Monetary policy in real time: the role of simple rules[1]

Kjetil Olsen, Jan Fredrik Qvigstad and Øistein Røisland,
Central Bank of Norway

Abstract

Setting the interest rate in an inflation targeting regime requires a total assessment, often translated into forecasts, of the outlook for inflation and real activity. In the assessment process, it is useful to have some references or cross-checks, in terms of *simple rules*. Although simple rules should not be followed mechanically, they provide a device for structuring and disciplining assessments. In addition, simple rules can also be useful as a checkpoint on whether or not monetary policy is "on track". The Taylor rule is one such, but is in practice difficult to calculate in real time. Data on output are often revised substantially, making real-time estimates of the output gap highly uncertain. We therefore consider alternative Taylor-type rules that do not require information about current gross domestic product (GDP). The rules are assessed by their ability to mimic the ex post Taylor rule. Despite uncertainty about the natural rate of unemployment, we find that the unemployment gap is a good indicator of the "true" output gap, ie the output gap that can be calculated ex post with the benefit of hindsight. An alternative that combines information on wage and credit growth is also able to mimic the behaviour of the ex post Taylor rule quite closely. The role of simple rules as a tool for detecting monetary policy misalignments is discussed with reference to monetary policy in Norway after 1995.

1. Introduction

It is a stylised fact that monetary policy affects inflation with long and variable lags. Moreover, although the forward-looking element of price determination has received considerable attention in the theoretical literature in recent years, there is evidence of relatively high persistence in inflation, so that current inflation is an important determinant of future inflation. These properties of the inflation process imply that inflation targeting central banks need to be forward-looking when setting the interest rate. Most inflation targeting central banks base their interest rate decisions on, and publish, forecasts of inflation and real activity. In Norway, where an inflation target of 2.5% was introduced in March 2001, the Central Bank of Norway (Norges Bank) sets the interest rate in such a way that, under most economic conditions, the interest rate is increased (decreased) if the inflation forecast two years ahead is above (below) the inflation target. The inflation forecast may therefore be interpreted as an intermediate target of monetary policy, as pointed out by Svensson (1997).

The process of producing an inflation forecast is far less mechanical in practice than commonly assumed in the theoretical literature. The inflation forecast and thus the interest rate are set on the basis of an overall assessment of the inflation outlook. In assessing the outlook, most central banks, including the Central Bank of Norway, use economic models. The outcomes from the various models are weighted together and adjusted using a considerable degree of judgment. Within a framework of inflation forecast targeting, producing an inflation forecast and deciding on the interest rate could be seen as an integrated process and are in practice two sides of the same coin. Although there is in practice hardly any alternative to this cumbersome and somewhat turbid process of producing the basis for monetary policy decisions, the approach has some limitations of which one should be aware.

---

[1] This paper was prepared for the Autumn Economists' Meeting held at the BIS on 14-15 October 2002. The views expressed in the paper are those of the authors and should not be attributed to the Central Bank of Norway. We would like to thank Bjørn Roger Wilhelmsen for data assistance.

First, the principal inputs in the assessment process are economic data. Econometric models are never better than the data on which they are built. Moreover, judgments on the economic outlook require data that give a correct picture of the current and past state of the economy. Unfortunately, many data series are not as good as one would like. In particular, data on GDP and productivity, which are important determinants of inflation, are often revised considerably relative to the first figures published (estimates). For example, national accounts data for Norway were revised substantially in June 2002. For the period 1995-99, growth in GDP for mainland Norway was revised up by on average close to 1% per year. The largest revision came for the year 1999. As late as May 2002, we believed that growth in GDP in 1999 was 1.1%. Revised figures now show a growth rate of 2.7%.

Second, there is uncertainty about the relevance of the economic models in use. Although models are rarely run without some add-factor adjustments based on judgment, the properties of economic models are often important elements in the overall assessment process, as they summarise economic theory and historical statistical correlations. However, one can never be sure that the economic relationships specified in the models will not break down or that they are not misspecified in the first place. The ghost called the Lucas critique, which may haunt econometric forecasting models, is usually invisible in real time.

Third, the central bank's forecast is not the only forecast available. Other institutions produce forecasts that may differ from those produced by the central bank. Although analytical integrity of central banks is important, one should not follow this line into arrogance by failing to pay attention to the assessments of other competent forecasters. But how the information from competing forecasts should be integrated into the central bank's own assessments is a question with no clear answer.

Due to the above-mentioned weaknesses of the assessment process leading to monetary policy decisions, there is a need for simple cross-checks that can serve as references for policy advice. The role of simple policy rules is to provide such a cross-check.

In this paper, we will first consider simple rules that can provide useful references in the assessment process. A requirement is that the rule must depend on variables that have sufficient informational content in real time. For example, the Taylor rule depends on the output gap, which is only known with some certainty after several years due to extensive revisions in GDP data series and uncertainty about trend output. We thus consider alternative simple rules that make use of variables with higher informational content in real time than the output gap. When searching for alternative real-time variables, we use the output gap estimated ex post using revised GDP data as the normative benchmark. The aim of the paper is limited to pointing towards some *potential* alternatives to the output gap in monetary policy rules and illustrating what it would have implied for the interest rate had the central bank followed such a rule. A more thorough analysis of optimal indicators of the output gap is left for future research. Moreover, we do not focus on uncertainty concerning the appropriate method of estimating the output gap. We would also like to stress that even if we use the Taylor rule as a benchmark in this exercise, it does not imply that we consider the Taylor rule with the "correct" output gap as the optimal reference for monetary policy. However, since the Taylor rule has indeed been shown to perform quite well in a variety of models, the rule satisfies some of the criteria for being a useful cross-check. After considering alternative Taylor-type rules that do not require information about the output gap, we go on to discuss whether simple rules could provide a useful device for detecting whether monetary policy is "off track".

2. Simple policy rules

A simple instrument rule is a mathematical relationship between the monetary policy instrument and some economic variables. It is important to distinguish between simple rules and optimal rules. Optimal instrument rules represent, as the name indicates, how the interest rate optimally should respond to all relevant variables given an objective function (loss function) and an economic model. With reasonably realistic models, optimal rules tend to become quite complex. Moreover, optimal rules are in general model-specific, and a rule that is optimal within one particular model may perform poorly in other models. Simple rules, however, state the instrument as a function of just a few variables. They are generally not optimal in any realistic model, but a good simple rule should be able to produce reasonably good results in a variety of models.

2.1 The Taylor rule

The best known example of a simple rule is the Taylor rule, proposed by John Taylor (1993). The Taylor rule can be written as:

$$i_t = r^* + \pi^* + \alpha(\pi_{t-n} - \pi^*) + \beta(y_{t-m} - y^*_{t-m}) \quad (2.1)$$

where i_t is the short-run nominal interest rate, r^* is the equilibrium real interest rate, π is inflation, π^* is the inflation target, y is (the log of) output (GDP) and y^* is (the log of) potential output. The subscripts $t-n$ and $t-m$ refer to the observation lag, where n and m denote how long it takes before data on output and inflation respectively are available. The original Taylor rule has the coefficients $\alpha = 1.5$ and $\beta = 0.5$. In addition to performing well in a variety of models,[2] the Taylor rule has a clear intuitive appeal, since the rule specifies that monetary policy should respond directly to what are generally considered the ultimate goal variables for monetary policy, namely inflation and output stability. In addition, the current inflation rate and output gap are determinants of future inflation. The rule may therefore seem to be an ideal reference for assessing the appropriate monetary policy stance.

Despite its attractive features, the Taylor rule has a number of weaknesses as a cross-checking device in the assessment process. First, to be operational, the rule requires estimates of both the equilibrium real interest rate and the output gap. Both are, in practice, subject to considerable uncertainty. Second, one needs to choose appropriate coefficients on inflation and the output gap, since the original coefficient values may not be appropriate for all countries. Third, the observation lag for national accounts data on GDP is quite long. Fourth, first releases of national accounts data on GDP are often erroneous. Since monetary policy assessments take place in "real time", one cannot wait for subsequent revisions. In this paper, we shall focus on the issue of data revisions and disregard uncertainty about appropriate coefficient values, uncertainty about the equilibrium real interest rate and uncertainty about the methods for estimating potential output. In particular, we will discuss alternative rules that do not require information about current GDP and are therefore potentially more robust to data uncertainty.

The output gap is the difference between actual output (GDP) and its potential level. Errors in measuring the output gap can come from both incorrect estimates of potential output and measurement errors in the national accounts data on output. Due to revisions in the data series, there are often substantial differences between the real-time estimates of the output gap and the final estimates. Using historical sources, Orphanides (1998) found that the real-time estimate of the output gap for the United States for the period 1980-92 on average was −3.99%, while the final estimate was only −1.64%. Using the original Taylor rule as a reference, this implies that the interest rate should have been on average more than 1 percentage point higher than it was. Moreover, Orphanides et al (2000) found that the measurement error in the output gap is highly persistent, so that one tends to drag earlier misperceptions into the future. Nelson and Nikolov (2001) performed a similar study for the United Kingdom and found that the average real-time estimate of the output gap in the period 1965-95 was −4.78%, while the final estimate was 0.06%. In terms of the Taylor rule, this suggests that the interest rate was on average 2.36 percentage points too low in this period.

Due to data limitations, we have not been able to produce "real-time" series for the output gap for Norway. To illustrate the problem with data revisions, we have calculated output gaps based on both the information we have now and on the information we had before national accounts figures were substantially revised earlier this year. The solid line in Graph 1 shows the "revised" output gap for Norway, ie the estimated output gap based on the information we have today.[3] The dashed line represents the "unrevised" output gap, which uses information that was available in May this year before the national accounts figures were revised. As we see, there are major discrepancies between the two output gaps, and the difference widens over time. We have reason to believe that the output gap calculations in real time would have been even more "flawed".

---

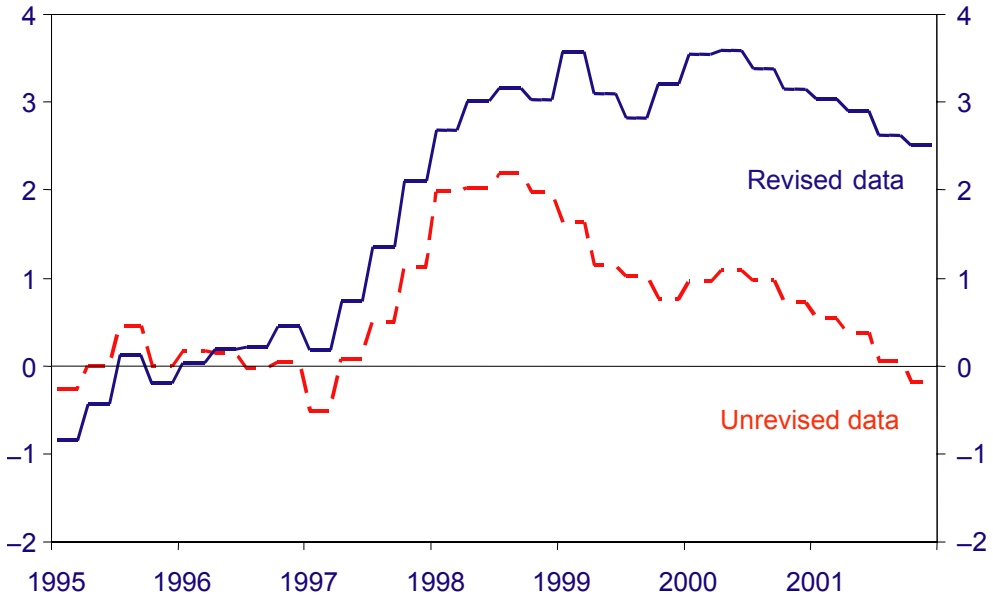
[2] See, for example, the articles collected in Taylor (1999).

[3] The output gap series were constructed using a production function method where a linear trend captures productivity growth and the development in the capital stock, which was omitted due to uncertainty about the capital stock. Specifically, potential output was estimated with OLS as $y^* = c + \alpha T + \beta H$, where c is a constant, T the trend and H the hours worked. The estimation period was 1978-98.

Graph 1

Output gap

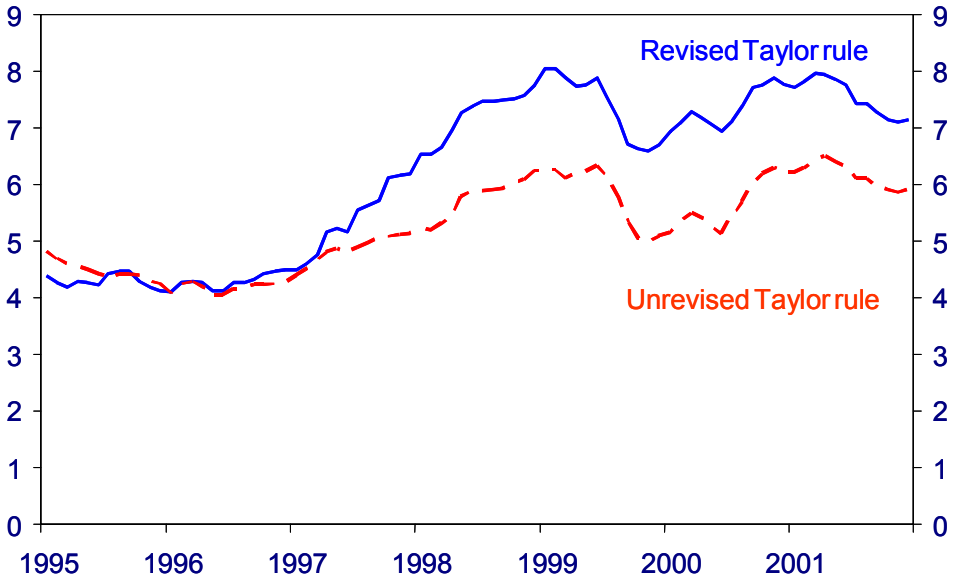
In percentages



Graph 2

Taylor rule interest rate

In percentages



Graph 2 translates the difference between the unrevised output gap and the revised output gap into the interest rate implied by the Taylor rule. As seen from the graph, the Taylor rate is on average 1.5 percentage points higher with the revised data than with real-time data in the period from 1998 to 2001.

2.2 Inflation-only rule

Uncertainty and observation lag of the output gap provide good reason to consider alternatives to the standard Taylor rule as references and cross-checks for policy advice. The most agnostic approach is simply to remove the output gap from the Taylor rule, so that the interest rate responds only to the rate of inflation:

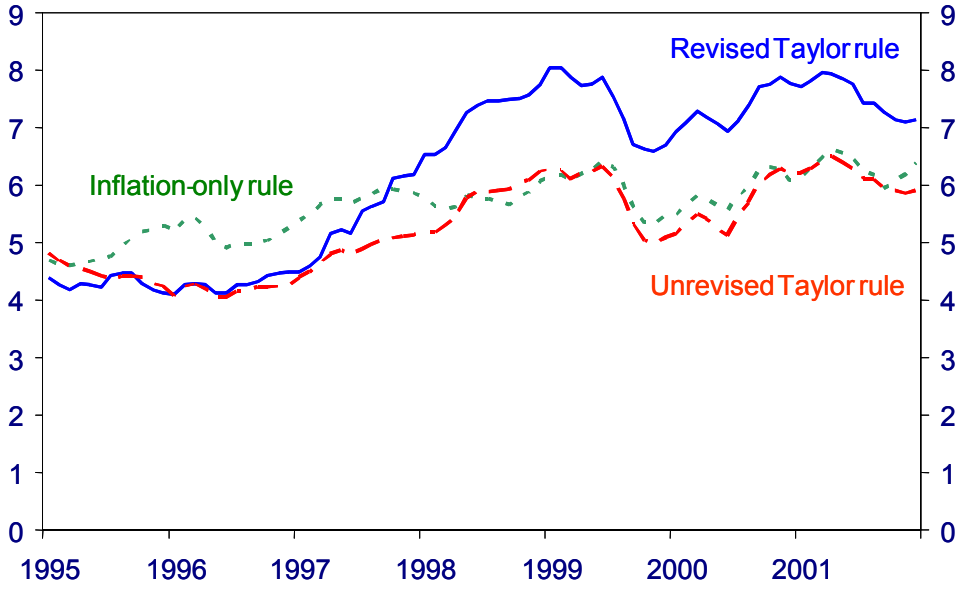
$$i_t = r^* + \pi^* + \alpha(\pi_{t-n} - \pi^*) \quad (2.2)$$

Disregarding the output gap may seem inappropriate, since the output gap is both a determinant of future inflation and a target variable itself. However, if the errors in estimating the output gap are sufficiently large, one may do worse when responding to the gap than when disregarding it. A counterfactual analysis performed by Orphanides (1999) suggests that a simple rule with only inflation outperforms a traditional Taylor rule when one takes account of the measurement errors in the output gap. Graph 3 illustrates the "inflation-only rule" in comparison with the "revised Taylor rule" and the "unrevised Taylor rule".[4] The inflation-only rule does not mimic the development in the revised Taylor rule any better than the unrevised Taylor rule. Thus, despite the attractiveness of a rule as simple as the inflation-only rule, the rule seems to be too simple to serve as a reference in monetary policy assessments.

Graph 3

Simple policy rules

In percentages



In order to improve the inflation-only rule, one may extend it by including the *change* in inflation in addition to the level, as suggested by Leitemo and Lønning (2001):

$$i_t = r^* + \pi^* + \alpha(\pi_{t-n} - \pi^*) + \gamma(\pi_{t-n} - \pi_{t-1-n}) \quad (2.3)$$

The idea is based on an "accelerationist Phillips curve": if output (or employment) is above its natural rate, inflation increases. If it is below the natural rate, inflation decreases. Using the change in inflation as a proxy for the output gap is, however, less valid if the Phillips curve is based on (partly) forward-looking rather than backward-looking expectations or if the variance of cost-push shocks is high. For Norwegian data, the correlation between the (revised) output gap and the change in inflation appears to be very small, which suggests that the above rule does not resolve the problem of poor output data in practice.

Orphanides et al (2000) advocate replacing the output gap with the change in the output gap and argue that this is subject to less uncertainty and, in particular, will counteract the high persistence in measurement errors mentioned above. Related to this is the proposal made by McCallum (1998) and later by Orphanides (1999) to let the interest rate respond to growth in nominal income. Although such "difference" rules are immune to misperceptions about potential output, they are still subject to uncertainty about current output, which is the main focus of this paper. Thus, we focus attention on simple rules that are not dependent on information about output.

[4] In the illustration, we have set $\alpha = 1.5$ for comparison with the original Taylor rule.

2.3 Unemployment gap rule

There is a close relationship between output and unemployment, known as Okun's law. One obvious alternative to the standard Taylor rule is thus to replace the output gap with the unemployment gap (ie, actual unemployment minus some measure of natural unemployment). An alternative to the simple Taylor policy rule could therefore be:

$$i_t = r^* + \pi^* + \alpha(\pi_{t-n} - \pi^*) + \delta(u_t - u_t^*) \qquad (2.4)$$

where u_t is the actual and u_t^* the natural unemployment rate.

Replacing the output gap with the unemployment gap has the advantage that the statistics on the number of registered unemployed are produced with only a few days lag after the end of each month, so that the observation lag is negligible. Furthermore, the unemployment data are not revised, since they are full counts of the number of registered unemployed each month.

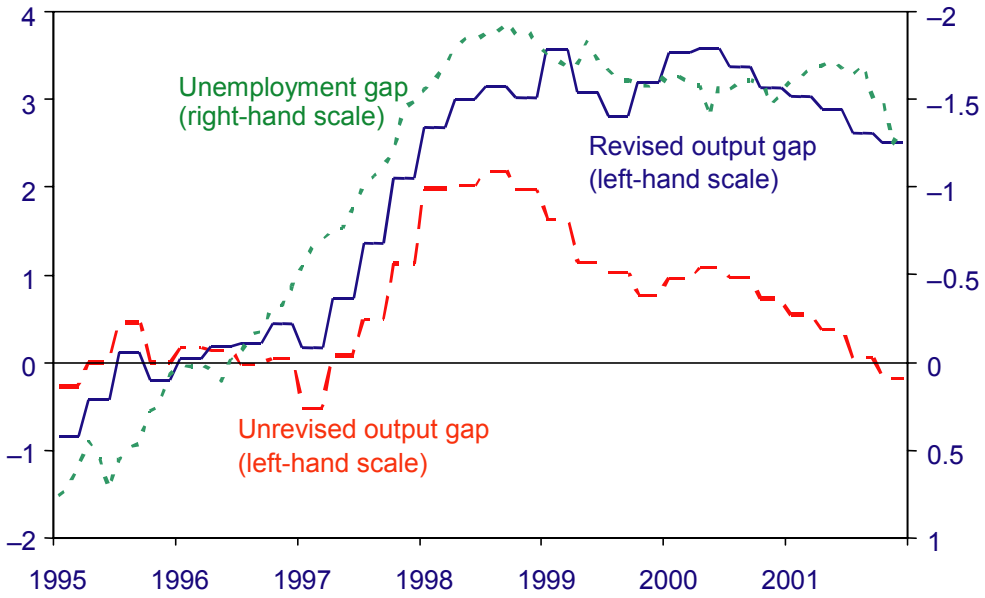
However, in order to make such a rule operational, one needs an estimate of the natural rate of unemployment. Estimating the natural rate is subject to the same problems as estimating potential output, and the natural rate probably shifts over time. Moreover, it is not clear which concept of the natural rate (structural, equilibrium, NAIRU, NAWRU, etc) is relevant. However, we will not go into a discussion of how to estimate the natural rate in this paper. To illustrate the "unemployment gap rule", we simply specify the unemployment gap as the deviation of actual unemployment from the average unemployment rate during the 1990s. In this period, wage growth averaged around 4.5%, which is consistent with our inflation target of 2.5%, given a plausible estimate of productivity growth. Since the range of variation for the unemployment rate has been about half of the range for the output gap, we set the coefficient for the unemployment gap at 1.[5]

Graph 4 shows that the unemployment gap tracks the revised output gap well. Using the revised Taylor rule as a normative benchmark, Graph 5 shows that the unemployment gap rule performs far better than the unrevised Taylor rule for the whole period considered. Thus, despite uncertainty about the natural rate of unemployment, the unemployment gap rule seems to be an interesting alternative to the standard Taylor rule.

Graph 4

Output gap and unemployment gap

In percentages and percentage points

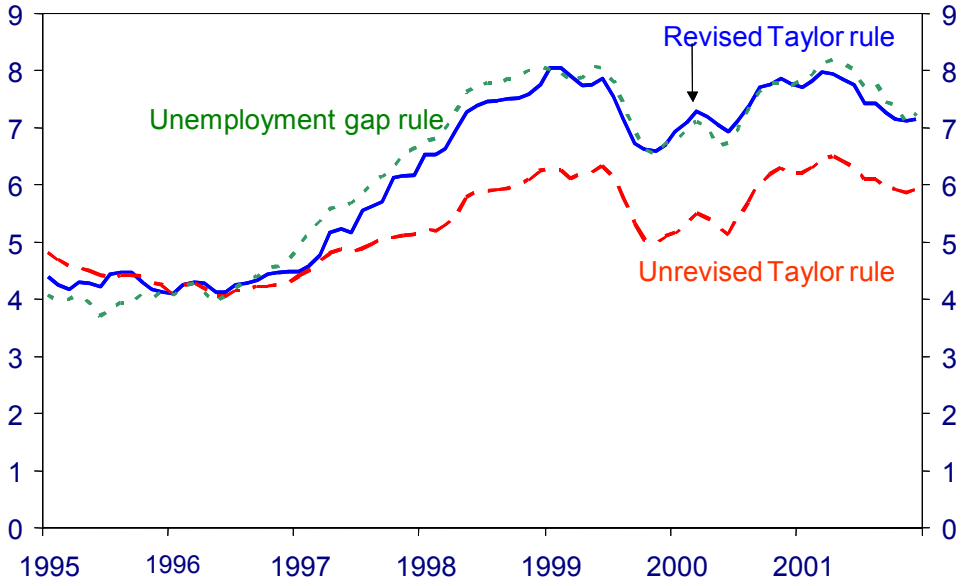


[5] The coefficient could, of course, be refined by a more thorough estimation of Okun's law, but for the purposes of illustration, a rough coefficient choice is sufficient.

Graph 5

Simple policy rules

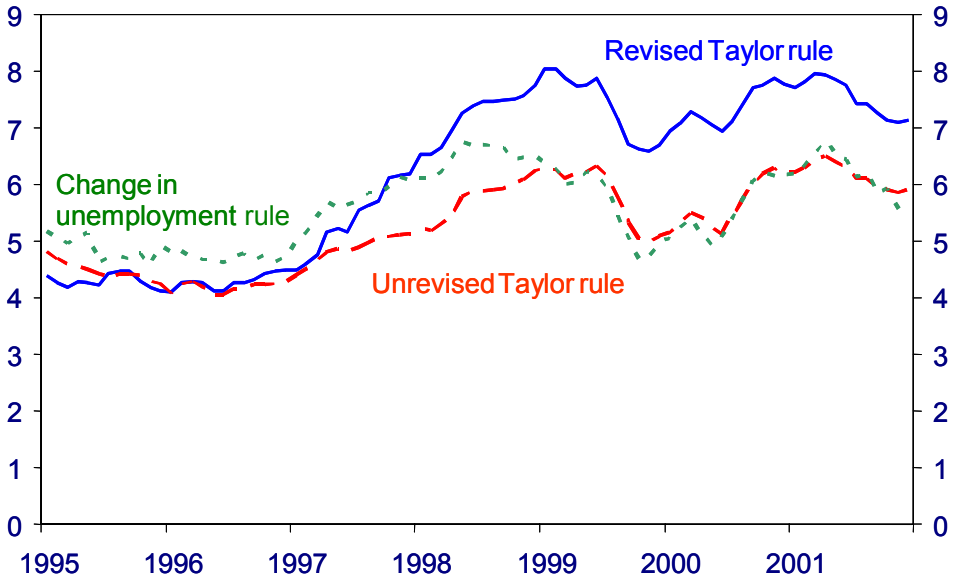
In percentages



Graph 6

Simple policy rules

In percentages



Due to the uncertainty about the natural rate, one may consider responding to inflation and changes in unemployment, as suggested by Orphanides and Williams (2002). The motivation is similar to the argument for substituting the output gap with output growth, as discussed above. Such a rule does not require knowledge of the natural rate of unemployment for setting policy and is consequently immune to the likely misperceptions in these concepts. In a world with no uncertainty about the natural rate, such a rule would, however, perform far worse than a rule with the unemployment level. For example, in a recession where unemployment is high, the "unemployment change rule" implies that, with inflation on target, the interest rate should be above neutral when unemployment starts to move down to the natural rate. An unemployment gap rule, however, would imply that the interest rate should be below neutral as long as unemployment is higher than the natural rate. Nevertheless, if misperceptions

about the natural rate are sufficiently large, the unemployment change rule might still outperform an unemployment gap rule. However, Graph 6 shows that the unemployment change rule does not track the revised Taylor rule much better than the unrevised Taylor rule, at least not after 1998.

2.4 Wage gap rule

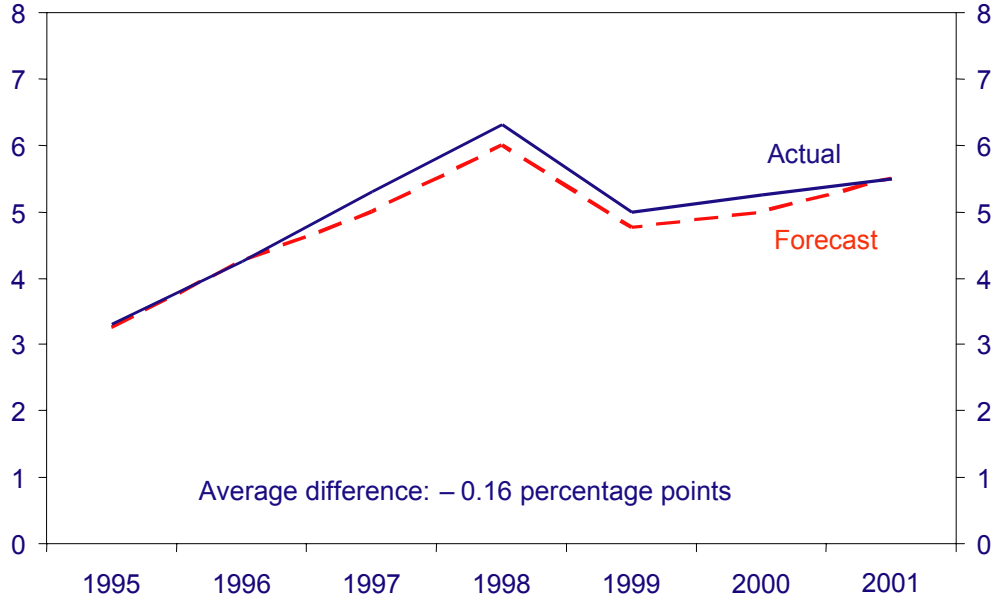
One way to try to overcome the problem of uncertain estimates of the natural rate of unemployment is to define the tightness of the labour market by way of wage growth. One crude definition could be as follows: when wage growth is high, the labour market could be characterised as tight. When wage growth is low, the opposite could be said to be true.[6]

In Norway, wage negotiations take place once a year in all sectors. Each spring, we obtain a direct measure of the tightness of the labour market through the outcome of these negotiations. Based on the outcome of all the sector-level wage settlements, we are able to make a fairly accurate forecast of annual wage growth by the end of the second quarter each year (Graph 7).

Graph 7

Annual wage growth

In percentages



Note: The graph shows forecasts in the second quarter of the same year and actual growth using data available four quarters later.

In the long run, real wages must be compatible with the value added that is generated by workers, ie labour productivity. Over time, the increase in real wages is therefore determined by developments in labour productivity. In Norway, productivity growth has averaged 2% over the last 20 years. If this trend continues, an increase in nominal labour costs of around 4.5% in the long term will be consistent with the inflation target of 2.5%.

An alternative to both the output gap and the unemployment gap in a simple monetary policy rule could therefore be the wage gap, ie the deviation between actual wage growth and the rate of growth that would be consistent with the inflation target over time:

[6] One needs, of course, to take into account special occurrences that generate wage shocks that do not reflect the tightness of the labour market.

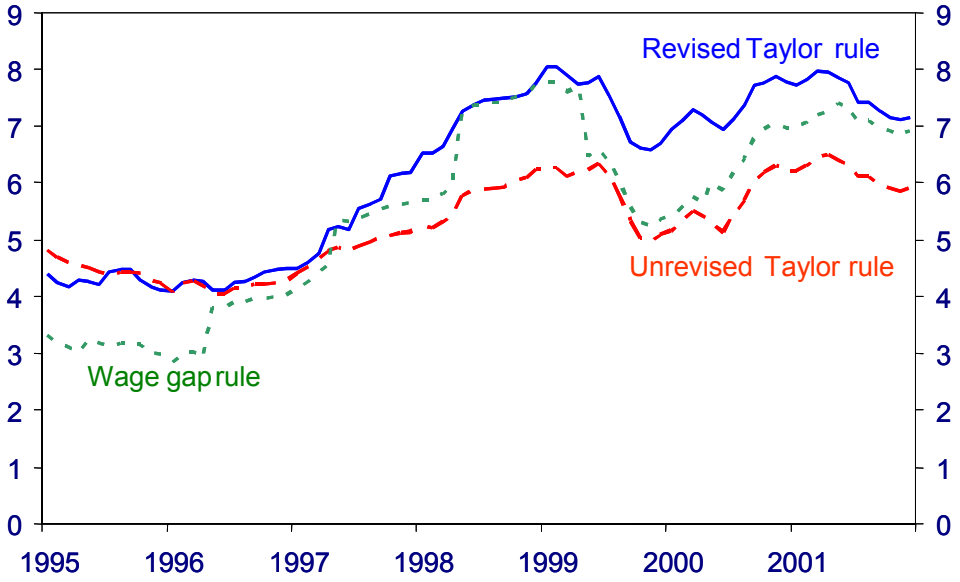
$$i_t = r^* + \pi^* + \alpha(\pi_{t-n} - \pi^*) + \varphi(\Delta w_{t-k} - \Delta w^*) \quad (2.5)$$

where Δw is wage growth and Δw^* is wage growth consistent with the inflation target.

Graph 8

Simple policy rules

In percentages



The variation in the output gap is somewhat larger than the variation in the wage gap. This would suggest a somewhat higher wage gap coefficient than the coefficient of 0.5 on the output gap in the original Taylor rule. In the "wage gap rule", we have chosen a wage gap coefficient of 1. Graph 8 shows the wage gap rule compared with the revised Taylor rule and the unrevised Taylor rule. As seen from the graph, the wage gap rule mimics the behaviour of the revised Taylor rule better than the unrevised Taylor rule during most of the period from 1995 to 2001. This suggests that when using the Taylor rule as a reference and cross-check in the monetary policy assessment process in real time, one should consider replacing the estimate of the output gap with the wage gap.

2.5 Asset prices and credit flows

There is extensive literature on the role of asset prices in monetary policy. Some authors support the view that monetary policy should respond to asset prices. We do not want to pursue this discussion here, but will instead focus on alternatives to the output gap in simple rules. It is well known that asset prices, such as stock prices and bond prices, are able to some extent to predict output.[7] In addition, since asset prices are observable in real time and are measured with almost absolute accuracy, one could argue that asset prices represent an alternative to the output gap in simple rules. However, asset prices such as stock and bond prices are subject to considerable "noise" due to shifting sentiments in financial markets and variable risk premia. An interest rate that responds directly to asset prices may therefore generate fluctuations in inflation and the real economy. One could, of course, develop some measure of "underlying" asset price movements, where such "noise" is filtered out. This would, however, reduce the value of the rule as a simple reference. Moreover, as pointed out by Woodford (1994), responding to asset prices may reduce their informational content, since agents in financial markets will take the central bank's reaction into account.

[7] See, for example, Stock and Watson (2001).

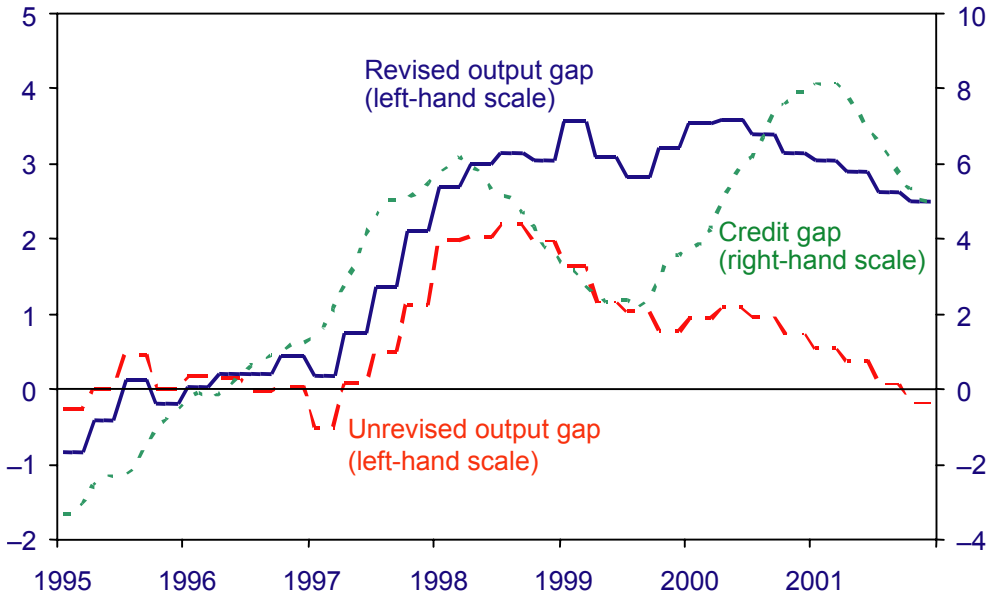
A more robust alternative is *credit growth*. As shown by Bårdsen et al (1999), credit growth in Norway is highly correlated with output. Data on domestic credit growth are, in addition, generally reliable and published with very short lags. Moreover, there are reasons to respond to credit growth per se, for example due to financial stability considerations.

Graph 9 compares the "revised" output gap and the "credit gap", which is defined as the deviation between domestic credit growth and trend growth. We assume that in steady state, nominal gross credit grows at the same rate as nominal GDP, which is assumed to have a trend growth of around 5% given an inflation target of 2.5%. As seen in the graph, the credit gap could be a useful indicator of pressures in the economy.

Graph 9

Output gap and credit gap

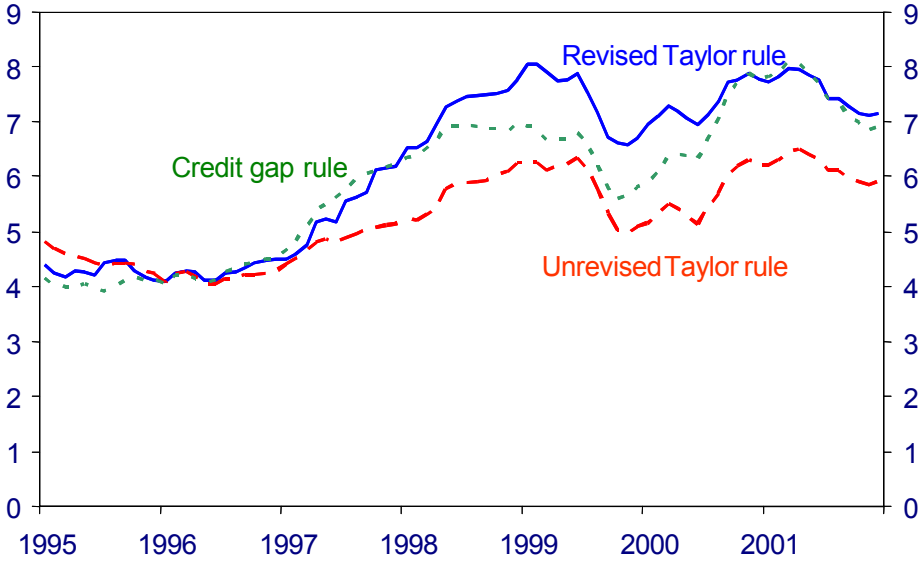
In percentages



Graph 10

Simple policy rules

In percentages



An alternative to both the output gap and the unemployment gap in a simple monetary policy rule could therefore also be the credit gap:

$$i_t = r^* + \pi^* + \alpha(\pi_{t-n} - \pi^*) + \tau(\Delta c_{t-k} - \Delta c^*) \quad (2.6)$$

where Δc is credit growth and Δc^* is trend credit growth.

The variation in the credit gap is larger than the variation in the output gap. This would suggest that the coefficient for the credit gap is somewhat lower than the output gap coefficient of 0.5 in the original Taylor rule. In the "credit gap rule", we have chosen a credit gap coefficient of 0.2.

Graph 10 shows the credit gap rule in comparison with the revised Taylor rule and the unrevised Taylor rule. As indicated in the graph, the credit gap rule also mimics the behaviour of the revised Taylor rule better than the unrevised Taylor rule during most of the period from 1995 to 2001.

2.6 Which indicator wins?

In the above, we have discussed various indicators of real economic pressures that can serve as alternatives to the output gap, since the data on GDP are subject to considerable "noise". Visual inspection suggests that the unemployment gap rule is the superior rule among all the alternatives examined, at least for the time period 1995-2001. Thus, the exercise performed in this paper suggests that when using the Taylor rule as a reference in "real-time" monetary policy assessments, the output gap should be substituted by the unemployment gap due to considerable uncertainty about GDP data in real time. The superiority of the unemployment gap as an indicator of the ex post revised output gap is particularly encouraging given that we did not make any serious attempt to estimate the natural rate of unemployment. However, only time will show if the unemployment gap will continue to be a good proxy for the "true" output gap.

Due to the uncertainty of the estimates of the natural unemployment rate, it is also of interest to consider a rule that consists of variables that do not require such information. Specifically, we consider a rule that consists of the wage gap, the credit gap and the change in the unemployment rate, where the coefficients are optimised. In other words, we take the revised Taylor rule to be the normative benchmark, and construct a rule that mimics this rule as closely as possible. We would like to stress, however, that treating the revised Taylor rule as the normative benchmark for alternative simple rules is only an analytical exercise and does not necessarily indicate that we consider the interest rate implied by this rule to be the appropriate rate.

Including the wage gap, the credit gap and the change in the unemployment rate and using optimised coefficients, so that the rule mimics the revised Taylor rule as closely as possible, gives the following rule:

$$i_t = r^* + \pi^* + 1.0(\pi_{t-n} + \pi^*) + 0.4(\Delta w_{t-k} - \Delta w^*) + 0.2(\Delta c_{t-l} - \Delta c^*) \quad (2.7)$$

The coefficient of the change in the unemployment rate in the best fit rule was (close to) 0. Graph 11 shows this combined "optimised" rule compared with the unemployment gap rule, the revised Taylor rule and the unrevised Taylor rule. As seen in the graph, by combining the wage gap and the credit gap it is possible to come fairly close to the revised Taylor rule and the unemployment gap rule. As stressed in the introduction, however, these results are only indicative. The robustness of the rules considered needs to be examined using longer time periods and more indicator variables.

3. Using simple rules to detect monetary policy misalignments

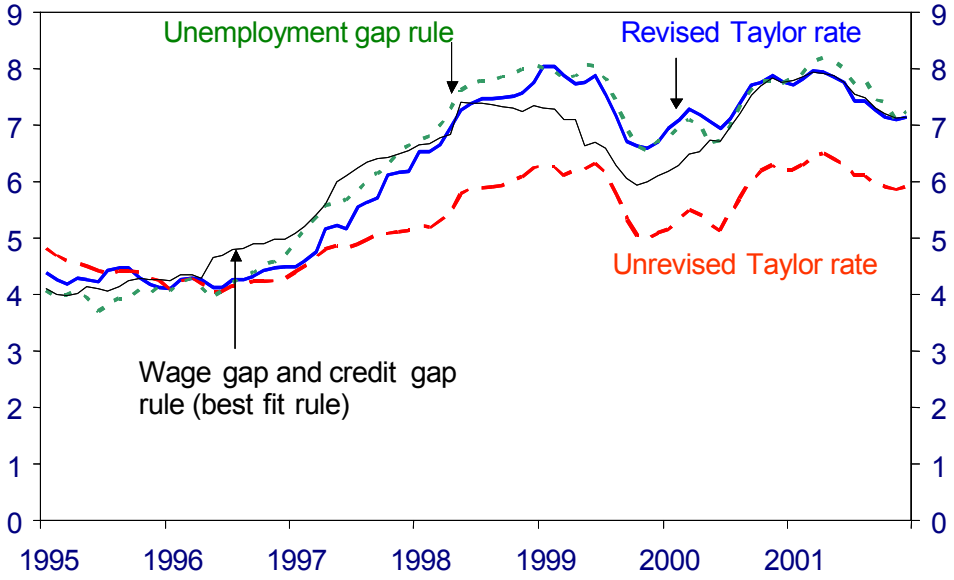
One may argue that in most cases interest rate decisions can be characterised as "fine-tuning". The interest rate is rarely changed by more than ½ percentage point in one step. Although such fine-tuning may be challenging enough, one may argue that what is most important for monetary policy is to avoid major policy mistakes that contribute to destabilising the economy. One feature of an appropriately specified simple rule, such as the Taylor rate, is that it ensures that the "Taylor principle" is satisfied. The Taylor principle says that when inflation rises, the interest rate should increase by more than the rise in inflation. This principle is a necessary condition for real equilibrium determinacy in most forward-looking sticky price models and a condition for stability in most backward-looking models. Moreover, the Taylor principle is a condition for stability in expectation formation in models that

(realistically) assume that agents form their expectations as an adaptive learning process.[8] The Taylor principle may therefore be considered a minimum requirement for a sound monetary policy. Policies that do not follow this principle may contribute to destabilising prices and economic activity.

Graph 11

Simple policy rules

In percentages



Since the coefficient on inflation in the original Taylor rule is 1.5, it satisfies the Taylor principle. In addition, as mentioned above, the Taylor rule is a natural cross-check in monetary policy assessments, since it appears to perform reasonably well across a variety of models. For illustration, we will therefore use the Taylor rule as a normative benchmark for detecting possible monetary policy misalignments in Norway. One should, however, note that the Taylor rule may not be as appropriate for a small open economy like Norway as for a large economy like the United States, since the rule does not include the exchange rate, which arguably is an important determinant of inflation and output in a small open economy.[9]

Graph 12 shows the alternative simple rules discussed above and the actual interest rate in Norway after 1995. The simple rules suggest that monetary policy in Norway was too lax in the period 1997-98. The key interest rate was lowered from 1996 to 1997 despite higher inflation and lower unemployment. Thus, not only was the Taylor principle violated, since the nominal interest rate did not keep track of the rise in inflation, the nominal rate was indeed *lowered* when inflationary pressures started to become worrying. How could monetary policy be that misaligned?

From 1994 until inflation targeting was adopted in March 2001, the mandate for monetary policy in Norway was stability in the exchange rate against European currencies. A target range was implicitly defined in the mandate but with no obligation on the part of the central bank to intervene. In the event of significant changes in the exchange rate, the mandate required the central bank to orient instruments with a view to returning the exchange rate to its initial range over time. The low interest rate in 1997 was a result of a relatively low rate in Germany. In addition, there were appreciation pressures on the krone exchange rate. In order to prevent the krone exchange rate from being too strong, the interest rate differential between Norway and Germany could not be too high. A higher

[8] See Bullard and Mitra (2002).

[9] Ball (1999) derives an "MCI Taylor rule" which in his framework is optimal for small open economies. See also Batini et al (2001) for a comparison of various policy rules within an optimising open economy model.

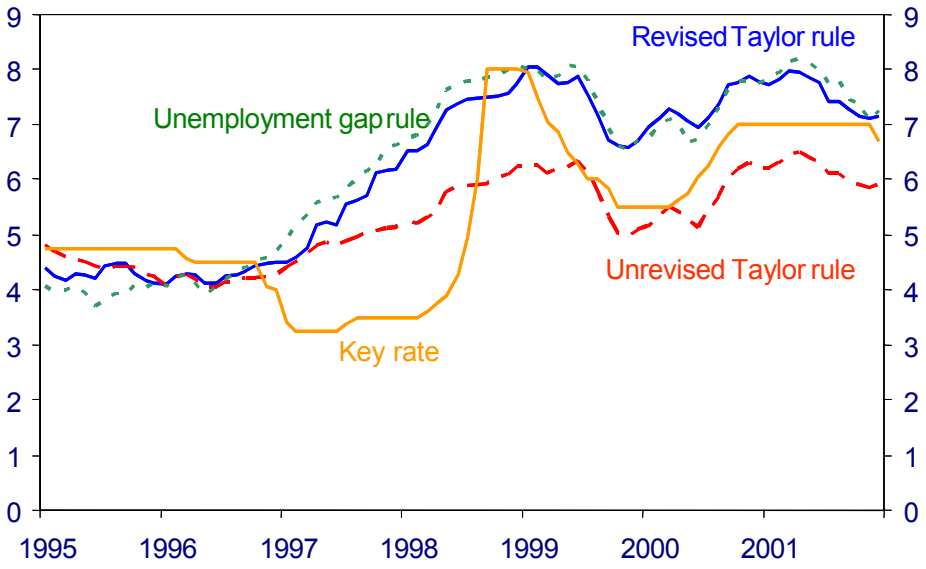
interest rate would probably have fuelled appreciation pressures and would have been in conflict with the mandate for monetary policy as it was interpreted at the time.

In the period 1996-2001, during which large oil revenues were channelled into government budgets, the task of counteracting increased economic pressures through a tight fiscal policy became increasingly difficult. In a letter to the government in 1997, the Central Bank of Norway asked for permission to put more weight on stabilising inflation and real activity than implied by the monetary policy mandate. The central bank also invited a group of international experts on monetary policy to analyse the existing monetary policy framework and assess possible alternatives. Their assessments are collected in Christiansen and Qvigstad (1997). During 1998, mounting wage growth and plummeting oil prices turned the sentiment in the krone market, leading to depreciation pressures. According to Graph 12, the sharp increase in the key rate during 1998 brought the interest rate up to a level more in line with what is suggested by the simple rules.

Graph 12

Simple policy rules and the key rate

In percentages



Measured by the revised Taylor rule, the key interest rate was again set too low in 1999. Although one could argue that this was the case ex post, one should bear in mind that the economic outlook for the world economy was particularly gloomy at the time. The fact that the economy did not evolve as negatively as expected does not in itself prove that the interest rate decisions were wrong in "real time", contrary to what was arguably the case in 1996-98. In fact, market participants expected the interest rate to be reduced even more than it was, as indicated by forward interest rates.[10] Since the autumn of 1998, the simple policy rules we have considered do not detect any significant policy misalignments. The interest rate may not have been "optimal" at every point in time, but the rules nevertheless suggest that monetary policy has been roughly "on track" in this period.

[10] See Qvigstad (2001).

4. Summary and final remarks

The output gap is an important variable in the theoretical literature on monetary policy. In addition, many simple policy rules, such as the Taylor rule, prescribe that the interest rate should respond directly to the output gap. Due to real-time uncertainty about current GDP and uncertainty concerning potential output, the output gap has some operational limitations, which are often neglected in the theoretical literature. In this paper, we have discussed these operational limitations and proposed various potential indicators of the output gap that are observed more accurately in real time. For the sake of illustration, we treated the Taylor rule with the output gap estimate based on the latest revision of national accounts as the normative benchmark. Deriving optimal indicators of the "true" output gap is an important area of research, which has not as yet reached any clear conclusions. In this paper, we have limited our ambitions to examining some variables that could potentially be useful indicators of the output gap. Specifically, we have considered unemployment, wage growth and credit growth. Our preliminary findings suggest that the "unemployment gap" is a better indicator of the output gap estimated ex post on revised data than the real-time estimate of the output gap. Alternatively, a weighted average of the "wage gap" and the "credit gap" as a real-time indicator seems to fit the ex post output gap quite well. Contrary to the "unemployment gap rule", this combined rule does not require any estimate of the natural rate of unemployment. Our results are, however, only indicative, and more research on robustness and other potential indicators of the output gap is required.

The output gap is not only useful in the internal assessment process. The Central Bank of Norway was recently evaluated by "Norges Bank Watch", which is an external and independent committee of academics and financial sector representatives that presents an annual report on the central bank. This year, it was led by Professor Lars E O Svensson.[11] Among other things, Norges Bank Watch wanted the central bank to publish estimates of output gaps and use these explicitly in the monetary policy assessment process as a tool for communicating policy.

Although the output gap is a fruitful concept, since it summarises and quantifies the degree of real economic imbalances, we have argued that the concept has several operational limitations. There is no single answer as to how the output gap should be estimated. It is not often that we get so little help from economic theory and econometrics as when we try to quantify the output gap. The degrees of freedom with respect to the choice of method, estimation period, etc, imply that the estimate must be based on substantial subjective judgments. That may, of course, not be an argument against publishing estimates of the output gap, since many assessments relevant to monetary policy have to be based on subjective judgments. However, it will be difficult, if not impossible, for the public to assess ex post whether the central bank was right in its assessment of real economic pressures. Moreover, the output gap is a difficult measure in itself and equally difficult to communicate to the majority of the public. Thus, although we have focused on data problems in this paper, there are also reasons other than uncertain GDP data for considering alternatives to the output gap for the purposes of assessment and communication.

References

Ball, L (1999): "Policy rules for open economies", in J B Taylor (ed), *Monetary policy rules*, Chicago, Chicago University Press.

Bårdsen, G, E Jansen and R Nymoen (1999): "Econometric inflation targeting", *Norges Bank Working Paper*, no 99-05.

Batini, N, R Harrison and S Millard (2001): "Monetary policy rules for an open economy", *Bank of England Working Paper*, no 91.

Bullard, J and K Mitra (2002): "Learning about monetary policy rules", *Journal of Monetary Economics*, 49(6), September, pp 1105-29.

[11] The report can be downloaded from http://www.princeton.edu/~svensson/norway/nbw.htm.

Christiansen, A B and J F Qvigstad (1997): *Choosing a monetary policy target*, Scandinavian University Press.

Leitemo, K and I Lønning (2001): *Simple monetary policymaking without the output gap*, Manuscript, Norges Bank.

McCallum, B (1998): "Issues in the design of monetary policy rules", in J Taylor and M Woodford (eds), *Handbook of macroeconomics*, North Holland.

Nelson, E and K Nikolov (2001): "UK inflation in the 1970s and 1980s: the role of output gap mismeasurement", *Bank of England Working Paper*, no 148.

Orphanides, A (1998): "Monetary policy evaluation with noisy information", *Finance and Economics Discussion Series*, no 1998-50, Board of Governors of the Federal Reserve System.

——— (1999): "The quest for prosperity without inflation", paper presented at the workshop on Inflation targeting and exchange rate fluctuations at Sveriges Riksbank, Stockholm.

Orphanides, A, R D Porter, D Reifschneider, R Tetlow and F Finan (2000): "Errors in the measurement of the output gap and the design of monetary policy", *Journal of Economics and Business*, vol 52, pp 117-41.

Orphanides, A and J C Williams (2002): "Robust monetary policy rules: the case of unknown natural rates of interest and unemployment", paper presented at the ECB workshop on monetary policy in Frankfurt, March.

Qvigstad, J F (2001): "Monetary policy in real time", *Norges Bank Working Paper*, no 01-01.

Stock, J H and M W Watson (2001): "Forecasting output and inflation: the role of asset prices", *NBER Working Paper*, no 8180.

Svensson, L E O (1997): "Inflation forecast targeting: implementing and monitoring inflation targets", *European Economic Review*, vol 41, pp 1111-46.

Taylor, J B (1993): "Discretion versus rules in practice", *Carnegie-Rochester Series on Public Policy*, vol 39, pp 195-214.

——— (ed)(1999): *Monetary policy rules*, Chicago, University of Chicago Press.

Woodford, M (1994): "Nonstandard indicators for monetary policy: can their usefulness be judged from forecasting regressions?", in N G Mankiw (ed), *Monetary policy*, Chicago, University of Chicago Press for NBER.