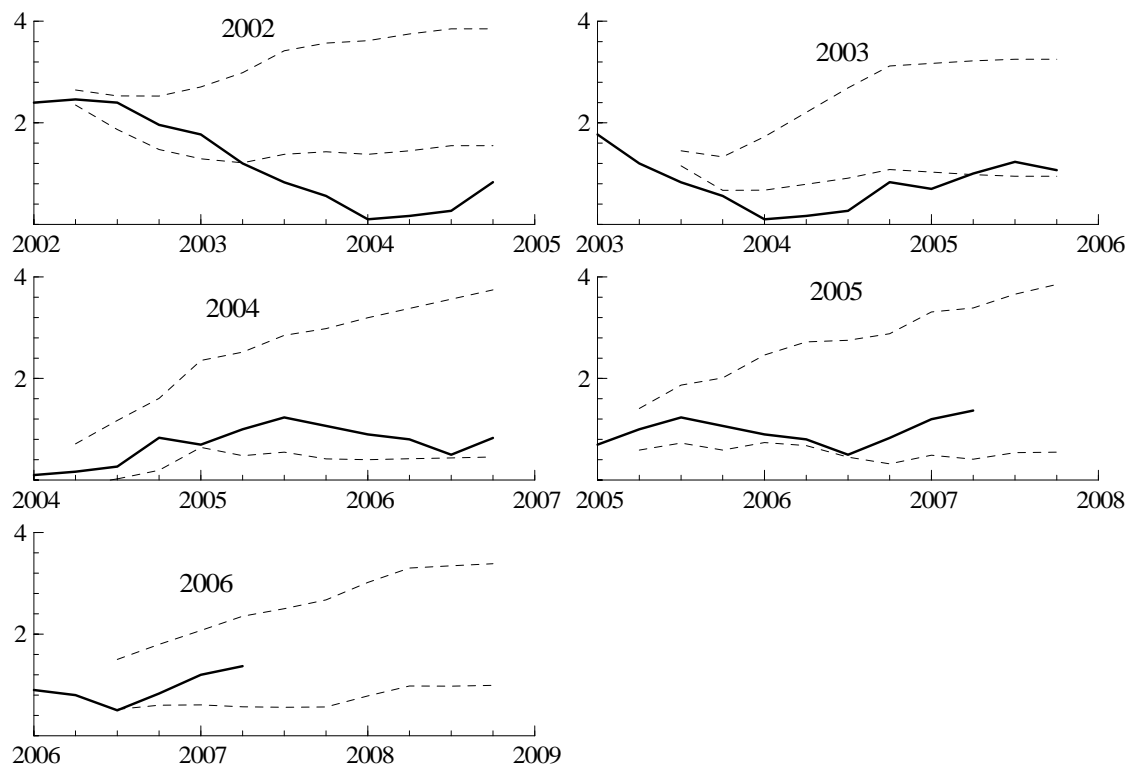


Figure 2.6. 90% confidence interval for inflation (CPI-ATE) forecasts in IR 2-2002-2003 and actual inflation

Source: Norges Bank



**NBW's view:**

**Norges Bank should consider a revision of the way they communicate statistical uncertainty in the published nowcasts and forecasts. The representation of uncertainty in the form of confidence fan charts is a good idea, but the confidence fans should to a larger extent communicate the actual distribution of past nowcast and forecast errors.**

**2.3. Assessment of labour market tightness**

Norges Bank's assessment of labour market tightness builds on data for changes in employment, unemployment and job vacancies. These variables are frequently updated and normally reliable even in real time. Yet, the interpretation of recent and current developments – in terms of the underlying trends, cycles and irregulars – may be subject to significant ex post revisions. It has been shown that the rate of unemployment in some cases provides a misleading picture of cyclical labour market developments; see Gaure and Røed (2007). In particular it tends to display its troughs and peaks some time after the underlying time path of employment opportunities has turned. This happens both because the unemployment rate is a stock variable, which reacts sluggishly to changes in the underlying flows, and because the magnitudes of these flows are not only determined by economic fluctuations, but also by the composition of the stocks from which they are generated (the group of unemployed individuals is more negatively selected – in terms of individual employment opportunities – in good times than in bad times). Changes in labour market *flows* may in some cases be more informative – and constitute a better foundation for early warnings – than corresponding developments in labour market *stocks*. Norges Bank could perhaps benefit from looking more systematically into the trend in some key labour market flow indicators, e.g., the rate at which different groups of job seekers obtain jobs and the rate at which employed individuals become unemployed.

During the coming years, Norges Bank should keep a particularly close eye on labour market behaviour – in terms of participation as well as hours worked decisions – among older individuals. According to the labour force sample survey, the rate of labour force participation among the elderly (55-66 years) rose by as much as 2.3% points from the third quarter of 2006 to the third quarter of 2007. In 2008, income testing of pension entitlements for 67-year old retirees is removed. This implies that work incentives are improved substantially for members of this age group. As the new pension system replaces

the old one from 2010, we may expect large shifts in employment patterns for individuals above 60 years of age which may, if unaccounted for, confound the assessment of cyclical fluctuations. Norges Bank also needs to monitor developments in health-related social security claims. If the government succeeds in its ambition to reduce the flow into – and increase the flow out of – social security dependency, the impacts on labour supply may be significant.

**NBW's view:**

**The assessment of labour market tightness may be improved through more systematic exploitation of variations in labour market *flows*; e.g., in terms of the six transition rates between employment, unemployment and non-participation. These could be constructed at a quarterly or yearly level on the basis of Statistics Norway's labour force sample survey or on the basis of administrative registers (NAV).**

***2.4. Properties of the core model***

The current Core Model (1A) has been criticised on the grounds that it disregards important inflation determinants (such as wage costs, unemployment and productivity) and that it does not “survive” a direct confrontation with Norwegian data; see Nymoen and Tveter (2007). The parameters in the Core Model are determined on the basis of theory, calibration and judgment, rather than on the basis of direct confrontation with the data in the form of estimation; see Husebø et al. (2004). Nymoen and Tveter (2007) estimate the parameters of the supply-side equation in the Core Model (the Phillips curve) on the basis of Norwegian (quarterly) data after 1999 (alternatively 1993) and argue that the best parameter estimates (from a statistical point of view) are different from those used by Norges Bank. Given the simplistic structure of the model, it is of course not necessarily the case that the parameters providing the best fit to historical data also can be expected to provide the best fit to future data. Hence, it seems reasonable to exploit “additional information” derived from theory and from relevant empirical evidence outside Norway. However, regular confrontation with the realities embedded in economic data must be a key ingredient of all modelling work. We have the impression that this concern is given priority in the development of the new core model NEMO. Our understanding of Norges Bank's economic analysis and forecasts is also that they do *not* rely solely on a “mechanical” application of the core model. On the contrary, a suite of models are applied

and a number of alternative scenarios are examined before the final forecasts are made. This process requires a significant element of judgment, however, which makes it difficult for outsiders to criticise and contribute to improvements in the forecasting model.

**NBW's view:**

**Since Norges Bank's structural model of the economy (currently 1A) plays an important role in forecasting as well as policy evaluation, its performance in terms of purely empirical criteria needs to be improved. Given the large difficulties associated with assessing the output gap in real time (see Chapter 2.2), we recommend that Norges Bank explores the possibilities of exploiting other and more reliable measures of inflationary pressure instead. Ultimately, policy decisions must be made on the basis of data that are actually available in real time, and this simple fact should constitute a guiding principle for all economic modelling aimed at informing monetary policy decision-makers.**

***2.5. Openness regarding the roles of formal models and judgment – creating an environment for cumulative learning and model improvement***

As indicated in the discussion above, Norges Bank's economic forecasts are based on a mixture of formal modelling and staff judgment. The distinctive roles of modelling and judgment are not clearly communicated, however. This limits the scope for constructive discussions with outside academics, particularly regarding model improvements obtained through direct confrontation with data and statistical testing. More transparency regarding the core model's forecasting performance could encourage dialogue between the different researchers and modelling environments in Norway, and perhaps also foster a competitive drive towards developing the "best" forecasting model. This will not be of less importance when the current Model 1A is replaced by the more sophisticated NEMO.

Given the current vagueness regarding the roles of cross-checks and judgment in the production of economic forecasts, outsiders may (rightly or wrongly) suspect that the core model's mechanical predictions are not published simply because they produce unreasonable results.

**NBW's view:**

**Norges Bank should facilitate a more open discussion regarding the empirical performance of their (mechanical) forecasting models by communicating the role played by the “judgment component” more clearly. This may encourage exploitation of the cumulative learning process in the scientific community as a whole, by which existing empirical models are improved or (eventually) overtaken by new and better ones.**

### **3. Potential output and the output gap – structural change and responsiveness towards labour demand**

The output gap, i.e., the difference between actual output and potential output, plays a key role in modern monetary policy in general, and in Norges Bank's economic models in particular. Potential output is defined as the level of output consistent with stable inflation. The problem with the output gap is that it cannot be observed; hence it has to be estimated. Even with hindsight, such estimations involve substantial elements of uncertainty. Norges Bank's ability to provide reliable assessments of current and future output gaps is therefore crucial for its ability to design appropriate monetary policies.

Norges Bank computes the current output gap by applying a Hodrick-Prescott filter on the GDP time series; see Kloster and Solberg-Johansen (2006). However, the results from this exercise may be adjusted if alternative statistical methods provide different results and on the basis of judgment. Bjørnland et al. (2007) provide a description and an evaluation of the various statistical methods that are used to compute output gaps. They find that the different techniques tend to produce similar results, but that multivariate methods display higher correlation with other indicators of economic activity than univariate methods do. They also conclude that the alternative measures of the output gap represent value added for inflation forecasting, in the sense that they provide information about future inflation beyond what is embedded in past inflation. These evaluations build, however, on the *ex post* calculated output gaps. Since these output gaps are not available in real time – and since recent experience suggests that *ex post* revisions may be major – this does not necessarily imply that the output gap represents value added for actual inflation forecasting.

Norges Bank's Core Model (1A as well as its successor NEMO) builds on the assumption that potential output is determined outside the model. This is consistent with the now conventional wisdom that monetary policy cannot affect output and employment in the long run. While we have no intention of challenging this basic view as a theoretical foundation for monetary policy, we will point out that important structural changes probably have taken place – and may also be expected to occur in the future – regarding the way potential output is determined. This makes the strategy of estimating the output gap on the basis of past developments questionable.

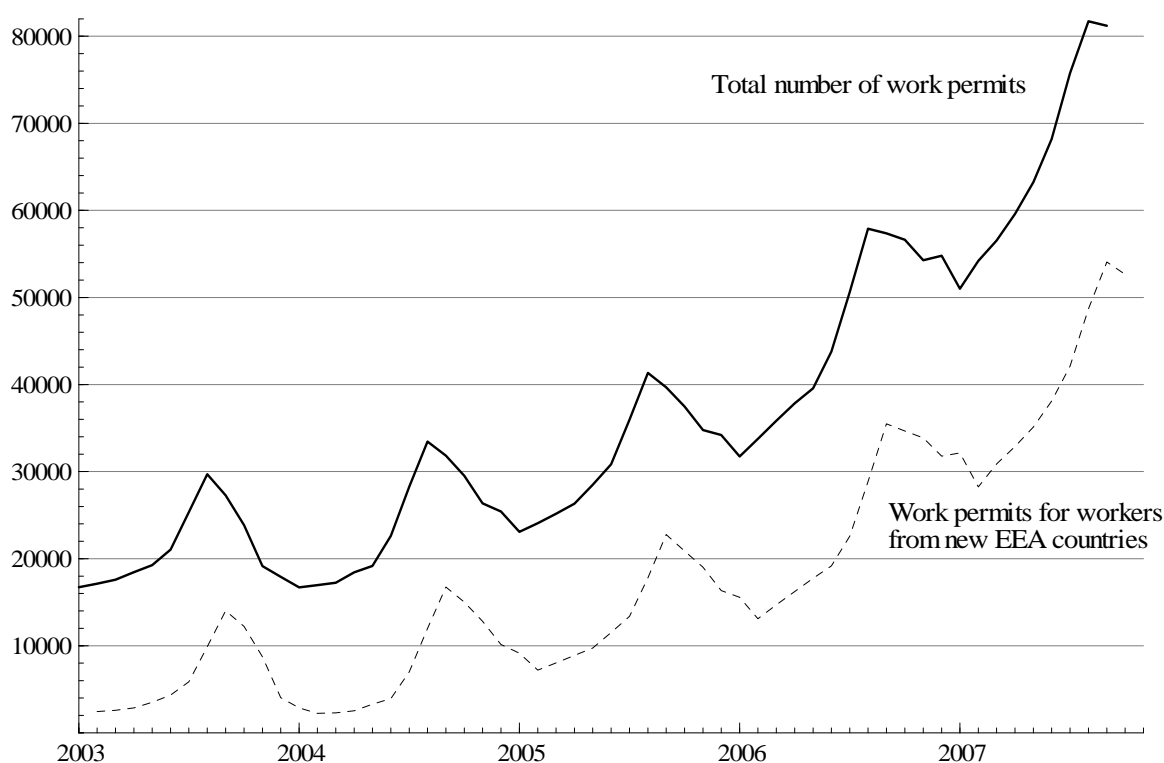


Figure 2.7. Immigration of labour to Norway – number of valid work permits 2003-2007

Source: Norwegian Directorate of Immigration

The most important structural change is probably the liberalisation of labour migration within Europe. For Norway, this has translated into large flows of labour immigration, which has increased output capacity substantially. The number of work permits for foreigners in Norway has increased sharply since 2004, and it reached its highest level ever of more than 80,000 in 2007; see Figure 2.7. In addition to these numbers, an unknown, but probably strongly increasing, number of immigrants arrive as

employees for foreign firms or as self-employed. And on top of that, there are large unregistered migration flows between the Nordic countries.

So far, there are no signs that the flow of labour migrants from Poland and the Baltic countries will taper off, despite improved employment prospects and earnings levels in their home countries; see Dølvik and Eldring (2008). Labour immigration not only increases labour supply; it also boosts labour demand as the immigrants use their purchasing power to buy goods and services in Norway. Hence, even though output capacity increases with the level of labour immigration, it is not obvious that the output gap is reduced accordingly. But since a relatively large fraction of the migration flows now take the form of shorter-term stays in Norway, we may expect that the supply effect dominates in the short run, implying that the output gap is reduced.

A distinguishing feature of current labour migration flows is that they seem to respond *endogenously* to labour demand; see Dølvik and Eldring (2008). Hence, at least in the short and medium term, *potential output is affected by monetary policies*. Rising rates of family unification also indicate that many migrants intend to stay permanently in Norway. There are also indications that the migration flows contain a sort of self-enforcing component related to the expansion of “migration networks” in Norway, the spread of information regarding employment opportunities and the reunification of families and friends (Dølvik and Eldring, 2008). The stronger ties that are forged with companies established in the new EU countries may also enhance the scope for various kinds of outsourcing, effectively moving some labour-intensive tasks from Norway to these countries.

Imports from low-cost countries outside the EU – such as China and India – also affect the potential output of the Norwegian economy because they affect the purchasing power of a given wage outlay. Lower import prices may provide workers with higher real wages at a relatively low cost in terms of nominal wage increases. Therefore equilibrium employment may rise; see Bjørnland (2007). This is probably one reason why Norges Bank has underestimated the output capacity of the Norwegian economy. Wage claims – and, hence, domestic inflationary pressures – have also been moderated by the increased competition for jobs resulting from the rise in actual as well as potential labour migration flows from the low-wage countries in Eastern Europe. More open borders clearly have the potential for causing more fundamental structural changes in the Norwegian wage bargaining process.

Structural changes in wage setting may also arise from domestic sources. In the private sector of the economy, increased usage of bonuses implies that downward nominal and real wage rigidities may become less predominant. According to Lunde and Grini (2007), the proportion of full-time employees in the private sector who received bonuses rose from 18% in 1997 to 28% in 2005. The average level of bonuses at the same time increased by 68%; from NOK 1,900 to NOK 3,200 per month. More weight on bonuses as opposed to ordinary wage increases has the implication that the direct linkage between “today’s” pay rises (including bonuses) and future expected inflation becomes weaker, particularly when today’s pay rises reflect particularly high profits. This argument may be modified, however, by the knock-on effects of bonuses in sectors of the economy without bonus payments.

Finally, a long period of high labour demand may facilitate structural reforms in the labour market, e.g., in terms of improved work incentives in the social security pension systems. It is conceivable that the current drive towards “activity orientation” of the social welfare system may mobilise additional labour resources in Norway; see Røed and Westlie (2007). The pension reform to be implemented in 2010 will also increase labour supply, since it provides a stronger link between lifetime social security contributions and pension entitlements. And if the government fulfils its aims of introducing a neutral (actuarial) early retirement system in Norway (and remove currently existing non-neutral early retirement schemes), the positive labour supply impacts can be expected to be substantial; see, e.g., Stensnes and Stølen (2007). Existing evidence suggests that there are strong complementarities in structural and demand-oriented measures to enhance labour market participation; conf., e.g., the literature regarding welfare reform in the US; see Blank (2003). It is also politically easier to implement reforms when there are plenty of jobs to be had. This suggests that a form of concerted action of fiscal and monetary policymakers may be called for in order to raise potential output in Norway. Otherwise, the favourable labour supply effects of structural reforms may be stifled by monetary policies founded on an essentially backward-looking time-series estimate of the economy’s output capacity.

An underestimation of current and future potential output, or of the potential output’s elasticity with respect to actual output, may entail the risk of restraining a desired economic expansion, and may undermine structural reforms.

**NBW's view:**

**The output gap is becoming an increasingly problematic concept on which to base monetary policy. The output capacity of the Norwegian economy has been – and will be – subject to substantial shocks related to migration, outsourcing and structural labour market reforms. Due to the large and responsive migration flows, the output capacity may also respond endogenously to labour demand and, hence, to monetary policy. Norges Bank therefore needs to rethink the role of the output gap in its economic models as well as in its forecasting strategy.**

**Norges Bank should in particular ensure that structural reforms of the Norwegian labour market that are implemented with the explicit aim of raising output capacity, such as pension and social security reforms, are accommodated by monetary policy. The degree of accommodation must be based on realistic assessments of the potential impacts of these reforms.**



## 4. A new core model for Norges Bank – finding a better NEMO

Since the first Norges Bank Watch report was published the bank has made a great improvement in developing economic models tailored for policy analysis and inflation targeting. While we fully support Norges Bank's endeavours in terms of building and using theory-consistent economic models, we also worry that some useful knowledge regarding empirical regularities and relationships between key macroeconomic variables in Norway may have been lost on the way; see Chapter 2. In this section we summarise how modelling has developed at Norges Bank and make a few recommendations that may have the potential for bridging the gap between theory and Norwegian realities/data.

### ***4.1. The history of modelling at Norges Bank***

The first model, Rimini, received much criticism in the 2002 NBW report. Rimini was a reduced-form model: statistical relationships were estimated on a long data series. Such models can often perform very good forecasts, but the main problem with them is that they are lacking an underlying economic theory; they describe relationships between a number of sectors in the economy without being equilibrium models.<sup>2</sup> As such it is impossible to make predictions conditional on alternative assumptions about the conduct of monetary policy. Having a theoretically consistent model of the economy becomes particularly important in an inflation targeting framework, like Norway, to evaluate the effects of different interest rate paths. With such a model one can obtain a more comprehensive picture of the economy's components, instead of relying on fragmentary analyses. A second important problem with reduced-form models is that they do not take explicit account of expectations, even though there is a wide consensus in monetary theory that expectations play a key role in monetary policymaking.

The 2002 NBW report called for building a structural model, where the structure should be borrowed from the recent monetary theory models. The first structural model developed, Model 1a, is a simple four-equation New Keynesian model; see Chapter 2.1. This model has been used in the Monetary Policy Reports during 2007. A richer structural model, named NEMO, has also been developed and was published in 2006 (Staff Memo

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<sup>2</sup> For an interesting discussion on this topic see Nymoene (2005).

N2006/6). NEMO has been used for forecasting purposes alongside Model 1a in the MPR 3-2007.

#### **4.2. NEMO – the new core model**

NEMO builds on the current stance of monetary theory and borrows the New Keynesian framework for modelling. Though it is not the only possible way to model monetary policymaking, in practice more and more central banks use this framework to analyse the consequences of their policy actions. In this section we first briefly summarise the role of monetary policy in this framework, and then make two recommendations on how the model might be improved to fit the Norwegian economy better.

NEMO is a modern Dynamic Stochastic General Equilibrium (DSGE) model which is micro founded, and it models Norway as a small open economy. The micro foundation implies that agents in the model, both firms and consumers, make optimal decisions. Their decisions are aggregated and a general equilibrium of all related markets is formed. The model is dynamic; agents make decisions depending on their expectations about the future. In forming their expectations agents take into account all available information, including the stochastic shocks that might hit the economy, the behaviour of other agents and what is the expected course of monetary policy.

One important implication of this model is that current economic behaviour depends critically on expectations about monetary policy. Therefore the credibility of the central bank becomes extremely important.

The current parameterisation of NEMO is based on calibration and Bayesian estimation. We would recommend proceeding with evaluating the model forecasts empirically. The forecasts of the model can be of good quality even if naturally the estimated model reflects average relationships of the past, and Norway has gone through several structural changes in the past (such as a change in the monetary policy framework). The Swedish economy went through similar changes and the Riksbank already had positive experience with its estimated model. The Swedish Riksbank's new core model, RAMSES, is similar to NEMO, a New Keynesian model partly calibrated and partly estimated, and the forecasting properties of the estimated model are promising. The forecasting performance compares

relatively well to a statistical model.<sup>3</sup> RAMSES is somewhat worse in forecasting inflation and somewhat better in forecasting GDP.<sup>4</sup>

### **4.3. Non-atomistic wage setters**

The New Keynesian model was developed and tested mainly for the US economy, therefore when applied to other countries one has to take into account the specific features of that country. Our first recommendation to improve NEMO is in this spirit, and we suggest an alternative model of the labour market that fits the Norwegian economy better.

NEMO assumes atomistic wage setters: wage setters are small compared to the whole market and therefore do not internalise the effect of their wage setting on aggregate variables. Therefore NEMO overlooks the potential strategic interaction between policymakers and large wage setters. This interaction is nevertheless potentially important, since Norway has a substantial degree of centralisation in the wage bargaining process compared to the United States. As Table 4.1 shows, Norway has maintained a much higher degree of concentration in bargaining than the US: both industry-level and central-level agreements are prevalent, while in the US wage setting happens typically at the firm level. Also horizontal coordination in the wage bargaining process is at a high level in Norway (see column two). The third column in Table 4.1 shows a supplementary variable, bargaining governability, which presents a measure of the extent to which collective contracts are effectively followed at lower levels. Norway has a high level also on this measure of vertical coordination.

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<sup>3</sup> An estimated Bayesian VAR.

<sup>4</sup> RAMSES also includes more variables than the Bayesian VAR, therefore it is able to forecast more variables. The Finnish Aino model (see Kilponen et al., 2006) is an overlapping generation model, where households are modelled as “workers” and “retirees”. This modelling approach allows for investigating the effect of the changing demographic structure. (See for example Kilponen and Ripatti, 2006)

Table 4.1. Wage-setting institutions in OECD countries<sup>5</sup>

	<b>Centralisation</b>	<b>Coordination</b>	<b>Bargaining governability</b>
	<b>1995-2000</b>	<b>1995-2000</b>	<b>2000</b>
<b>Finland</b>	5	5	4
<b>Germany</b>	3	4	4
<b>Ireland</b>	4	4	1
<b>Norway</b>	(4.5)	(4.5)	4
<b>Poland</b>	1	1	-
<b>Spain</b>	3	3	3
<b>Sweden</b>	3	3	4
<b>United States</b>	1	1	3
<b>United Kingdom</b>	1	1	1

Figures in brackets are period averages in cases where at least two years differ from the period's modal value.

Centralisation:

1= Company and plant level dominant.

2= Combination of industry and company/plant level, with an important share of employees covered by company bargains.

3= Industry level predominant.

4= Predominantly industrial bargaining, but also recurrent central-level agreements.

5= Central-level agreements of overriding importance.

Coordination:

1= Fragmented company/plant bargaining, little or no coordination by upper level associations.

2= Fragmented industry and company-level bargaining, little or no pattern-setting.

3= Industry level bargaining with irregular pattern-setting and moderate coordination among major bargaining actors.

4=

a) informal coordination of industry and firm level bargaining by (multiple) peak associations;

b) coordinated bargaining by peak confederations, including government-sponsored negotiations (tripartite agreements, social pacts), or government imposition of wage schedules;

c) regular pattern-setting coupled with high union concentration and/or bargaining coordination by large firms;

d) government wage arbitration.

5=

a) informal coordination of industry-level bargaining by an encompassing union confederation;

b) coordinated bargaining by peak confederations or government imposition of a wage schedule/freeze, with a peace obligation.

Bargaining governability:

4 = When collective agreements are legally enforceable and there is an automatic peace obligation during the validity of the agreement.

3 = When collective agreements are legally enforceable and there is widespread (but optional) peace obligation clauses in agreements.

2 = Where there is legal enforceability, but no effective tradition or practice of peace obligation clauses.

1 = Where none of the above conditions are effectively present.

The presence of large wage setters in the economy may have important implications for monetary policy; see, e.g., Holden (2005) and Gnocchi (2006). Since unions are not atomistic, they internalise the effect of their wage setting on inflation, anticipating that a wage rise will increase inflationary pressures. If monetary policy is

<sup>5</sup> Source: OECD Employment Outlook 2004.

committed to an inflation target it will counteract excessive wage growth with an increase of the policy interest rate, which in turn will reduce employment. A tougher inflation stabilisation policy punishes wage increases with higher interest rate hikes and a bigger contraction in aggregate labour demand, giving unions a higher incentive to refrain from wage increases. Therefore a unionised labour market calls for a tougher monetary policy compared to the baseline case with atomistic wage setters.

NEMO models the labour market with different types of labour (monopolistically competitive wage setters) and with nominal rigidities in wages. The degree of market power of workers depends on the elasticity of substitution between different labour types. The market power of workers can be interpreted as a measure of inefficiencies in the labour market, and thereby as a measure of equilibrium, or structural, unemployment.

The elasticity of substitution between labour types is calibrated to be similar to the Bank of England Quarterly Model's elasticity. It is argued in the documentation of NEMO that there is a similar structural level of unemployment in the UK and Norway. We find this questionable for two reasons: (1) the unemployment level in the UK is typically higher than in Norway, and (2) the centralisation in wage bargaining is substantially different in the UK and in Norway (see Table 4.1).

There is an important difference when labour markets are modelled with atomistic wage setters or unionised markets. Technically speaking, under atomistic wage setting the real wage is a constant mark-up over the marginal rate of substitution between leisure and consumption, where the mark-up increases with the monopoly power of a worker type. Gnocchi (2006) shows that when unions are explicitly modelled, the mark-up depends not only on the elasticity of substitution among labour types, but also on the number of unions and the central bank's aggressiveness in stabilising inflation. A tough monetary policy discourages wage increases in the negotiations and decreases the mark-up. Moreover, this channel is more important, the more concentrated the wage setting in the labour market.

It follows that modelling explicitly a unionised labour market introduces a channel for the transmission mechanism through labour supply, rather than the aggregate demand. Through this channel the credibility of Norges Bank becomes even more important. To decrease wage pressures the central bank should make markets believe that its policy is tougher in stabilising inflation compared to an economy where unionisation is not prevalent.

**NBW's view:**

**NEMO should be further developed to include a more realistic (non-atomistic) description of wage formation in Norway. Building such a model also has important policy implications. A model where the unions' wage bargaining is taken into account in the monetary policy setting calls for a more aggressive monetary policy compared to the current specification in NEMO.**

#### ***4.4. How private agents form their expectations***

Our second recommendation is a refinement in terms of how to model the expectations of the private sector. In this section we summarise why the formation of expectations is an important issue, and we then present an analysis of Norwegian survey expectations of inflation. In NEMO private agents are modelled as rational. We present simple rationality tests and also tests of approximating survey expectations as least squares learning algorithms.

In Norway relatively little attention has been paid so far in modelling to the formation of private expectations. Nevertheless, for the conduct of monetary policy this is of utmost importance. One reason for this is that the success of the inflation targeting framework depends on how well private expectations can be anchored. Another, less trivial reason is that the optimal monetary policy should be different when private expectations are formed in a different fashion. A better understanding of the formation of private expectations implies a better understanding of how monetary policy actions and communication influence private expectations.

In economic theory the importance of forward-looking behaviour in economic decision-making has long been recognised. However, the modelling of expectations about the future remains a matter of controversy. Since Muth (1961) published his seminal work on rational expectations, this has been regarded as a consensus for acceptable modelling procedure. Simply stated, under rational expectations agents do not make systematic forecast errors. However, the rational expectations hypothesis is often rejected in the data and has been frequently criticised on the ground that it presupposes too much knowledge of agents, more than a highly skilled econometrician would possess in real life.

An alternative expectation formation model that recently has become widespread, both in theory and in practice, is least squares learning. Simply stated, least squares learning models private agents as econometricians running regressions on past data to

make forecasts, and updating their estimates whenever new data become available. Even though this is a deviation from rationality, agents are “learning from their mistakes” and their expectations can converge to rational expectations.<sup>6</sup>

Least squares learning became widespread also because it performs well empirically, especially in explaining the short-run dynamics in the economy. This is the main reason why several central banks have already incorporated least squares learning in their core models as an alternative specification for the private sector’s expectation formation. The Federal Reserve, for example, developed FRB\US, a large-scale quarterly macroeconomic model, in 1996, which had two specifications for private expectations: rational expectations and least squares learning. The new SIGMA model of the Fed (Erceg, Guerrieri and Gust, 2006) also includes learning. Smets and Wouters (2004) estimated a DSGE model with learning with Bayesian methods for the ECB.<sup>7</sup> In the Magyar Nemzeti Bank (Hungarian National Bank) Jakab and Vilagi (2007) estimate a model with two types of learning: agents learn about the trend inflation and about the cyclical component of inflation too. The novelty of the Jakab and Vilagi paper is to provide a framework that can be estimated without detrending data.

#### **4.5. Survey expectations of inflation**

In this section we analyse inflation expectations explicitly, based on survey data.<sup>8</sup> We examine whether rational expectations are an appropriate assumption regarding the Norwegian private sector’s inflationary expectations and also investigate whether modelling agents as econometricians is a good assumption. In the latter case we also examine what economic data private agents are likely to pay attention to when they form their expectations of inflation.

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<sup>6</sup> For alternative ways of formulating learning algorithms, see for example Evans and Honkapohja (2000).

<sup>7</sup> Although the use of this model in forecasting is not explicit. The new New Area-Wide Model (NAWM) developed at the ECB does not include learning either.

<sup>8</sup> Survey evidence is subject to the caveat that survey respondents may not have incentives to provide accurate information. So survey expectations are at best a noisy measure of inflation expectations and at worst tell us nothing about actual inflation expectations. However, it may boost confidence in the usefulness of survey expectations that they are helpful in modelling inflation and in predicting inflation, wages and interest rates. See for example Roberts (1995), Roberts (1997), Englander and Stone (1989) and Mehra (2002).

## Data

We use survey data from the Consensus Survey and the Gallup Survey. Consensus Forecasts is a survey where macroeconomic analysts are interviewed about their inflation expectations by Consensus Economics. We use the expectations of forecasts of CPI inflation one year ahead, which are surveyed every quarter. The TNS Gallup expectations survey is conducted every quarter. We use the inflation expectations one year ahead of four main groups: Experts (employees in the finance industry, macro analysts and academics), Employers and employees' organisations, Business leaders and Households.

Figures 4.1-4.4 show the evolution of survey expectations and CPI inflation. CPI inflation is shifted back in time by four quarters, so that the difference between surveys and CPI data reflects actual forecast errors. For example the first data point in Figure 4.1 shows that in the second quarter of 1998 the Consensus Survey on average forecast 3.2% inflation for the second quarter of 1999, while actual inflation in the second quarter of 1999 was 2.3%.

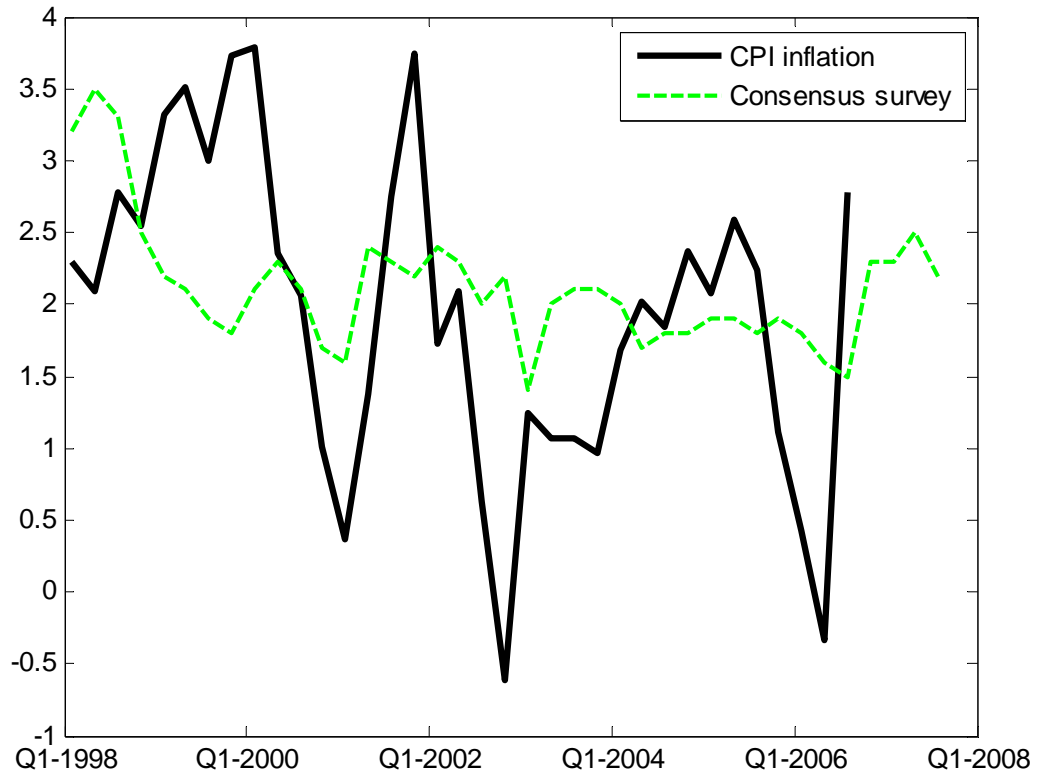
The sluggishness in surveys is clear. First, in times of generally rising inflation, like in 1999, expected inflation often under-predicts actual inflation. In contrast, in times of falling inflation, the forecasts appear to over-predict inflation. For example in 2002-2003, when inflation dropped substantially, expectations decreased only gradually. Second, the turning points in expected inflation consistently lag the turning points of actual inflation. This sluggish behaviour is indeed a general feature of survey inflationary expectations. Thomas (1999) documents sluggish turning points and under-predicting inflation for periods of upward-ratcheting inflation and over-predicting inflation for periods of decreasing inflation in two different survey measures of inflationary expectations for the US: the Livingston survey and the Survey of Professional Forecasters.

These regularities suggest a strong adaptive or backward-looking element in the formation of inflation expectations. In other words it is likely that private agents pay too much attention to past data and they do not revise their expectations even if they made the same type of mistake for a long period.

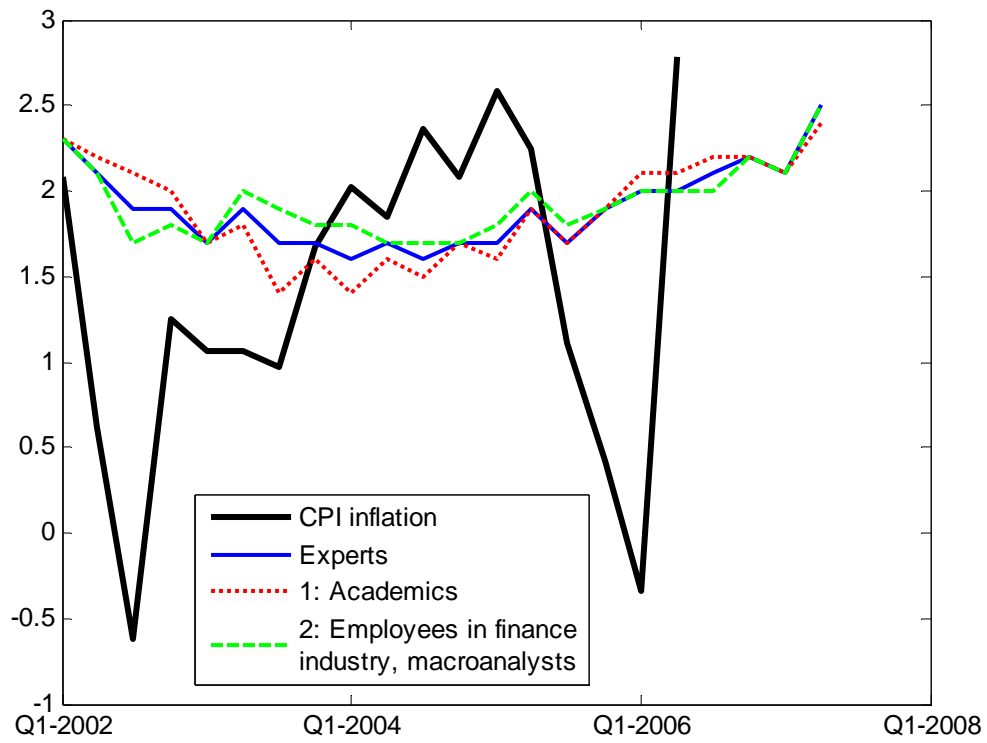
We would also like to note that of course long periods of making mistakes of the same sign is not necessarily a sign of backward-looking expectation formation, it might as well be caused by a series of unexpected shocks. For example in 2002-2003, the forecasts of the central bank showed a similar over-predicting pattern (see Chapter 2.1), and possibly can be largely attributed to unexpected supply shocks. Therefore for this episode, it is not a



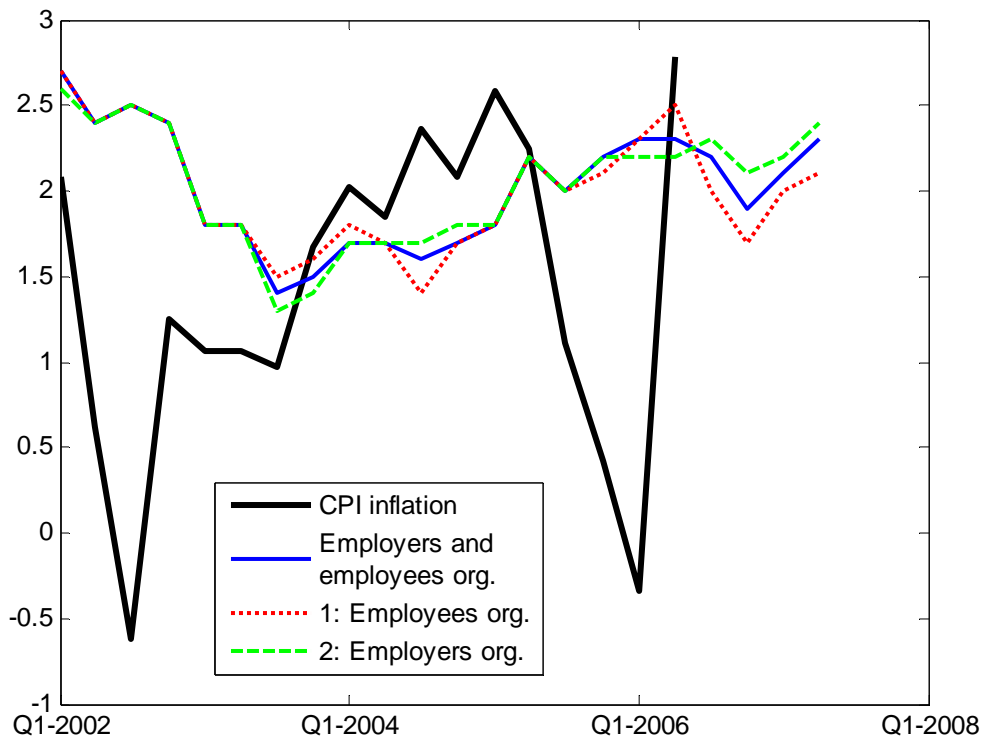
surprise that private agents made similar mistakes as the central bank, given that they have less capacity for making forecasts than the central bank.



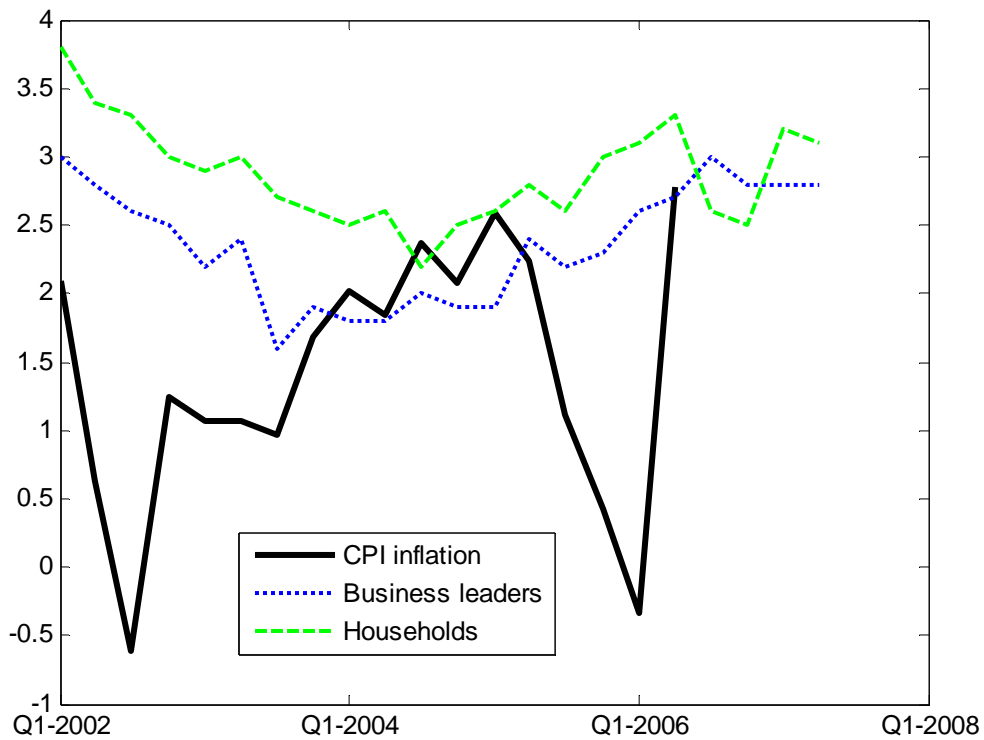
**Figure 4.1. Consensus survey of one year-ahead inflation expectations and CPI inflation. CPI inflation is shifted backwards by one year, so the difference between the two lines reflects forecast errors.**



**Figure 4. 2. Gallup survey of one year-ahead inflation expectations and CPI inflation. CPI inflation is shifted backwards by one year, so the difference between the two lines reflects forecast errors.**



**Figure 4.3. Gallup survey of one year-ahead inflation expectations and CPI inflation. CPI inflation is shifted backwards by one year, so the difference between the two lines reflects forecast errors.**



**Figure 4.4. Gallup survey of one year-ahead inflation expectations and CPI inflation. CPI inflation is shifted backwards by one year, so the difference between the two lines reflects forecast errors.**

### Rationality tests

Several studies examine the statistical properties of survey expectations, with the objective of testing for departures from rationality. Such departures usually test unbiasedness and efficiency.

We make a simple test of unbiasedness. We run the regression  $\pi_t = \alpha + \beta\pi_t^e + u_t$ . Where  $\pi_t$  is the actual inflation observed at time  $t$ , and  $\pi_t^e$  is the survey forecast of time  $t$  inflation made four quarters before, and  $u_t$  is the forecast error. The null hypothesis of unbiasedness requires that  $\alpha = 0, \beta = 1$  jointly in the regression.<sup>9</sup> If the null hypothesis cannot be rejected, then the survey expectations are unbiased, in other words correct on average.

<sup>9</sup> To test efficiency, one regresses the forecast error on the variable in the information set; i.e., on a variable available to the survey respondents.

Test results are summarised in the Appendix. In most cases unbiasedness, and therefore rationality, is rejected. The non-rationality of expectations is very clear. For example, Figure 4.4 shows that business leaders and households almost always overestimated CPI inflation.

Consensus surveys and the Experts from the Gallup survey, however, are making positive and negative forecast errors too. On average it turns out that their forecast error on average is statistically zero. Therefore for these surveys unbiasedness cannot be rejected.<sup>10</sup>

There are more advanced rationality tests, however, for the sake of our argument it is sufficient to show that there is substantial backward-lookingness in the survey data, and three of the survey series are also biased, survey respondents make similar mistakes for long time periods and their mistakes do not cancel out even on average. For the survey of professional analysts (Consensus survey and Gallup expert survey) expectations seem to be rational on average.

### **Learning in survey expectations**

Next, we approximate survey expectations with a least squares learning algorithm. In other words we model agents as econometricians, assuming they run a vector autoregression of several variables. We examine what regression provides the best fit. With this we also answer the question what variables agents are paying attention to when they are forming their expectations about inflation. We also allow them to discount past data, and pay more attention to recent data. (See Appendix for technical details.)

We consider a set of macro variables, and examine which of them are likely to be used by private agents. We use several interest rate data obtained from Norges Bank: the sight deposit rate, the bank's rate on overnight loans, and the yield of government bonds of 3-, 5-, and 10-year maturities.<sup>11</sup> All other macro data are from the Datastream database. We

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<sup>10</sup> We did not perform a full-fledged analysis of efficiency. We ran some simple tests for the Consensus survey and the Gallup experts survey. In the examined cases efficiency could not be rejected.

<sup>11</sup> "Norges Bank's key policy rate is the sight deposit rate, which is the interest rate on banks' deposits in Norges Bank... Sight deposits became interest-bearing deposits as from 1 January 1991. Up to summer 1993, however, the interest rate on banks' overnight loans (D-loans) was Norges Bank's key rate. The banking system was in a permanent borrowing position vis-à-vis Norges Bank, and the interest rate on banks' overnight loans formed a floor for short-term money market rates." [www.norges-bank.no](http://www.norges-bank.no)

use GDP, mainland GDP, unemployment rate, oil price, euro and US dollar exchange rate. (For a more detailed data description, see the Appendix.)

Table 4.2 shows the estimation results. We report the root mean square deviation (RMSD) of the least squares learning forecast from the survey expectations. The smaller the RMSD the better the least squares learning approximation is to surveys. In the table we only report the best approximations. The variable  $\gamma$ , shows how much survey respondents discount past data. This is the so-called tracking parameter in the learning algorithm, a high  $\gamma$  implies that they discount past data heavily and pay more attention to recent data.

Therefore a high degree of discounting would imply that the current data influence private expectations more than past data.

**Table 4.2. Approximating survey expectations by least squares learning**

	RMSD	$\gamma$	Lag	Variables
<b>Consensus</b>	0.3557	0	2	dlog(cpi) r_sd
<b>Experts</b>	0.1519	0	1	dlog(cpi) dlog(gdp) r_sd dlog(rx_usd)
<b>Employers and employees org.</b>	0.245	0	1	log(cpi) r_sd
<b>Business leaders</b>	0.324	0.037	1	dlog(cpi) u dlog(rx_usd)
<b>Households</b>	0.384	0.0153	1	dlog(cpi) r_overn
<b>Perfect foresight</b>	0.6619	0	4	log(cpi) log(gdp) r_sd log(rx_eur)

RMSD - root mean square deviation of the least squares learning forecast from the survey expectations

$\gamma$  - tracking parameter, Lag - number of lags in the VAR specification, Variables - variable included in the VAR specification

**Table 4.3. Standard deviation of macro variables**

	Norway	USA	Sample period
CPI	3.48	2.93	1q1978:4q2007
GDP	1.94	1.96	1q1978:4q2007
Interest rate	2.20	1.65	1q1991-4q2007

Standard deviation of yearly CPI and GDP growth. Standard deviation of the sight deposit rate for Norway and the Federal funds overnight rate for the US.

Discounting past data (using a high tracking parameter) is useful when there are structural changes in the environment (See Benveniste et al., Part I. Chapters 1. and 4.). In other words agents are more likely to use a high gain parameter when they confidently believe that structural changes occur, therefore recent data are “trusted more”.<sup>12</sup>

<sup>12</sup> A disadvantage of using a high gain parameter is that it allows the noise in the data to influence more the forecast. Therefore there is a trade-off between tracking structural changes versus filtering the data. For a theoretical paper about structural changes and the optimal gain parameter see Evans and Ramey 2006.

Table 4.2 also shows the specification of the regression that best approximates a given survey: how many lags of the variable are used, and what variables are used. These variables are the ones to which agents are likely to pay attention to.

Table 4.1 shows that the estimated gain parameter is small for all the survey data, in other words agents do not discount past data. (Zeros mean very small numbers, which are zero approximated up to four digits.) This is in line with estimation results for the US (see Orphanides and Williams 2004). In the US and in Norway private agents give similar weight to past and recent data in forming their expectations. Agents perceive the economic environment similarly stable in Norway as in the US, and assign a small probability to structural changes in the economy. The economic environment is indeed similar in the US and in Norway, Table 4.3 shows that the standard deviation of macro variables in Norway and in the US is similar in magnitude; both countries are characterised by a low variance of the main macro variables.

Least squares learning gives the best approximation to the Gallup Expert survey, and the worst approximation to the Gallup Household survey. This suggests that experts are more likely to use sophisticated econometric techniques than households.

We find that agents do pay attention to the sight deposit rate, and therefore pay attention to the central bank's decisions.<sup>13</sup> The only exception is the Business leaders' survey. However, the Business leaders' survey shows that they pay attention to the main macroeconomic variables. Their expectation is better approximated with the unemployment rate and the USD exchange rate.

The policy rate of Norges Bank (the sight deposit rate or the overnight lending rate) is clearly more important for private agents than long-term government bond yields.

Survey respondents are also likely to pay attention to the GDP figure. Mainland GDP did not show up as more important than total GDP. Another variable that plays a role in shaping private expectations is the exchange rate. This is reasonable, since Norway is a small open economy. The price of oil did not show up as an important variable.

For all surveys we find that agents use more information than simple adaptive expectations, which would imply using only lagged values of inflation. This means that private agents are more knowledgeable than simple adaptive expectations, they pay attention to the main macro variables.

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<sup>13</sup> Similarly close fit is found with the overnight interest rate of the Norges Bank.

The last row of Table 4.2 shows what would be the best possible regression to run. This is calculated by approximating the perfect foresight CPI data with the same method. In other words we approximate the actual CPI inflation data with learning algorithms, and check which variables give the best approximation. If agents had run this regression, they would have come as close as possible to actual CPI inflation. We find that the best regression would imply a similarly low degree of discounting of past data, and the best regression should include CPI inflation, GDP, the policy rate and the EUR exchange rate.

It is interesting to compare the forecasting performance of surveys to the perfect foresight VAR. Table 4.4 shows that surveys have a bigger forecasting error than the best possible VAR they could have used, but still their forecasting performance is good. The best VAR would have had a mean forecast error of *0.66*, while the consensus survey's forecast error is only *1.1*. Table 4.4 suggests that the worse forecasts are made by the households and the best forecasters are the professionals, the Consensus survey and the Gallup expert survey.<sup>14</sup>

**Table 4.3. Forecast errors of surveys and best VAR  
– root mean square deviation from actual inflation**

Survey	Forecast error
Consensus	1.1001
Experts	1.0786
Employers and employees org.	1.2415
Business leaders	1.3763
Households	1.8588
Perfect foresight VAR	0.6619

Forecast error – the mean squared difference between forecasts and actual inflation

Our results suggest that expectations are well approximated with a simple least squares learning algorithm. Private agents in Norway are clearly paying attention to the policy rate of the central bank (the sight deposit rate or the overnight rate). Private inflation expectations are also influenced by the GDP and the exchange rate. Business leaders are more likely to pay attention to the unemployment rate than the GDP measure. Agents learn in a similar way as in the US, they do not pay more attention to recent data than past data. This suggests that they do consider the Norwegian economy as a stable economy.

<sup>14</sup> Forecast errors are also in line with the forecast errors of US survey respondents. The forecast error of the Survey of professional forecasters is 1.1825, while the household survey, the Michigan survey, has a forecast error of 1.5361.



Nevertheless the survey of professional forecasters is possibly also well approximated with rational expectations, given that their forecast on average is not biased. This suggests that modelling of private agents can be done in a similar fashion as for the US, where forecasts are made both with rational expectations and a least squares learning algorithm that does not discount heavily past data.

### **Minor comments about NEMO**

NEMO is a rich model with many modelling shortcuts that deviate from the optimal behaviour of agents. The effects of these are hard to understand, and it would be useful to present first a model without these and then present the effect of them. One example is the specification of consumers; there are savers and spenders. It is not clear whether spenders are needed for a good econometric fit. Another example is introducing oil investment without modelling the oil sector. For a way to model the oil sector explicitly see Nakov and Pescatori (2007).

### **NBW's view:**

**We recommend that Norges Bank introduces more empirically validated expectations formation mechanisms into NEMO. A promising alternative or supplement to the rational expectations assumption is the assumption of least squares learning. Least squares learning typically improves the short-run dynamics of New Keynesian models, like NEMO. Least squares learning also provides a good approximation to Norwegian survey data. A promising finding of our analysis is that private agents clearly do pay attention to the central bank policy rate. In modelling expectations in NEMO therefore the policy rate should be included in the specification of the learning algorithm.**

## Appendix: Chapter 4

### Data

CONS- Consensus Survey of one year-ahead inflation expectations. Source: Consensus Economics

TNS Gallup expectations survey:

EXPERT- Experts, Employees in finance industry, macro analysts and academics

LABOR- Employers and employees org.

BUSIN- Business leaders

HH- Households

Interest rates: r\_sd-sight deposit rate, r\_overn- interest rate on bank's overnight loans (D-loans), yields on government bonds (1, 3 and 10 years). Source: Norges Bank.

All other macro data are from Datastream. CPI, GDP, GDP mainland, u- total unemployment rate, rx\_eur and rx\_usd - exchange rate with EUR and USD, OILP- Export Prices, Crude oil and remaining mineral fuels, Index

### Simple rationality tests

The following rationality test is conducted.  $\pi_t = \alpha + \beta\pi_t^e + u_t$ ;  $H_0 : \alpha = 0, \beta = 1$

Variable	Coeff	Std Error	T-Stat
Signif			
*****			
**			
<b>Consensus survey</b>			
1. Constant	0.8106092311	0.8665730280	0.93542
	0.35636738		
2. CONS	0.5357626282	0.4036158043	1.32741
	0.19348449		
F(2,33)=	1.04649 with Significance Level 0.36253144		

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**Experts, Gallup survey**

1. Constant	0.4779184211	1.8750594913	0.25488
	0.80170380		
2. EXPERT	0.5598421053	0.9840154719	0.56894
	0.57643022		

F(2,18)= 1.19856 with Significance Level 0.32458745

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**Employers and employees org., Gallup survey**

1. Constant	2.216613511	1.317420192	1.68254
	0.10972931		
2. LABOR	-0.332808563	0.633514216	-0.52534
	0.60576032		

F(2,18)= 4.47833 with Significance Level 0.02639115

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**Business leaders, Gallup survey**

1. Constant	1.642168115	1.301997429	1.26127
	0.22331423		
2. BUSIN	-0.045459578	0.547972698	-0.08296
	0.93479930		

F(2,18)= 7.31980 with Significance Level 0.00471791

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**Households, Gallup survey**

1. Constant	1.3994586997	0.2346146607	5.96492
	0.00001211		
2. HH	0.0013323704	0.0007426310	1.79412
	0.08960893		

F(2,18)=1007681.15092 with Significance Level 0.00000000

## Least squares learning

Constant gain learning in a recursive formulation is

$$\begin{aligned} R_T &= R_{T-1} + \gamma(x_T'x_T - R_{T-1}), \\ \beta_T &= \beta_{T-1} + \gamma R_T^{-1}x_T'(y_T - x_T\beta_{T-1}), \end{aligned}$$

where  $R_T$  is the covariance matrix at time  $T$ ,  $\beta$  is the coefficient vector,  $y$  is the dependent variable,  $x$  are the independent variables.

This corresponds approximately to weighted least squares. Minimizing the sum

$$\sum_{t=1}^T \alpha^t (y_t - x_t\beta)^2. \quad (1)$$

$\gamma \simeq (\alpha - 1)/\alpha$ .

We determine  $\alpha$  by a grid search method, which involves the following steps:

1. First we determine the time interval that is used to compare the survey results with the VAR forecasts: that is, we determine an interval  $[T_1, T_2]$ .
2. Then we chose  $\alpha$ .
3. Next, we estimate the VAR-s minimizing (1), with the data available until each  $[T_1 \leq T \leq T_2]$ , and calculate one-year-ahead forecast of inflation. (In all cases the survey contains one-year-ahead forecasts of inflation (year-on-year index of the price level).)
4. We the calculate the root mean squared difference (RMSD) between the VAR forecasts and the survey data.
5. We repeat steps 2) - 4) for different values of  $\alpha$ , and chose the one with the minimal RMSD.

## Appendix: Interviews

Thursday 15 November 2007	Ministry of Finance Nina Bjerkedal, Arnt Skjæveland, Knut Moum and others
Thursday 13 December 2007	Norges Bank Svein Gjedrem, Anne Berit Christiansen Amund Holmsen and others
Monday 14 January 2008	Ragnar Nymoen, University of Oslo
Monday 14 January 2008	Statistics Norway Øystein Olsen, Ådne Cappelen and Torbjørn Eika
Wednesday 16 January 2008	Hilde Bjørnland, BI
Tuesday 12 February 2008	Krisztina Molnar interviewed Guttorm Schjelderup at NHH

## References

- Adolfson, M., Laséen, S., Lindé, J and Villani, M. (2007) RAMSES – a new general equilibrium model for monetary policy analysis, *Sveriges Riksbank Economic Review*, 2007/2
- Benveniste, A., Metivier, M. and Priouret, P. (1990) *Adaptive Algorithms and Stochastic Approximations*, Berlin: Springer, 1990
- Bergo, Jarle (2007) Interest rate projections in theory and practice. Speech at seminar of the Association of Norwegian Economists, January 2007
- Bergo, Jarle (2008) Nominal and financial stability in a new economic world. Speech at seminar of the Association of Norwegian Economists, February 2008
- Borio, Claudio and Lowe, Phillip (2002) Asset prices, financial and monetary stability: exploring the nexus. BIS Working Paper July 2002
- Bjørnland, H. C. (2007) Statsbudsjettet i en uvanlig høykonjunktur. *Økonomisk Forum* nr. 8/2007, 7-11.
- Bjørnland, H. C., Brubakk, L. and Jore, A. S. (2007) Forecasting inflation with an uncertain output gap. *Empirical Economics* DOI: 10.1007/s00181-007-0165-y
- Bjørnland, H. C., Leitemo, K. and Maih, J. (2007) Estimating the natural rates in a simple Keynesian framework. Norges Bank Working Paper 2007/10
- Blank, R. M. (2003) U.S. Welfare Reform: What's Relevant for Europe? CESifo Economic Studies. Vol 49, No. 1, 48-74
- Brayton, F. and Tinsley, P. (1996) A guide to FRB/US: a macroeconomic model of the United States, Finance and Economics Discussion Series 96-42, Board of Governors of the Federal Reserve System (U.S.)
- Brubakk, L., Husebø, T. A., Maih, J., Olsen, K. and Østnor, M. (2006) Finding NEMO: Documentation of the Norwegian economy model, Staff Memo 2006/6
- Dølvik, J. E. and Eldring, L. (2008) Arbeidsmobilitet fra de nye EU-landene til Norden – utviklingstrekk og konsekvenser. TemaNord 2008:502, Nordisk Ministerråd, København
- Edge, T. M, Kiley, M. T. and Laforde, J-P. (2007) Natural Rate Measures in an Estimated DSGE Model of the US Economy. Federal Reserve Board, March 2007

- Englander, A. S. and Stone, G. (1989) Inflation expectations surveys as predictors of inflation and behavior in financial and labor markets, Federal Reserve Bank of New York Quarterly Review, 1989, pp. 20-32, Fall
- Erceg, C. J., Guerrieri, L. and Gust, C. (2006) SIGMA: a new open economy model for policy analysis, Board of Governors, International Finance Discussion Papers, 2006 n.835
- Evans, G. W. and Honkapohja, S. (2001) *Learning and Expectations in Macroeconomics*, Princeton University Press, 2001
- Evans, G. W. and Ramey, G. (2006) Adaptive expectations, Underparametrization and the Lucas Critique, *Journal of Monetary Economics*, vol. 53, No. 2, pp. 249-264
- Gaure, S. and Røed K. (2007) How Tight is the Labour Market? Sources of Changes in the Aggregate Exit Rate from Unemployment across the Business Cycle. *Journal of Business Cycle Measurement and Analysis*, Vol., 3 (2007), No. 2
- Gjedrem, Svein (2003) Finansiell stabilitet, formuespriser og pengepolitikk. Speech for Centre of Monetary Economics, 3 June 2003
- Gnocchi, S. (2006) Optimal simple monetary policy rules and non-atomistic wage setters in a New-Keynesian framework, Working Paper Series 690, European Central Bank
- Holden, S. (2005) Monetary regimes and the co-ordination of wage setting. *European Economic Review*, Vol. 49, 833-843
- Husebø, T. A., McCaw, S., Olsen, K. and Røisland, Ø. (2004) A small, calibrated macromodel to support inflation targeting at Norges Bank. Staff Memo No 2004/3, Norges Bank
- IMF (2007) Norway 2007 Article IV Consultation for Norway, Preliminary Conclusions of the Mission. March 2007
- Jakab, Z. and Világi, B. (2007) An Estimated DSGE Model of the Hungarian Economy, mimeo
- Kallum, J-R., Sjøtil, M. B. and Haugland, K. (2005) Norges Banks regionale nettverk. Penger og Kreditt, Vol. 22 No. 2, 91-97, Norges Bank
- Kilponen J., Kinnunen H. and Ripatti A. (2006), Population ageing in a small open economy – some policy experiments with a tractable general equilibrium model, Bank of Finland Discussion Papers 2006/28

- Kilponen J. and Ripatti A. (2005) Labour and product market competition in a small open economy – Simulation results using a DGE model of the Finnish economy, Bank of Finland Discussion Papers 2005/5
- Kloster, A. and Solberg-Johansen, K. (2006) Prognosearbeidet i Norges Bank. Penger og Kreditt, Vol. 34, No. 2, 76-86, Norges Bank
- Lunde, H. and Grini, K. H. (2007) Bonus – hvor mye og til hvem? Rapporter 2007/18, Statistisk sentralbyrå
- Mehra, Y. P. (2002) Survey measures of expected inflation : revisiting the issues of predictive content and rationality, *Economic Quarterly*, 2002, pp 17-36
- Muth, J. A. (1961) Rational Expectations and the Theory of Price Movements, *Econometrica*, Vol.29,6, pp.315-35
- Nakov A. and Pescatori A. (2007.) *Oil and the Great Moderation*, Banco de España Research Paper No. WP-0735
- Norges Bank (2006) Inflation Report 3-2006. November 2006
- Norges Bank (2007) Monetary Policy Reports 1, 2 and 3 2007
- Norges Bank Watch, previous reports. Centre for Monetary Economics at BI, Oslo
- Nymoen, R. (2005) Evaluating a Central Banks Recent Forecast Failure. Memorandum No. 22/2005, Department of Economics, University of Oslo
- Nymoen, R. and Tveter, E. (2007) Er Norges Banks pengepolitiske model en god nok model for norske økonomi? *Økonomisk Forum*, nr. 5 2007
- Nymoen, R. (2007) An evaluation of automatized econometric forecasts (AIF) for Norwegian core inflation for the periode 2004q2-2007q3. Unpublished. Available from [http://folk.uio.no/rnymoen/AIF\\_evaluation\\_231107.pdf](http://folk.uio.no/rnymoen/AIF_evaluation_231107.pdf)
- Orphanides, A. (2001) Monetary Policy Rules Based on Bad Real-Time Data. *American Economic Review*, Vol. 91, No. 4, 964-985
- Orphanides, A. and Williams, J. C. (2004) The Decline of Activist Stabilization Policy: Natural Rate Misperceptions, Learning, and. Expectations, Board of Governors of the Federal Reserve System, (U.S.), International Finance Discussion Papers, 2004, n. 804
- Roberts, J. M. (1995) New Keynesian Economics and the Phillips Curve, *Journal of Money, Credit and Banking*, Vol. 27, pp. 975-984
- Roberts, J. M. (1997) Is inflation sticky? *Journal of Monetary Economics*, vol. 39., N.2, pp. 173-196



- Røed, K. and Westlie, L. (2007) Unemployment Insurance in Welfare States: Soft Constraints and Mild Sanctions. IZA Discussion Paper No. 2877
- Smets, F. and Wouters, R. (2004) Forecasting with a Bayesian DSGE Model: An Application to the Euro Area (November 2004). CEPR Discussion Paper No. 4749
- Stensnes, K. and Stølen, N. M. (2007) Pension Reform in Norway. Microsimulating effects on government expenditures, labour supply incentives and benefit distribution. Discussion Papers 524 – Statistics Norway
- Taylor, John B (2007) Housing and Monetary Policy. Jackson Hole September 2007
- Thomas, L. B. (1999) Survey Measures of Expected U.S. Inflation, *Journal of Economic Perspectives*, Vol. 13, n.4, pp. 125-144, Fall