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## Communicating monetary policy intentions: The case of Norges Bank

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# Communicating Monetary Policy Intentions: The Case of Norges Bank<sup>\*</sup>

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## **Abstract**

Monetary policy works mainly through private agents' expectations. How precisely future policy intentions are communicated has, according to theory, implications for the outcome of monetary policy. Norges Bank has gone further than most other central banks in communicating its policy intentions. The Bank publishes its own interest rate forecast, along with forecasts of inflation, the output gap, and other key variables. Moreover, Norges Bank aims to be precise about how the policy intentions are formed. The Bank currently uses optimal policy in a timeless perspective as the normative benchmark when assessing the policy intentions. Given the reaction pattern based on the timeless perspective, the Bank identifies and explains the factors that bring about a change in the interest rate forecast from one Monetary Policy Report to the next. The main arguments for publishing the interest rate forecast are discussed and validated against three years of experience with such forecasts. In this paper, we find evidence of reduced volatility in market interest rates on the days with interest rate decisions, which suggests that communicating policy intentions more precisely improves the market participants' understanding of the central bank's reaction pattern.

**Keywords:** Transparency, optimal monetary policy, interest rate forecasts

**JEL Codes:** E52, E58

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<sup>\*</sup> The views expressed are the views of the authors, and not necessarily the views of Norges Bank. We would like to thank Andy Levin, Rick Mishkin, Lars Svensson and Michael Woodford for useful comments and discussions.

## 1 Introduction

It is now widely accepted that monetary policy works mainly through private agents' expectations. The widespread influence of the New Classical Synthesis (New-Keyensian 'model') in academic research on monetary policy and the trend towards using DSGE models in central banks have underpinned the focus on expectations. Woodford (2005) puts it in a clear-cut way: "*For not only do expectations about policy matter, [...] very little else matters*". The interest rate set by central banks is normally a very short-term interest rate, which in itself has minor effects on economic decisions. It is mainly expectations about future policy rates that affect market interest rates and thus economic decisions.

Most central banks communicate future policy intentions in one way or another. The majority of central banks communicate indirectly through forecasts based on technical interest rate assumptions, and by giving verbal signals about future interest rate decisions in policy statements and speeches. With such indirect communication, the market participants gain information about the *sign* of the future interest rate decisions, but may have less information about the *size*. Until November 2005, Norges Bank used technical interest rate assumptions in the monetary policy reports. Since then, the Bank has used endogenous interest rate forecasts. Norges Bank was the second central bank that started publishing interest rate forecasts, following the Reserve Bank of New Zealand which introduced it in 1997.<sup>2</sup> More recently, also the Swedish Riksbank and the Czech National Bank have started to publish interest rate forecasts.

The move to publication of the interest rate forecast was gradual. When using market expectations of future interest rates as a technical assumption, Norges Bank commented on how it assessed the appropriateness of market expectations. In addition, in the summer of 2004, Norges Bank started to publish a "strategy interval" of the policy rate four months ahead.<sup>3</sup> The width of the "strategy interval" is normally 1 percentage point, and the midpoint of the interval is usually interpreted as close to the point forecast of the policy rate four months ahead. Therefore, the main change when introducing explicit forecasts in November 2005 was that the Bank then started publishing forecasts of the

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<sup>2</sup> See Archer (2004, 2005) for a discussion of the New Zealand experience.

<sup>3</sup> The strategy intervals had until then been revealed ex post.

policy rates 2-3 years ahead, and not only four months ahead. There is also a formal difference between the “strategy interval” and the interest rate forecast. The forecast is presented to the Board by the Governor for discussion whereas only the strategy is formally voted on.

Being explicit about future policy intentions raises a number of issues, and there is disagreement among both academics and central bankers on whether such a high degree of transparency is beneficial or not. The key issue in the debate is whether such communication implies guidance or noise. Some of the arguments for transparency relate to the beneficial effects when private agents understand the central bank reaction function, such that market interest rates adjust appropriately to economic news.<sup>4</sup> Publishing the interest rate forecast may not be sufficient for communicating the central bank’s reaction function, as one specific forecast does not in itself convey much information about how the central bank responds to various shocks. One could argue that full transparency about future policy intentions includes three ingredients:

- (i) the forecasts,
- ii) how the central bank responds to shocks, and
- iii) the criteria that lie behind the reaction function.

The first two ingredients provide efficiency in monetary policy, in the sense that private agents knowing the central bank’s assessments and reaction function can respond appropriately to economic developments.<sup>5</sup> The third ingredient contributes to a better understanding of the objectives of monetary policy and the link between objectives and policy. This could underpin the credibility of the reaction function, and is also important for democratic accountability. In addition, the reaction function could change over time, for example due to a change in how the economy works or an improvement of the understanding of economic mechanisms. The criteria could then give some guidance to the public on how and why the reaction function might change.

The five central banks that publish their own interest rate forecasts differ somewhat in how precise they are about the reaction to shocks and the criteria behind the forecasts and reaction functions, i.e., the second and third ingredients above. Norges Bank appears to be more precise than the other central banks on these issues. For example, in each Monetary

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<sup>4</sup> Woodford (2003).

<sup>5</sup> This assumes that the signal to noise ratio in the central bank’s information is sufficiently large to prevent such information to be counterproductive, as in Morris and Shin (2002).

Policy Report, the Bank presents an “interest rate account”, which quantifies the contributions of various types of shocks on the change in the interest rate forecast from the previous Report. Moreover, Norges Bank has developed a set of criteria for a good interest rate path, which are documented in the Report.<sup>6</sup> Moreover, Norges Bank derives forecasts using optimal monetary policy in a ‘timeless perspective’ (Woodford, 1999) as a normative benchmark. The Bank has been transparent about the loss function used to derive optimal interest rate paths, although it is important to emphasise that such loss functions are simplifications of actual policy objectives.

In this paper, we describe Norges Bank’s communication approach and analyse the effects of the increased transparency on market interest rates. The paper is organised as follows: Section 2 gives an overview of the academic debate on transparency, with particular focus on the debate on publication of interest rate forecasts. In Section 3, we describe how Norges Bank communicates the forecasts, the reaction function and the criteria behind the forecasts and reaction function. We also explain how the interest rate path is modelled. Section 4 discusses Norges Bank’s experience of the new communication approach, with reference to the arguments in the academic debate. We analyse whether the new communication has had effects on the money market and find evidence of reduced volatility in market interest rates on the days with interest rate decisions after the interest rate forecasts were introduced. This suggests that the market has gained a better understanding of Norges Bank’s reaction function. Section 5 summarises.

## **2 Transparency and communication – the academic debate**

There has been a strong trend towards increased transparency in monetary policy in the last 20 years. Transparency and communication have gained considerable attention in the academic literature in recent years. Some argue that transparency is important for democratic accountability, in particular when central banks have gained more independence. However, according to Geraats (2006), transparency practices do not seem to be driven primarily by required accountability. Instead, central banks appear to have embraced transparency for its perceived economic benefits. Geraats notes that transparency can have different types of effects on economic decisions, where the distinction between *information effects* and *incentive effects* is important. Information

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<sup>6</sup> See Qvigstad (2006) for a discussion of these criteria.

effects are direct effects of information disclosure, which implies that the public gets more information and the central bank loses a potential information advantage. Incentive effects are indirect effects where information disclosure alters the behaviour of the central bank.

The increased focus on the beneficial effects of transparency reflects the development in monetary theory. The earlier view was that monetary policy could affect the real economy only to the extent the central bank could *surprise* the market participants. This view can be illustrated by the fact that before 1994, the Federal Reserve did not announce its target for the federal funds rate, and left it to the market participants to try to figure it out. Such a view could be rationalised by models based on the “Lucas supply curve”, where monetary policy could affect output and employment through unanticipated changes in inflation.

In the last decade, models based on policy surprise have been replaced by a new theoretical consensus based on the New Keynesian (New Neoclassical Synthesis) paradigm. Within this theoretical framework, monetary policy affects inflation and output mainly through expectations. By affecting private sector expectations, the central bank can achieve a better outcome of policy. Monetary policy has become “management of expectations” (Woodford, 2003). Due to the important role of expectations within the New Keynesian framework, there has been enhanced focus on the role of commitment in monetary policy. Woodford (2005) highlights the benefits of commitment, and argues that in order to achieve these benefits, central banks should be transparent about their reaction pattern. By publishing the central bank’s own forecast of the interest rate, it will be easier for private agents to confirm that the central bank follows a commitment strategy. Svensson (2006a and 2008) applies similar arguments in favour of publishing the interest rate forecast. Rudebusch and Williams (2008) provide a more thorough analytical argument within a New Keynesian model, and confirm the views of Woodford and Svensson that publishing the forecast of the interest rate path makes the private agents’ estimate of the central bank’s reaction function more precise, which improves welfare.

The literature on transparency is, however, not unambiguous as regards the merits of transparency. Morris and Shin (2002) showed in a much debated article that transparency could under certain assumptions be harmful, notably if private agents might put too much weight on public information and this information is erroneous. Svensson (2006b)

showed, however, that with realistic parameter values, the Morris and Shin finding is turned into a pro transparency result. Walsh (2007) and Gosselin, Lotz, and Wyplosz (2008) have applied similar arguments within a New Keynesian model. Walsh shows that optimal transparency decreases with the degree of accuracy in the central bank's forecasts of demand shocks, while the optimal degree of transparency increases with the accuracy of the central bank's forecasts of cost-push shocks. Gosselin, Lotz, and Wyplosz show that transparency can be harmful if the central bank's forecasts of cost-push shocks are sufficiently noisy.

Despite the above cited arguments against (full) transparency, there seems to be consensus among researchers that central banks should be as transparent as possible about their objectives. With regard to the interest rate assumption behind the inflation forecasts, there is more disagreement. As mentioned above, Woodford (2005) and Svensson (2006a and 2008) advocate publishing an endogenous interest rate path, while others are more sceptical. One commonly held view, e.g., by Mishkin (2004) and Goodhart (2005), is that publishing the central bank's interest rate forecast might lead private agents to interpret the path as an unconditional promise and thereby put too much weight on the central bank's forecast.

Mishkin and Goodhart also give a more practical argument against publishing the interest rate path: It is difficult for a monetary policy committee to agree on a whole path of future interest rates. Blinder and Wyplosz (2004) argue that the choice of interest rate assumption could depend on the type of decision-making framework in the central bank. Agreeing on a specific interest rate path is particularly difficult, they argue, in individualistic committees like e.g., the MPC in the Bank of England. However, based on the recent experience with publishing interest rate forecasts at the Riksbank, Svensson (2008) disputes the difficulty of such a committee deciding on an interest rate path.

Some have argued that policymakers themselves may put too much weight on the interest rate forecast when the forecast is published, in the sense that they may feel too constrained by the published interest rate path, particularly if publishing the interest rate path turns into prestige. It may then be more difficult to adapt the interest rate to economic developments. Gersbach and Hahn (2008) model this as a penalty for deviating from the forecasts in the central bank's loss function and find that the announcement of future interest rates is socially detrimental. We will show in Section 5, however, that

Norges Bank's forecasts have indeed been adjusted when economic developments have deviated from expectations. We would argue that deviating from the announced interest rate forecast is not perceived as costly to the central bank as long as it is possible to give plausible reasons for it. On the contrary, we would argue that *not* responding appropriately to new developments would harm the central bank's credibility far more than letting the interest rate deviate from the forecast. The decomposition of changes in the interest rate forecast described in section 3.2 gives a framework for explaining in some detail why the interest rate forecast has changed. The fan chart around the forecast also indicates that such changes are likely to occur.

In addition to the theoretical and practical arguments against publishing the central bank's own interest rate forecast, there is an empirical argument. An implicit assumption behind the rationale for providing such information is that a clear communication of the central bank's interest rate intentions affects longer term market interest rates. In other words, the expectations theory of the yield curve is assumed to work. However, the expectations theory has previously been rejected in econometric studies. (See, e.g., Shiller, Campbell, and Schoenholz (1983) and Bekaert and Hodrick (2001)). However, based on identification of different types of shocks, Roush (2007) argues that the results are more nuanced. For example, Roush finds that the expectations theory works for monetary policy shocks, while it fails for aggregate supply shocks. As long as it holds for monetary shocks, however, the assumption behind the rationale for an interest rate forecast seems valid. This finding also fits well with the experiences of Norges Bank, which we shall discuss in section 5.

The empirical literature on the effects of publishing interest rate forecasts is not vast. As no central bank has a long history of publishing interest rate forecasts, with the notable exception of the Reserve Bank of New Zealand, there are few empirical studies on this specific topic. Most of the empirical literature on transparency deals with aspects of transparency other than publication of interest rate forecasts, for example transparency about inflation targets, verbal communication, voting records etc. The ultimate objective of monetary policy is to provide a credible nominal anchor and, given that, contribute to macroeconomic stability. Transparency and communication can be regarded as a means to achieve the ultimate objective. Chortareas, Stasavage and Sterne (2002) and Cecchetti and Krause (2002), and Geraats, Eijffinger and van der Cruysen (2006) find that transparency makes monetary policy more credible and better capable of achieving the ultimate

objective. They do not, however, consider the last step of publishing the central bank's interest rate forecasts.

A large part of the empirical literature on communication considers predictability of monetary policy. If monetary policy becomes more predictable, there will be less volatility in market interest rates, and monetary policy becomes more effective. Evidence of improved monetary policy predictability due to transparency is provided by Muller and Zelmer (1999), Haldane and Read (1999), Poole and Rasche (2003), Fracasso et al (2003), and Bernoth and von Hagen (2004). We know of only two studies that consider the role of interest rate forecasts. Ferrero and Secchi (2007) study the effects of announcing future policy intentions, with focus on the Reserve Bank of New Zealand. Volatility in short-term money market rates on the days of interest rate decisions has decreased along with the introduction of qualitative and quantitative announcements on future policy intentions. There are too few observations to discriminate between qualitative and quantitative announcements in Ferrero and Secchi's study. Moessner and Nelson (2008) study the effects of communication in the US, the euro area, and New Zealand, and find that communication influences market rates. Moreover, they do not find any evidence that interest rate forecasts impair the functioning of financial markets, which has been claimed in the academic debate.

We will expect that future academic work on transparency and communication will depend on the experiences of central banks. The tendency towards greater transparency continues, and the practice of publishing the central bank's own forecast of the interest rate seems to be the next step in this process, that increasingly is gaining terrain both among researchers and practitioners.

### **3 Communication approach**

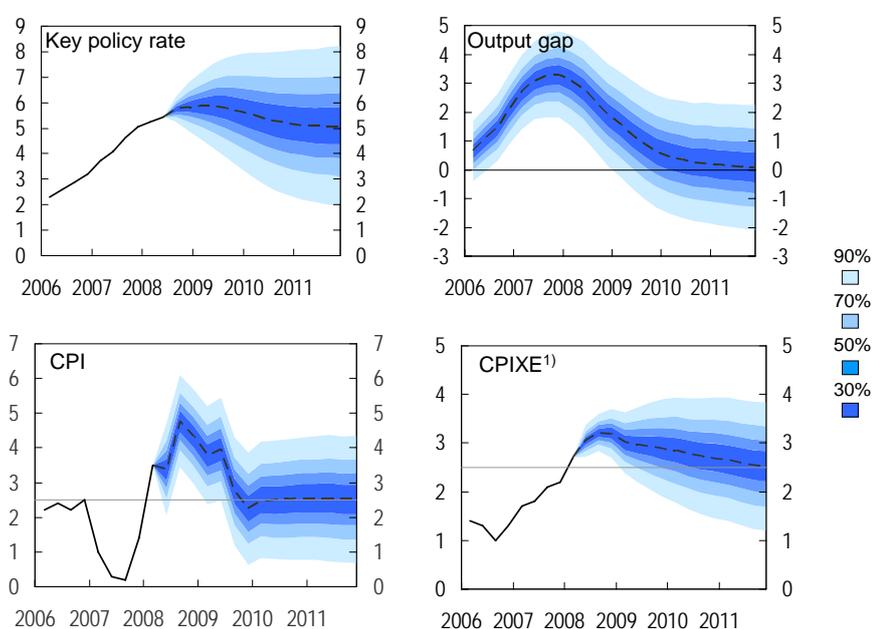
We will in the following describe how Norges Bank communicates the forecasts, the reaction function, and the criteria and assessments behind the chosen interest rate path and compare our approach with that of comparable central banks.

#### **3.1 The forecasts**

Today, the central banks in New Zealand, Norway, Sweden and the Czech Republic publish forecasts based on an explicit endogenous interest rate path. Norges Bank and

Sveriges Riksbank have forecasts of the policy rate, while the Reserve Bank of New Zealand and the Czech National Bank have forecasts of the money market rate, i.e., the 90-day interest rate and the 3-month PRIBOR respectively.

Among the central banks publishing interest rate forecasts, all but the Reserve Bank of New Zealand present a probability distribution (“fan chart”) around the point forecast of the interest rate. Communicating uncertainty through fan charts in the inflation reports was introduced by the Bank of England in 1997. The fan charts for inflation were meant “to convey to the reader a more accurate representation of the Bank’s subjective assessment of medium-term inflationary pressures, without suggesting a degree of precision that would be spurious.” (Britton, Fisher and Whitley, 1998). While the fan charts for inflation illustrated that inflation could not be controlled perfectly by the central bank, this argument does not apply for the policy interest rate. The fan chart for the interest rate serves, however, a different purpose. It illustrates that the interest rate path is not a promise, but a forecast which is conditional on the outcomes of the other variables which are uncertain. Moreover, it reflects that the central bank adjusts the interest rate as a response to economic developments which are subject to uncertainty.



<sup>1)</sup> CPIXE: CPI adusted for tax changes and excluding temporary fluctuations in energy prices

**Figure 3.1** Baseline scenario in *Monetary Policy Report 2/08*.

Figure 3.1 shows Norges Banks' forecasts of the key variables. As will be explained in Section 5, the forecasts are based on a DSGE-model using optimal policy in a "timeless perspective" as a normative benchmark.

The fan charts for the key macroeconomic variables, including the interest rate, in Norges Bank's Monetary Policy Report are based on model simulations, where the shocks are identified using a small macro model<sup>7</sup> and historical variances of the shocks.

### 3.2 Reaction to new developments

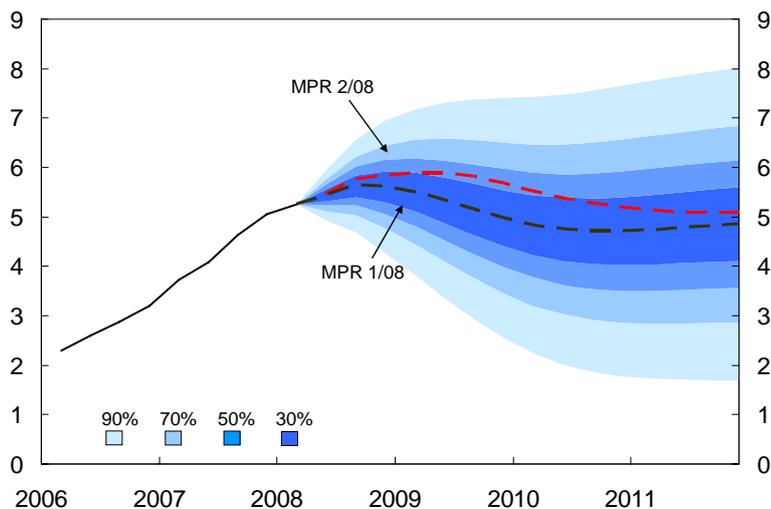
Monetary policy becomes more effective if market participants can react adequately to economic news. The forecast is not in itself sufficient to disclose the central bank's reaction pattern in the case of unexpected disturbances to the economy. In order to convey a broader reaction pattern, some central banks, including Norges Bank, indicate how the bank would react should certain disturbances occur. However, since no central bank follows a specific reaction function mechanically, it would be misleading to present a single reaction function specified mathematically. Judgement is always applied when responding to shocks, and a specific reaction function will give a very simplified representation of the reaction pattern. There is thus a risk of on the one hand misguided precision and on the other hand uninformative generality. Norges Bank tries to balance these risks by supplying various approaches to communicating the reaction pattern.

First, the Bank presents alternative scenarios in the Monetary Policy Report, as in Figure 3.2 where the interest rate response to a positive and a negative shock to inflation are illustrated. The exact specification of the shocks in the illustrations can differ somewhat from one Report to the next, but the shifts in the interest rate, and the corresponding scenarios for inflation and the output gap give an indication of how the Bank responds.<sup>8</sup> The shifts are specified such that, if shocks of the same type and size should occur, the alternative interest rate path is the Bank's best estimate of how the interest rate would be set in such a situation. The shifts are consistent with the main scenario in the sense that they are based on the same loss function guiding the response of the central bank.

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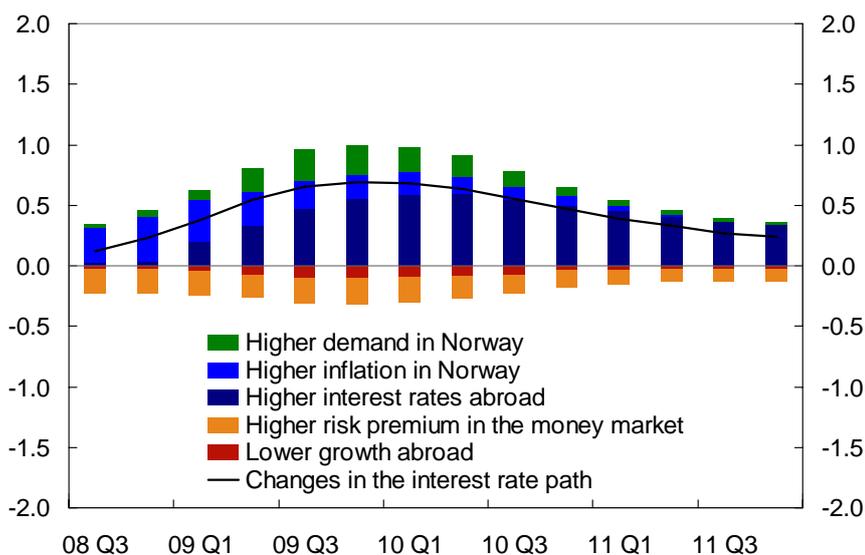
<sup>7</sup> Husebø *et al.* (2004).

<sup>8</sup> The introduction of DSGE models allows for a more detailed and precise approach to different kinds of inflation shocks, e.g. to distinguish between cost-push shocks and mark-up shocks that potentially may call for quantitatively different policy actions.



**Figure 3.2.** Alternative paths for the key policy rate with lower inflation and with high price and cost inflation. *Monetary Policy Report 2/08*

In addition to presenting policy reactions to new developments, the Monetary Policy Reports include an account of the disturbances that have led to a change in the interest rate forecast from the previous report. This “interest rate account” is represented in Figure 3.3.



**Figure 3.3.** Factors behind changes in the interest rate path from *Monetary Policy Report 1/08* to *Monetary Policy Report 2/08*. Percentage points.

The “interest rate account” is a technical model-based illustration of how the change in the interest rate forecast from the previous report can be decomposed by different exogenous shocks to the model. The illustration shows how changes in the assessment of international and domestic economic variables as well as changes in the shock processes have affected the interest rate path. The decomposition is based on the Bank’s DSGE model NEMO, where the various exogenous shocks are categorised according to what parts of the model they enter, using a simple economic model to study the effects.<sup>9</sup> Since the “interest rate account” follows from a specific model, the exact decomposition is model-dependent and should thus be interpreted as a model-based illustration rather than a precise description of the Executive Board’s reaction pattern. Notwithstanding this reservation, the “interest rate account” serves several useful purposes. First, it gives information about the reaction function. Second, it provides a compact summary of the Monetary Policy Report. Third, it is a tool for communicating commitment. As will be explained in the next Section, Norges Bank’s forecasts imply clear elements of commitment. When the central bank commits to a time-inconsistent reaction pattern, a change in the interest rate forecast should reflect economic news and not re-optimisation of monetary policy. With an “interest rate account”, the public is better able to check whether the central bank responds to news only or whether it re-optimises.

### **3.3 The criteria and assessments**

Most of the central banks that publish interest rate forecasts communicate the criteria and assessments behind the interest rate forecast in quite general terms. For example, the Riksbank communicates the criteria behind the forecasts as follows: *“The Riksbank’s forecasts are based on the assumption that the repo rate will develop in such a way that monetary policy can be regarded as well-balanced. In the normal case, a well-balanced monetary policy means that inflation is close to the inflation target two years ahead without there being excessive fluctuations in inflation and the real economy.”*<sup>10</sup>

Norges Bank aims at communicating the criteria and assessments as precisely as possible, without limiting the Board members’ room for manoeuvre. The Bank has developed a set of criteria for an appropriate interest rate path. The criteria serve both the purpose of communicating the reasoning behind the interest rate path to the public, and of providing an agenda for the Board’s discussion, which makes it easier to decide on a particular path.

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<sup>9</sup> For an overview of NEMO, see Brubakk *et al.* (2006).

<sup>10</sup> See p.3 in the Riksbank’s Monetary Policy Report.

### 3.3.1 The five criteria

The criteria used by Norges Bank to assess the interest rate reflect the general policymakers' views and assessments. They are therefore not "carved in stone", but can be changed and modified due to new insights. Currently, the Bank uses five criteria, which can be summarised as follows:<sup>11</sup>

#### *1. Achievement of the inflation target*

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. Reasonable balance between the inflation gap and the output gap*

Norges Bank conducts flexible inflation targeting, which implies that stabilising inflation around the target should be weighed against stability in the real economy. The chosen interest rate path should therefore imply a reasonable balance between the objectives if there is a conflict in the short term between stabilising inflation around the target and stabilising the real economy. What is meant by a "reasonable" balance is obviously a matter of judgement and is an important element in the Board's discussions.

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. Robustness*

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. Designing a robust policy is clearly a challenging task, and the literature on robustness does not provide any clear guidance. Even if some results in the literature, in particular the part applying robust control techniques, find the policy should be more aggressive under uncertainty, most policymakers would probably apply a more cautious policy, in line with the Brainard (1967) principle. This approach follows Blinder's (1998) description of a good monetary

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<sup>11</sup> See Qvigstad (2006) for a more thorough discussion of the criteria.

policy, where central banks should calculate the change in policy required to “get it right” and then do less. An important exception is when there is uncertainty about the credibility of the policy regime.

#### *4. Gradualism and consistency*

Interest rate adjustments should normally be gradual and consistent with the Bank’s previous response pattern. Gradualism may have several interpretations. First, although gradualism is not exactly the same as Brainard attenuation, gradualism could be interpreted as a way of operating within an uncertain terrain. Second, gradualism may also be motivated by financial stability concerns. Large shifts in the interest rate could lead to large movements in asset prices and higher risks of financial instability. This relationship is, however, not unambiguous, as a (very) gradual policy might in some cases not prevent the build-up of financial imbalances. Third, a gradual approach is consistent with the “history-dependence” which characterises optimal policy under commitment, as shown by Woodford (1999).

It is frequently debated in the literature what could be the reason for the apparent practice of interest rate smoothing. Rudebusch (2006) argues that the apparent weight on interest rate smoothing in estimated reaction functions may be a result of an estimation bias due to missing variables rather than reflecting true interest rate smoothing. We will not go deeply into the debate about how the apparent gradualism in interest rate setting should be interpreted, but rather assert that policymakers seem to prefer interest rate paths that do not include large shifts in the interest rate.

#### *5. Cross-checking*

It is important to cross-check the Board’s judgements on the interest rate path against other information. One natural cross-check is market expectations about the future interest rate, as represented by implied forward interest rates (adjusted for risk and term premia). In addition, simple interest rate rules like the Taylor rule and other variants suggested in the literature provide potentially useful cross-checks.

### 3.3.2 Taking the criteria to the model

To ensure consistency, the Bank produces the forecasts using a core macroeconomic model,<sup>12</sup> but where considerable judgments are applied. One important issue that arises is how to model monetary policy. With exogenous interest rate assumptions, like constant rate or implied forward rates, the problem of modelling monetary policy is not on the table, even though such exogenous assumptions may be highly problematic in a DSGE model when the interest rate is assigned the task of anchoring inflation. When publishing the Bank's own interest rate forecasts, however, one has to consider how to model the interest rate. In the literature, there are two common ways to model monetary policy: either by a simple interest rate rule, or by optimal monetary policy, in the sense of minimising a loss function.

When Norges Bank started to publish interest rate forecasts, the interest rate was first modelled by a generalised Taylor rule of the following type:

$$i_t = \rho i_{t-1} + (1 - \rho)[r_t^* + \pi^* + \alpha_1(E_t \pi_{t+k} - \pi^*) + \alpha_2 E_t(y_{t+i} - \phi y_{t+i-1})] \quad (3.1)$$

where  $i_t$  is the nominal interest rate,  $r_t^*$  is the neutral real interest rate,  $\pi_t$  is the inflation rate,  $\pi^*$  is the inflation target, and  $y_t$  is the output gap. The rule opens up for having both the level and the change of the output gap, depending on the coefficient  $\phi$ . This type of rule has been shown to perform reasonably well in a variety of models, and is the most commonly used way to specify monetary policy in forecasting models. Among the other central banks publishing interest rate forecasts, the Reserve Bank of New Zealand and the Riksbank model the interest rate path using such rules.<sup>13</sup> In addition to serving as a normative benchmark, estimated Taylor rules can give a good representation of actual monetary policy.<sup>14</sup> However, because of the normative aspect of the interest rate forecast, it may be wrong to apply a specification that “fits” the historic interest rate pattern. In practice, one has to find a specification that provides the maximum achievement of the central bank's objectives.

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<sup>12</sup> From 2008 the core model is a medium-sized DSGE model, see Brubakk *et al.* (2006) for a description. Until the end of 2007, the Bank has used a smaller model with “New Keynesian” features but with no explicit micro foundation, see Husebø *et al.* (2005).

<sup>13</sup> See Hampton (2002), and the Riksbank's Monetary Policy Report 1/2007.

<sup>14</sup> Examples of both applications of the rules are found in Taylor (ed.) (1999).

Since the interest rate path should reflect the decision-makers' assessments, the staff's role is to make forecasts that incorporate these assessments. This implies that one should specify the interest rate rule such that the forecasts "look good" in the eyes of the decision-makers. There is, however, a pitfall of choosing the coefficients in the rule such that the forecasts "look good". In models with forward-looking expectations, there is in general a time-inconsistency problem, which implies that a policy based on discretion gives a different outcome than with commitment. When forecasts are made, it is commonly assumed that the central bank follows the chosen rule in the future. However, a specification of a rule that makes forecasts "look good" today may not appear as an appropriate specification in the future. There is then an incentive to "re-optimize" by choosing a different specification of the rule in the future. When modelling the interest rate, the question of commitment cannot be omitted. If the central bank is able to commit to a specific reaction pattern, inflation can be controlled more efficiently, and the central bank can improve the achievement of its objectives. However, honouring past commitments may lead to monetary policy looking sub-optimal today, and the central bank risks criticism for this.

Modelling monetary policy by an interest rate rule like (1.1) has the advantage of being simple, intuitive and easy to implement in the model. It has, however, at least two disadvantages. First, it does not address the time-inconsistency problem explicitly. Second, due to its simplicity it is not "optimal" in the sense of fully minimising a loss function. These disadvantages have led Norges Bank's staff to model the interest rate through optimal policy. Simple rules are, however, still used as cross-checks.

When computing optimal policy, one needs to specify a loss function. The second criterion for an appropriate interest rate path, as discussed above, could be interpreted as minimising a standard loss function with the inflation gap and the output gap as arguments. In practice, minimising a loss function with the inflation gap and the output gap as the only arguments often leads to quite aggressive interest rate responses to shocks and may therefore not satisfy criteria 3 and 4.<sup>15</sup> To derive reasonable interest rate paths, i.e., paths that do not look unacceptable to the policymakers at first glance, our experience is that we need to add an interest rate smoothing term in the loss function. Norges Bank uses the following loss function when computing optimal monetary policy:

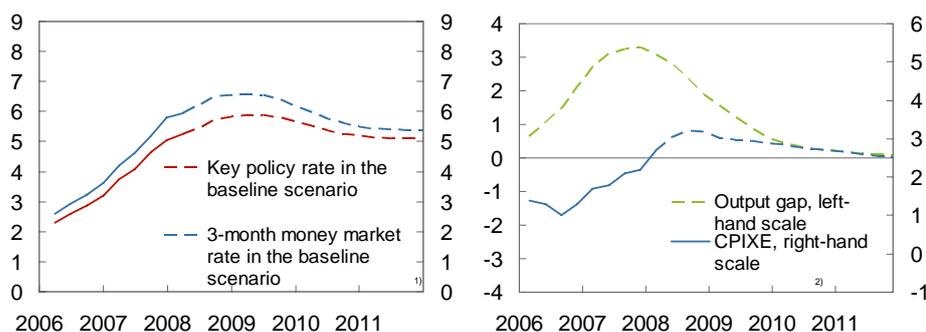
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<sup>15</sup> This is a larger problem with minimisation under discretion than under commitment in a timeless perspective, as in the latter case the interest rate is more inertial and the immediate shock response is smaller.

$$(3.2) \quad E_t \sum_{k=0}^{\infty} \beta^k [(\pi_{t+k} - \pi^*)^2 + \lambda y_{t+k}^2 + \gamma (i_t - i_{t-1})^2]$$

With micro-founded DSGE-models, it is possible to derive true welfare loss functions based on utility maximisation. However, such welfare functions are very model-specific, and the Bank has therefore chosen to use the standard *ad hoc* loss function (3.2) until the research on utility-based welfare loss function has advanced further.

When computing optimal policy, one has to be explicit about commitment versus discretion. According to New Keynesian theory, a commitment policy would imply that after a negative inflation shock, monetary policy should continue being expansionary also after the effect of the shock has disappeared, such that inflation will overshoot the inflation target.<sup>16</sup> The intuition is that when price-setters are forward-looking, they take the future expansionary policy into account, so that they do not reduce prices as much when the shock occurs as they would have done if they did not expect an expansionary monetary policy in the future. The overshooting of the inflation target is, however, time-inconsistent, as the gain from commitment was realised when the shock occurred and honouring the commitment would feel costly.



1) Projected key policy rate including projected risk premium in the 3-month money market rate.

2) CPI adjusted for tax changes and excluding temporary changes in energy prices.

**Figure 3.4.** Forecasts in the *Monetary Policy Report 2/08*

<sup>16</sup> In the canonical New Keynesian model with a standard loss function, the overshooting of the inflation target is such that the price level becomes stationary, see Clarida, Gali and Gertler (1999).

Figure 3.4 shows that Norges Bank's forecasts have clear elements of commitment. The negative shocks to inflation in the period 2003 – 2006 implied that a commitment policy should not only bring inflation up to the target, but above the target for a period. A discretionary policy would have implied a more contractionary policy to prevent inflation from overshooting the target.

When minimising the loss function under commitment, one has to consider what type of commitment one assumes that the central bank makes. Two often discussed types of commitment is a) the “Ramsey rule”, where the central bank exploits the initial conditions, but commits in all future periods, and b) the timeless perspective, suggested by Woodford (1999), where the central bank acts as if it made the commitment far in the past. The Ramsey rule has the advantage that it, by construction, gives the lowest expected loss from today onwards. The rule is, however, dynamically inconsistent, as pointed out by Woodford, since it treats the initial period differently than the subsequent periods. Although alternative types of commitment solutions have been proposed, see e.g., Blake (2001) and McCallum (2005), the timeless perspective has received considerable attention as a solution to the dynamic inconsistency of the Ramsey rule.<sup>17</sup> From the point of view of monetary policymakers, the timeless perspective seems more adequate because of its dynamic consistency. Moreover, it may be argued that it is easier to establish credibility with a timeless policy than a policy where the central bank optimises in the first period. For these reasons, Norges Bank has since 2006 been using optimal policy in a timeless perspective as a normative benchmark when developing the interest rate forecasts.

A challenge to applying the timeless perspective in a medium-scale DSGE model is that the lagged Lagrange multipliers corresponding to the constraints on forward-looking variables need to be estimated. The Lagrange multipliers have been estimated assuming that they were zero at a point sufficiently long ago and by inserting the subsequent estimated shocks and state-variables into the law of motion for the multipliers. This implies an assumption of optimal policy in the past. See Adolfson *et al.* (2008) for details about this method and for alternative methods of estimating the Lagrange multipliers.

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<sup>17</sup> Although dynamically consistent, the timeless perspective is still time-inconsistent, since the policymaker has an incentive to re-optimize.

It may be argued that full commitment is too strong an assumption about central bank behaviour. Therefore, the staff also derives forecasts assuming “loose commitment” (or “quasi-commitment”) based on the work by Debortoli and Nunes (2006) and Schaumberg and Tambalotti (2007), where it is assumed that there is a given probability that the central bank re-optimises.<sup>18</sup>

One of the tasks of the staff is to alert the Board if the preferences on inflation stability versus output stability appear to have changed. To do this, the modelling team at the Bank calibrates the weights in the loss function such that the forecasts under optimal policy in a timeless perspective replicate the Bank’s actual forecasts. Then, when new shocks have occurred and the Bank has produced new forecasts, one can check whether the preferences revealed in the new forecasts are consistent with those of the previous forecasts. Having constant preferences (weights) is not a goal in itself, but the Bank finds it useful to be explicit about it when they appear to have changed. The optimal policy approach is also essential for the “interest rate account”, cf. section 3.2, since it is able to distinguish between changes in the interest rate path due to new economic developments and changes due to a shift in policy preferences.

#### **4. Does publishing interest rate forecasts matter?**

As discussed in Section 2, communication can be thought of as a means to contribute to achievement of the ultimate objective of monetary policy. The period of publishing interest rate forecasts in Norway is too short to analyse possible effects on credibility and price stability. In order to analyse whether the new communication approach has had any beneficial effects, we consider some more indirect measures of credibility. First, one may argue that monetary policy can affect output and inflation more efficiently if it is able to manage market expectations. An indirect test of credibility is then to check whether market expectations of future interest rates are aligned with the central bank’s interest rate forecast. Second, as argued by Woodford (2005), it is important that private agents understand the central bank’s reaction pattern in order to achieve the gains from commitment. One test of whether the reaction function is understood by the market is that there are normally small jumps in market interest rates when the central bank announces

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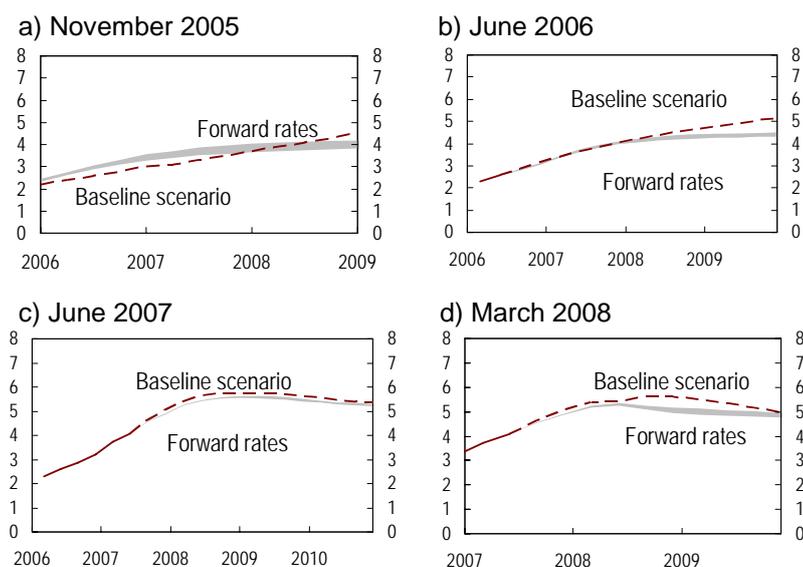
<sup>18</sup> We thank Davide Debortoli for implementing the codes on loose commitment in Norges Bank’s modelling framework.

the policy decisions. We shall thus test whether there has been increased predictability of monetary policy after the introduction of interest rate forecasts.

#### **4.1 Are market expectations aligned with the forecast?**

The panel in Figure 4.1 shows the interest rate forecasts and the market expectations, represented by implied forward rates adjusted for estimated risk and term premia. We see that the market expectations are well aligned with the Bank's forecast up to one year, but on some occasions deviate somewhat further out on the curve. This may indicate that the interest rate forecast reflects both the central bank's policy *intentions* and its forecast of the variables in the reaction function. At the short end of the interest rate path, there is less uncertainty about the variables in the reaction function, such that the forecast mainly reflects the policy intentions, which the market probably take as given. Further out on the path, there is more uncertainty about the variables in the reaction function, such as international economic developments, and a discrepancy between the central bank's interest rate forecast and market expectations might reflect different assessments of these variables. A discrepancy does therefore not necessarily reflect lack of credibility. If it indicates that the market participants do not believe in the reaction pattern that the Bank has communicated, there would be more reason to worry.

Another potential reason for the discrepancy is that the expectations theory may not hold, as discussed in Section 2. If the results from Roush (2007) hold, that is, that the expectations theory holds for monetary policy shocks, one should expect that publishing the interest rate forecast can have the desired effect on market expectations.



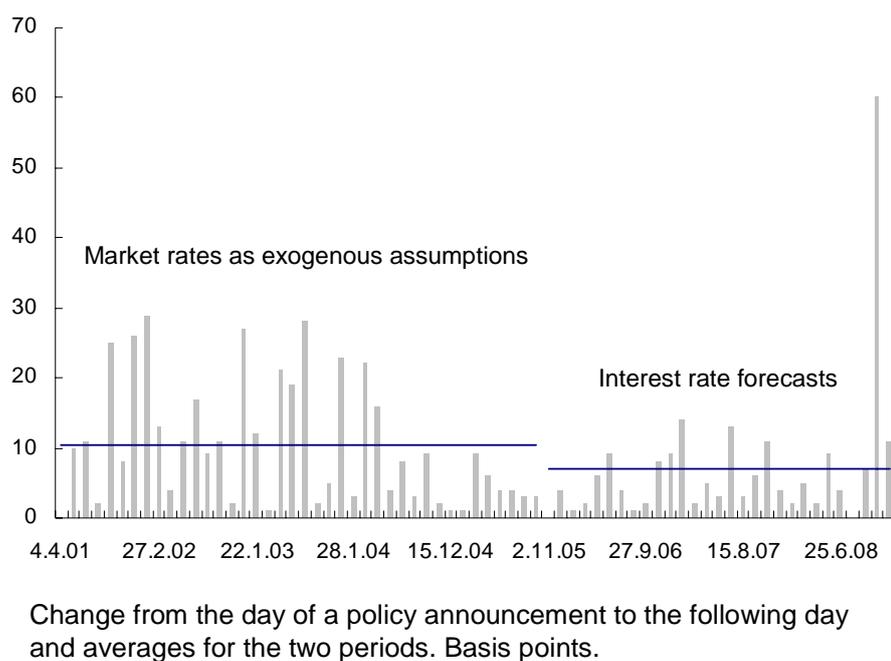
**Figure 4.1.** Market reactions after publishing monetary policy reports

#### 4.2 Has monetary policy become more predictable?

A large part of the empirical literature on transparency, briefly discussed in Section 2, considers the effect of transparency on monetary policy predictability. If the central bank's reaction function is well understood by the market, one would expect that most of the adjustments in market interest rates occur when new data arrive, and not when the central bank announces the interest rate decisions. We shall here analyse whether the introduction of more precise communication of policy intentions has resulted in less volatility in market rates on the day of interest rate decisions.

To measure volatility in market rates, we consider the change in money market rates from the day before the interest rate decision to the day after. We consider money market rates with maturities from one week up to twelve months. The interest rate announcements from Norges Bank are given at 2 pm on the days of interest rate meetings. With the Norwegian interest rate data, the changes in interest rate series are measured from the announcement day at 12.00 ( $t$ ) to 12.00 the following day ( $t+1$ ). The interest rates that are examined are the short money market rates listed above, for which absolute values of the daily changes have been computed. We have considered the period of inflation targeting in order to keep the reaction function approximately constant, but divided the sample into 2 sub-periods. The first period is from 2001, when the inflation target was introduced, to the introduction of the interest rate forecasts in November 2005. The second period covers

the period of publishing interest rate forecasts; From November 2006 up until November 20 2008. In order to control for a general change in the volatility in market rates in the period, which can not be attributed to the central bank communication, we have subtracted the median daily changes from the change in the market rates on the day of the interest rate decisions.



**Figure 4.2.** Average absolute changes the 12-months money market interest rates on key policy rate announcements. The large surprise followed an extra interest rate meeting on October 15, 2008.

Figure 4.2 shows the changes (in absolute value) in the 12-month money market rates on the days of interest rate decisions. We see that the market rate has on average reacted less to policy decisions in the period of interest rate forecasts, as illustrated by the horizontal lines. However, the figure suggests that the increased predictability of policy decisions started before the introduction of interest rate forecasts. As mentioned in the introduction, Norges Bank started to publish *ex ante* the “strategy interval” for the policy rate in 2004. This “strategy interval” could be regarded as an implicit forecast of the policy rate four months ahead. Thus, it seems to be the publication of “strategy intervals”, and not the longer-term interest rate forecasts that increased the predictability of monetary policy. This suggests that publishing the forecast of the interest rate on longer terms is less important for predictability than providing information on the short-term interest rate forecast. A possible interpretation of this is, as argued above, that the short-term forecast

of the interest rate (e.g., for the next four months) gives mainly information about policy intentions, and is less affected by economic news, while the forecast of the interest rate 1 – 3 years ahead mainly reflects the central bank’s forecast of economic developments, and less of policy intentions. Table 1 shows the tests for structural breaks in the effects on money market rates of policy decisions for different maturities.

**Table 1: Tests of differences in interest rate changes following policy announcements**

Significance of the difference in means between the two time periods  
 $P(T \leq t)$  one side

	Average for all series	12m	9m	6m	3m	2m	1m	2w	1w
Break on 2 November, 2005	0.357	<b>0.091</b>	0.159	0.308	0.329	0.195	0.388	0.443	0.329
Break on 1 July, 2004	<b>0.017</b>	<b>0.003</b>	<b>0.008</b>	<b>0.016</b>	<b>0.026</b>	<b>0.008</b>	0.120	<b>0.067</b>	0.168
Break on 1 July, 2004 and adjusted for different median changes in the two periods	<b>0.048</b>	<b>0.009</b>	<b>0.024</b>	<b>0.042</b>	0.067	<b>0.024</b>	0.209	0.140	0.250

Statistical tests confirm the impression that the publication of the strategy intervals has had a greater impact on the interest rate reactions than have the key rate forecasts. According to t-tests for two samples with assumed different or equal variances<sup>19</sup>, the changes in money market rates following policy announcements were significantly lower after the strategy interval was published *ex ante* for the money market rates in the sample longer than 1 month, see table 1. Only the 12-month money market rate shows different reactions when breaking the series in November 2005, when the key policy rate forecast was introduced, and the differences are then significant only at the 10 per cent level.

The general volatility in interest rates has varied substantially since the inflation target was introduced in Norway in 2001. The differences between the average and median changes in the interest rates in the two periods depend on the break date. When setting the break on July 1, 2004, period 2 includes a long time of extraordinarily stable interest rates, until the recent turmoil began in 2007. However, when setting the break date in November 2005, this stable period is no longer included in period 2, and the median change in the two periods is the same. To allow for these differences in general volatility in the two periods before and after July 2004, which cannot be attributed to the central bank communication, the median daily change in each interest rate series over each of the

<sup>19</sup>The two-sample t-tests, assuming either equal or different variances, were conducted after using F-tests to decide whether the variances of the interest rate series were significantly different in the two periods.

two periods was subtracted before testing the differences in responses to policy announcements. The significance is then somewhat lower for all the series, but the overall results are still the same.

Some caveats to the results on policy predictability should be mentioned. First, the measures of volatility may be misleading if the central bank is giving information about future policy decisions between the interest rate meetings. Perez -Quiros and Sicilia (2002) argue that shocks may also appear on days when there are no MPC meetings, and they find that only some 22-23% of the monetary policy surprises in the US and the Euro area appeared on the days of MPC meetings.<sup>20</sup> Norges Bank has, however, not given hints about future policy decisions since the endogenous path was introduced<sup>21</sup>, so this cannot explain the lower volatility in the second period.

Second, it could be the case that there have been other news on the same days as the interest rate decisions, which could in principle drive the results. Each announcement date has, however, been investigated to reveal special effects that may have moved the markets that day, focusing on foreign markets and domestic key figure announcements, in line with Connolly *et al* (2004). The only special event found to coincide with a policy announcement was the general unrest of financial markets in September 2001, influencing the market expectations before the interest rate decision on 19 September 2001. It is likely that the other surprises are closely related to the monetary policy announcements. The reduced market rate volatility at the time of policy announcements found above implies that policy outcomes may to a larger extent be incorporated in the market rates before the announcements. As argued in Section 2, publishing interest rate forecasts could increase market knowledge about the central bank's reaction function and enable market participants to react more in line with the central bank to economic news between the monetary policy reports.

## **5. Summary and final remarks**

Norges Bank started to publish its own interest rate forecasts in November 2005, following the Reserve Bank of New Zealand. Prior to that, the Bank published a “strategy

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<sup>20</sup> This analysis covers the period from 1999 – 2002.

<sup>21</sup> The last such hints were given by the Governor in a speech in June 2003. Despite this information, the market reactions following the subsequent policy announcement were substantial.

interval” for the policy rate four months ahead, which served as a short-term forecast of the interest rate. In addition to the forecast, Norges Bank strives to be transparent about its reaction function and the criteria used by the Board for assessing monetary policy in general and the interest rate forecast in particular. Even if several arguments against publishing the interest rate forecast have been raised in the academic literature, Norges Bank’s experiences are so far reasonably good. The market seems to understand that the interest rate path is conditional on economic developments, and monetary policy appears to have become more predictable after the Bank started to publish “strategy intervals” and interest rate forecasts. It is, however, too early to reach a final verdict on the merits of the communication approach.

One internal effect of publishing interest rate forecasts is that it provides discipline in the internal decision process and good incentives for the staff. With an endogenous interest rate path, there is a stronger link between the assessments of inputs like investment, productivity, consumption etc, and the interest rate. Each sector expert may then see more directly the implication of his or her analysis for monetary policy. Moreover, computing optimal policy in a timeless perspective in a modern DSGE model as a normative benchmark brings policy discussions closer to the research frontier. Although it is important to recognise the simplifying assumptions and limitations of DSGE models, letting the interest rate forecast be based on optimal policy in such models forces the staff and the decision makers to use modern macroeconomic theory as a framework for discussions. The staff and the decision makers have to take a stand on challenging questions like: which variables should enter the loss function? What concept of the output gap should one apply? How important is the expectations channel? What type of issues is the model not suited to address adequately? If nothing else, the Bank’s communication approach should make better economists.

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