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Working Paper

Monetary Policy Wing

Monetary policy in real time

by

Jan Fredrik Qvigstad

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Monetary policy in real time

Jan Fredrik Qvigstad[1]

The interest rate is set by the central bank with a view to securing a nominal anchor for the economy in the long term. The setting of interest rates is based on evaluations of economic trends and the balance of risks. In some periods, the assessment of economic prospects and the balance of risks can change considerably. This may be due to three factors: sizeable revisions to economic data series, new information, or just a change in perceptions. In the 1970s, forecasts of productivity growth in the US were way off the mark. The boom period in Norway in the mid-1980s was first identified after the peak had been passed. The reunification of East and West Germany reversed what one thought would be an economic upturn in Europe to a downturn. The projected cyclical downturn in Norway at the turn of the millennium was over before it actually started. The basis for interest rate setting has not been perfect in these periods. What consequences has this had for monetary policy? Have monetary policy decisions been inappropriate? The answer is that sometimes things have gone wrong, while other times the monetary policy strategy has been sufficiently robust. Limited information is one argument for proceeding gradually when making monetary policy adjustments. When historians are to pass judgement on monetary policy, it is also important to assess policy on the basis of the information available when the decisions were taken. Monetary policy is conducted in real time and not retrospectively.

Ten years ago, when Erling S. Andersen was 50 years old, IT technology was not as well developed as it is today. In order to save on IT resources, gross settlement of individual transactions between banks was undertaken on a continuous basis, while netting was executed at the end of the day. Today, the settlement of larger transactions is undertaken on a gross basis and in *real time*. This means that gross transactions are settled at the time they actually take place. Banks' settlements in the central bank and monetary policy are the two "mandatory" functions of a central bank in addition to issuing notes and coins.

However, the concept real time has a broader scope and is of considerable importance when we are to subsequently evaluate to what extent policy in the past was appropriately oriented. Assume, for example, that data at a given time imply that the authorities should conduct a more expansionary policy, while revised data show that this policy stance was inappropriate. An *ex post* evaluation of policy must be carried out in real time, i.e. decisions must be evaluated on the basis of information that was available when the decisions were taken. This type of problem is often underestimated in economic analyses, but may have considerable consequences when history is to be written. It is easy to criticise decision-makers of the past under

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the guise of hindsight, but far more difficult to make ongoing decisions when the data are uncertain and the only certainty is that the data will later be revised.

In this paper, we will look more closely at the central bank's role with regard to monetary policy and, in particular, link this to factors of uncertainty facing the central bank in its conduct of monetary policy. There may be three reasons why forecasts and the basis for decisions for monetary policy change:

- Data may be revised at a later time
- New information on economic developments may emerge
- Perceptions may change

We will demonstrate through various examples how these factors have played a role for Norges Bank and other decision-makers.

How should monetary policy be conducted?

In the US, mobility between academia and government is fairly common. Alan Blinder continued this tradition. He was a professor of Economics at Princeton University. Between 1994 and 1996 he was vice chairman of the Federal Reserve before returning to academic life. In his book "Central Banking in Theory and Practice", he describes the modern approach to monetary policy on the basis of his own experience.

In general terms this can be described as follows: the central bank is given a *mandate ("objective")* of low inflation, stable production and perhaps stability in the external value of money. The bank has certain *instruments* at its disposal. The interest rate and interventions are the most common instruments. Unless the central bank only has one objective, the central bank must weigh the various objectives against each other. The central bank is therefore facing an optimisation problem.

Let y be a vector for the endogenous variables in the economy (a few of them are target variables for the central bank), x a vector for policy variables (for example, the interest rate) and z a vector other exogenous variables. Let e be a stochastic disturbance. Assume that there is a known description of the macroeconomy in the form of:

$$y = F(y,x,z) + e$$

It is assumed that the endogenous variables in the period t (y_t) are explained by the exogenous variables for the same period and earlier periods (x_t, x_{t-1}, x_{t-2},… and z_t, z_{t-1}, z_{t-2},…), but also by endogenous variables in *earlier* periods (y_{t-1}, y_{t-2},…).

The monetary policy authorities are assumed to have a welfare function

$$W = W(y)$$

In order to arrive at the *optimal monetary policy rule*, the monetary policy authorities must maximise $W(.)$ with regard to x given the constraint found in $y = F(.)$. The result of this optimisation is

$$x^* = H(z)$$

where x* is the optimal level of the policy variable.

This approach is very simple. Can it really be this way? Theoretically the answer is yes, but in practice there are many complicating elements such as uncertainty, lags and factors linked to the welfare function.

Uncertainty

The projections used as a basis for monetary policy are uncertain. It is difficult to provide estimates for developments in the world economy, oil prices are uncertain and, strangely enough, it has proved very difficult in Norway to estimate growth in general government expenditure.[2] Blinder demonstrates that the problem of uncertainty in exogenous variables is easy to solve in principle: an uncertain future variable is replaced by the expected value of the variable (certainty equivalence principle).

Uncertainty also exists with regard to the parameters in the model that describe the economy. What is the actual effect of a change in the interest rate on the real economy, and what is the effect of a change in the real economy on wage and price inflation? In order to solve this problem, we can brush the dust off an old "classic" like Brainard (1967). He demonstrated that under certain conditions the political authorities should be conservative. They should calculate the "appropriate" policy change (for example, that the interest rate should be reduced by 2 percentage points) and then "do less" (by, for example, only reducing the interest rate half a percentage point).

Uncertainty also exists as to what is the "correct" model for describing the economy. Is it F(.) that describes the economy correctly or is it another model? Levin et al. (1999) show that the interest rate rule $x^* = H(z)$ is crucially dependent on F(.) being the right model. A number of empirical macroeconomic models exist for the US economy. Assume that one arrives at the interest rate rule $x^* = H(z)$ on the basis of one of these models. Then assume that there is another macroeconomic model that is "correct". The interest rate rule $x^* = H(z)$ then provides a less satisfactory result compared with simple interest rate rules such as the Taylor rule (we will revert to this later).

Lags

If the central bank finds that inflation will be too high in the period ahead, the central bank will increase interest rates to avoid this. It is necessary to look ahead as changes in interest rates will not have an immediate impact on the real economy, and there is also a lag between changes in real economic variables and the time at which it is possible to register changes in nominal variables such as the price level. If inflation at a given time is higher than desirable, interest rates should not necessarily be raised. This should have been done two years earlier. It may be that the economy is entering a period of sharp contraction that will result in very low price inflation two years ahead. Perhaps one should instead lower interest rates?[3]

A general guideline

The approach described above provides the following prescription as to how the central bank should conduct monetary policy:

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[2] The estimate for general government expenditure is the variable that has proved to be the least accurate in Norges Bank's forecasts, see Madsen (1996) and Jore (1998, 1999 and 2000).

[3] An analogy to describe this: it takes time to get intoxicated after drinking whiskey. If you stop drinking when you think you have had "enough", you will discover half an hour later that you have had too much. It is important to be aware of lags and the relationship between alcohol intake and intoxication in order to stop in time.

- Estimate to what extent monetary policy shall be tightened or relaxed with a view to what is "appropriate". Then do less.
- See how things go.
- If everything goes as planned, tighten or relax policy a little more.
- If developments in the economy appear to be different from what is expected, adjust policy accordingly.

Mandate in the form of a welfare function?
Central banks have not been given a mandate by the political authorities in the form of a welfare function W(.). Central banks' mandates are as a rule formulated in general terms either in the Constitution or in the form of a treaty (such as the Maastricht treaty), in legislation or in the form of a Government decree (as in Norway where the mandate is laid out in a regulation issued by the King in the Council of State). It is common that central banks are transparent as to how the mandate is interpreted. In Norway, the central bank provided its interpretation in the budget submission (submission on economic policy for 2000, Norges Bank's submission of 21 October 1999 to the Ministry of Finance[4]). The ECB provided a further clarification of the Maastricht treaty's objectives at a meeting of the Governing Council on 13 October 1998.[5]

Different practical approaches

Inflation targeting
The Swedish economist, Lars Svensson, has had a considerable influence on the development of monetary policy theory in recent years. Svensson's approach is in keeping with the general approach explained above. In Svensson (1997, 1998), the welfare function W(.) is assumed to have the form of a "loss function" which the central bank shall minimise.[6]

$$L = (\pi - \pi^*)^2 + \lambda\sigma^2$$

π is inflation, π^* is the inflation target and σ is the output gap. λ is a parameter that measures the emphasis placed on having stable production and employment in relation to low inflation. The discounted sum of the loss functions is minimised over future time periods.

If $\lambda = 0$, emphasis is only placed on inflation. This is often described as a "strict inflation target".[7]

If $\lambda > 0$, we have a "flexible inflation target", which is what Svensson recommends. It is worth noting that what is referred to as "inflation targeting" does not mean that emphasis is solely placed on low inflation. If $\lambda > 0$, emphasis is not only placed on low inflation but also on stabilising the real economy.

[4] See www.norges-bank.no.
[5] Published in a press release of 13 October 1998, see www.ecb.int.
[6] In Blinder's approach, a welfare function W(.). is *maximised*. In Svensson's approach, a loss function L(.) is *minimised*.
[7] Mervyn King, Deputy Governor of the Bank of England, describes people who are of the view that $\lambda = 0$ as "inflation nutters", see King (1997).

Since the terms of the loss function are squared, the central bank will be just as interested in avoiding above-target inflation as below-target inflation, and the same is true of the output gap.

Central banks draw up forecasts for the economy (*y)* on the basis of all available economic data which are *z, x* and lagged values for *y*. Using a model for the functioning of the economy *F(.)* and a loss function *L(.),* an interest rate rule is derived on the basis of an optimisation process. The interest rate rule is forward-looking because there is a lag. It takes time before the interest rate influences the real economy, and it takes time before the real economy influences nominal variables.

The "loss function" itself is set by the political authorities.[8] In practice, this means that the Government chooses a target for inflation and the extent to which real economic stability shall be taken into account. The central bank, however, is free to set the interest rate so that the objective formulated is satisfied to the greatest possible extent. A distinction is often made between "target independence" and "instrument independence". In the approach described above, the central bank has instrument independence, but not target independence.

Interest rate rules

If you are outside the central bank and are either academically curious as to how the central bank thinks, or you are financially dependent on being able to guess what the central bank will do, the approach described above may be very complicated and demanding.

John B. Taylor is a professor at Stanford University in California. In 1993, he wrote an article[9] in which he attempted to describe the Federal Reserve's behaviour. Like most other academics, he did not have ample resources at his disposal. He therefore assumed that the Fed's behaviour could basically be described using a very simple rule.

Taylor's rule says that

$$r = r^* + p^e + 0.5(p-p^*) + 0.5\sigma$$

where p, p^e, p*, σ, r and r* are, respectively, inflation, expected inflation, the inflation target, the output gap[10], the nominal interest rate and the long-term real interest rate. Taylor implicitly assumes that market operators have backward-looking expectations and also use actual inflation (p) as an estimate for inflation expectations (p^e).

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[8] The authorities do not usually formulate the mandate so precisely that "λ" can be quantified. As a rule, mandates are formulated in general terms, but an implicit λ can often be derived ("revealed preferences"). The most important way to take real economic stability into account is through the "*target horizon"* selected for achieving the inflation target. By choosing a longer target horizon, for example 1½ to 2 years, it will be possible to a greater extent to promote stable developments in the real economy and interest rates. The real economy can also be taken into account by making exceptions to the inflation target if certain types of shock occur. In New Zealand, exceptions have been made e.g. for sizeable changes in export or import prices (terms of trade). Moreover, it is possible to operate using an underlying price index that results in more stable interest rate setting. For a pedagogical review of the target horizon, see Apel et al. (1999)

[9] Taylor (1993).

[10] The output gap can be measured in several ways. One simple measure is to compare actual output with average output over a specific period in the past, defined as full capacity utilisation. If actual output is higher than full capacity utilisation, the output gap is positive, and a contractionary monetary policy is necessary to "cool off" the economy.

If inflation is equal to the inflation target and the output gap is zero, the nominal interest rate should then be set at the sum of the long-term real interest rate plus inflation expectations. If inflation is higher than the inflation target and/or the output gap is positive, the nominal interest rate should be set so that the real interest rate is higher than the equilibrium real rate. This contractionary monetary policy will reduce inflation and the level of activity, and over time will push the economy towards equilibrium. If, on the other hand, inflation is lower than the inflation target and/or the output gap is negative, the nominal interest rate should be set so that the real interest rate is lower than the equilibrium real rate. Monetary policy is then expansionary.[11]

Taylor showed that this rule generally provided a good description of how monetary policy had actually been conducted in the US.[12]

Whereas Svensson's interest rate rule is a result of a complicated optimisation process, Taylor's rule is only dependent on a very limited set of information, notably

- actual inflation
- capacity utilisation

Taylor's rule is not forward-looking.[13] On the other hand, the Taylor rule assumes that we "know" the equilibrium real rate (r*) and the central bank's inflation target (*p**).

Considerable research has been carried out in recent years in order to study "how robust" the Taylor rule is compared with rules that are a result of optimising welfare functions. If the interest rate rule that results from an optimisation process does not deviate significantly from the Taylor rule, we can use the Taylor rule to evaluate the actual monetary policy that has been conducted. Policy has been "appropriate" if it does not deviate significantly from the Taylor rule. The literature[14] shows that, as an approximation, the Taylor rule can be used as a standard for determining whether policy has been "appropriate".

Monetary policy conducted in real time and retrospectively may produce differing results

According to Blinder's general approach, the conduct of monetary policy presupposes the existence of forecasts for exogenous variables and knowledge of data regarding the state of the economy. Svensson's approach may be viewed as a specification of this general approach.

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[11] Taylor assumed in his original article that the equilibrium real rate was 2. He also assumed that the inflation target was 2. The Taylor rule can then be described as

$$r = 2 + p + 0.5\,(p - 2) + 0.5\sigma$$

If inflation is at the target (p=2) and there is full capacity utilisation in the economy (σ=0), the interest rate should be set at 4. If actual inflation is 3 and there is more than full capacity utilisation in the economy (σ is, for example, 2), the interest rate should be set at $r = 2 + 3 + 0.5\,(3 - 2) + 0.5*2$, *i.e.* $r = 6.5$.

[12] The Taylor rule does not seem to describe the period 1972-1982 very well. See the discussion concerning Orphanides later in this article.

[13] It is not forward-looking unless we consider capacity utilisation as a simple predictor of future inflation.

[14] See, for example, Rudebusch and Svensson (1999).

Simple interest rate rules, such as the Taylor rule, appear to be less demanding with regard to information about the economy, but even simple interest rate rules require knowledge about the state of the economy (capacity utilisation and inflation).

In some periods, assessments of economic prospects and the risk outlook have been revised extensively. This may be ascribed to three factors:

- Revisions of economic data series
- New information
- Changes in perceptions

We shall look at various episodes of this kind and their consequences, starting with an example from the US.

Period of inflation in the US in the 1970s

After the Second World War, the US economy was characterised by strong growth and low inflation. The late 1960s saw signs of a rise in inflation, which reached around 5 per cent. Inflation stabilised to some extent and even fell somewhat in connection with the economic slowdown in 1970/1971. After that, inflation began to rise again during the cyclical upturn in 1972, culminating in an explosive rise in connection with OPEC I. The decade of "Great Inflation" lasted from 1972 to 1982. In 1974/1975, inflation reached double-digit levels. Inflation also approached double-digit figures around the start of 1980 as a result of OPEC II.

Arthur Burns was Chairman of the Federal Reserve from 1970 to 1978. It may seem something of a paradox that he should have been Chairman of the Federal Reserve in the decade of high inflation, since he was known to be a strong opponent of inflation. In his 1957 lecture *Prosperity Without Inflation*, he criticised Congress' 1946 Employment Act, which he felt fuelled inflation. He was of the opinion that, by promising maximum employment, the Act had encouraged an overly expansionary policy and triggered wage pressures and an upward drift in prices. Burns argued that the Employment Act should be amended to include a price stability objective. With an appropriate policy, it should be possible to achieve full employment and price stability. So why did things go wrong, despite this stance on the part of the Chairman of the Federal Reserve? Why was inflation so high in this decade?

Taylor (1998) ascribed the high inflation in the decade of Great Inflation to inappropriate policy. The monetary policy of the Federal Reserve in the 1970s was too expansionary under Arthur Burns, and in the early 1980s under Volcker it was too contractionary.

Orphanides (1999) is critical of analyses of this kind. His main contention is that historical analyses of alternative policy formulations are often based on unrealistic assumptions concerning data. Orphanides performs his analyses using two sets of data:

- One set of data for inflation and output gap based on data that were available at the time monetary policy decisions were made – *"real-time data"*.
- One set of data for inflation and output gap based on *"final data"*.

Real-time data are often more uncertain that "final data". Data have later been revised, particularly data on capacity utilisation. Chart 1 shows projected developments in the output gap. Figures on inflation have been revised to a far lesser

extent. For example, the first output gap estimate for 1974 corresponded to 13 per cent unutilised capacity. However, the final figures showed under-utilisation of productive capacity of around 4 per cent. The output gap estimate was incorrect because the forecast for productivity gains was off the mark. At the start of the 1970s, there was a break in the strong productivity growth of the 1950s and 1960s. This shift was discovered too late.

Chart 1. The evolution of history during the 1970s output gap measurement

The dark solid line indicates the final historical series for the output gap with data available at the end of 1994. Each of the thin lines shows the historical series for the output gap based on data available in the first quarter of the year shown.
Source: Orphanides (1999)

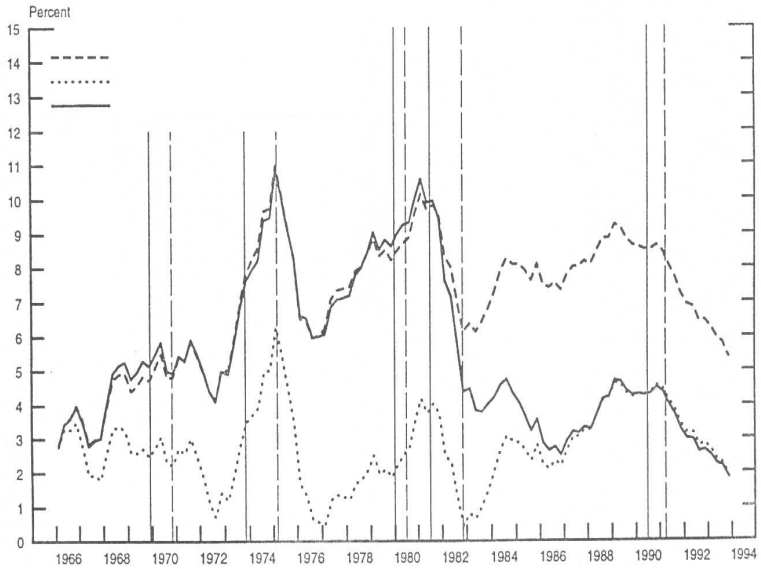
The *solid bold line* in Chart 2 shows actual inflation in the US from the mid-1960s to 1994. As noted, inflation rose towards the end of the 1960s, was high in the 1970s and fell back to a low level in the 1980s.

The *dotted line* in Chart 2 shows what inflation would have been had the Taylor rule been followed and if the final national accounts figures had been available at the time decisions were taken. If the Federal Reserve had set its federal funds rate in accordance with the Taylor rule, the period of high inflation could have been avoided and inflation would have been around 2 per cent. OPEC I and OPEC II remain visible in the data. However, inflation would only have been 5 per cent towards the end of 1974, rather than the actual 11 per cent. Orphanides also shows that had the Taylor rule been used in this way, it would have stabilised output and it would have been possible to avoid the substantial drop in output following Volcker's anti-inflationary policy in the early 1980s. The Federal Reserve chairmen's failure to apply the Taylor rule appears to be behind the decade of high inflation and Volcker's deflation.

But is it as simple as that? Not according to Orphanides. When assessing the performance of Arthur Burns and Paul Volcker as chairmen of the Federal Reserve, it is important to assess them on the basis of data that were available to them when decisions were made. Monetary policy must be assessed in "real time". The *dotted line* in Chart 2 shows the results that would have been produced by the Taylor rule, had the rule been applied to the real-time data (simulation with noise). In the 1970s, we see that an application of the Taylor rule using real-time data reflects the

historical data well. It appears that Burns did indeed follow a Taylor rule. The Great Inflation was due to Burns actually following a Taylor rule, but using the data available at the time. Volcker's deflation policy in the early 1980s represented a break with the Taylor rule. If Volcker had followed the Taylor rule, using the data available to him at the time, it would have taken even longer to achieve low inflation.

Chart 2. Inflation with Taylor rule



The solid and dashed vertical lines denote NBER (National Bureau of Economic Research) cycle peaks and troughs, respectively.
Source: Orphanides (1999)

Most economists agree that a rule which includes both inflation and an output gap is superior to one that contains inflation only.[15] However, Orphanides[16] shows that an interest rate rule that only looks at inflation[17] would have produced a better result. In other words, an imperfect rule may produce better results than the "correct" rule, since the imperfect rule is not dependent on data that subsequently prove to be wrong.[18]

The period of high inflation in the US was probably due to all three of the above factors (data revisions, new information and changes in perceptions), but revisions of data (productivity growth and hence capacity utilisation data) were in all likelihood a paramount factor.

[15] In its original form, the Taylor rule had the coefficient 0.5 in front of the deviation of actual inflation from the inflation target, and for the output gap. In a simplified Taylor rule in which the focus is on inflation alone, the coefficient in front of the output gap is set at 0.
[16] See Chart 13, Orphanides (1999).
[17] "If actual inflation is higher than the inflation target, the interest rate should be higher than a neutral interest rate. If inflation is lower than the target, the interest rate is set at a level that is lower than the normal rate."
[18] As noted earlier in this article, there is uncertainty as to which macroeconomic model provides the most accurate description of the economy. Levin et al. (1999) show that even though a Svensson rule gives the "best" policy if model F(.) provides the "correct" description of the economy, it is not certain that this rule gives the best policy if another model is "correct". In the examples studied by Levin et al., the simple Taylor rule is more robust to incorrect specification of F(.) than a Svensson rule.

The case of Norway

Economic policy in 1985 was far too expansionary, at least in hindsight. This was partly because policy was based on extremely inaccurate forecasts. Table 1 shows estimates and actual figures for a number of key variables in the mid-1980s. In the National Budget for 1985[19], the projection for mainland GDP growth was 2.3 per cent. The preliminary national accounts for 1985, published in February 1986, estimated growth at 4.5 per cent. The final national accounts, published in 1988, calculated growth at 5.9 per cent.[20] The largest source of error was in the estimate for the household savings ratio. The National Budget's estimate for the savings ratio was 4¾ per cent. The preliminary national accounts showed a savings ratio of 3.7 per cent, while the final accounts showed that the actual savings ratio was –2.7 per cent.[21] The statistics most likely to be studied when preparing forecasts for private consumption, and hence the savings ratio, are those for the retail sales index. This proved to be misleading. After this episode, the method for constructing the index was revised.

Table 1. Estimates and actual figures for key variable in the mid-1980s[22]

Mainland GDP	1985	1986	1987
National Budget	2,3	2,9	1,2
Preliminary national accounts	4,5	3,5	0,4
Final (before main revision)	*5,9*	*3,4*	*1,2*
Final (after main revision)	*5,6*	*2,9*	*1,7*
Saving ratio			
National Budget	4 ¾	-	-
Preliminary national accounts	3,7	-3,0	-3,0
Final (before main revision)	*-2,7*	*-6,1*	*-6,2*
Final (after main revision)	*-1,8*	*-4,7*	*-4,6*
Private consumption			
Nasjonalbudsjettet	2,4	3,5	0,4
Preliminary national accounts	7,5	5,5	-1,9
Final (before main revision)	*9,9*	*5,6*	*-1,0*
Final (after main revision)	*9,4*	*5,0*	*-0,8*

Source: Statistics Norway

Norway has also some examples of changes in the preconditions for monetary policy. The domestic-led bubble burst in 1986, at the same time that oil prices had started to fall. The terms of trade deteriorated by 17½ per cent from 1985 to 1986. A tightening

[19] Published in October 1984.
[20] After the main revision in 1995, the final growth figure was calculated at 5.6 per cent.
[21] The main revision set the final savings ratio at –1.8 per cent.
[22] Final figures *after* the main revision should be regarded as the definitive final figures. Final figures *before* the main revision are included here to provide a complete picture. It was primarily in 1985 that the National Budget estimates for both GDP and the savings ratio/private consumption were inaccurate. The figures for these variables in the preliminary accounts were also inaccurate, although to a lesser extent. National Budget estimates for private consumption were also extremely inaccurate in 1986, and somewhat inaccurate in 1987. Estimates for GDP growth in these two years reflected actual growth well. The corresponding figures in the preliminary accounts were fairly inaccurate in 1986, but the preliminary accounts underestimated growth again in 1987. For 1987, the estimates in the National Budget were considerably more accurate than the figures in the preliminary accounts.

of fiscal policy was necessary. The structural budget balance was tightened by 4½ per cent for the period 1986-1988 as a whole. In the decade of devaluation from 1976 to 1986, an accommodating monetary policy had been conducted. The Norwegian krone was devalued by 9.2 per cent in May 1986, but after that it was kept stable, and a non-accommodating monetary policy was thus conducted. The Norwegian economy entered into a period of recession from 1987 to 1990. Mainland GDP fell by 1½ per cent in this period.

In the autumn of 1989, it seemed likely that the macroeconomic balances would be more or less in place again in the course of the following year, and most economic analysts believed that the Norwegian economy was on the verge of an upturn. Hermod Skånland, Governor of Norges Bank, made the following statement in connection with the presentation of the economic outlook in September 1989: *"The steepest hill is now behind us. It is not wise to put your foot on the accelerator when travelling downhill."*[23]

The upturn, however, did not materialise. There are several possible explanatory factors. It is possible that the recession in the Norwegian economy was deeper than had been assumed. The most likely explanation, however, lies outside the Norwegian economy: the Berlin Wall fell in December 1989. German reunification led to a sizeable need for investment in the former East Germany. However, this expenditure was not fully financed through increased taxes or reductions in other public expenditure. The result was a very tight monetary policy in Europe, which spilled over into Norway through the fixed exchange rate peg to the ECU. The upturn did not materialise until 1993, when it was triggered by the general fall in interest rates in Europe.

With hindsight, one may ask whether it might have been possible to decouple movements in Norwegian interest rates from European interest rates in 1990. This issue is discussed in an article by Eitrheim and Qvigstad (2001).

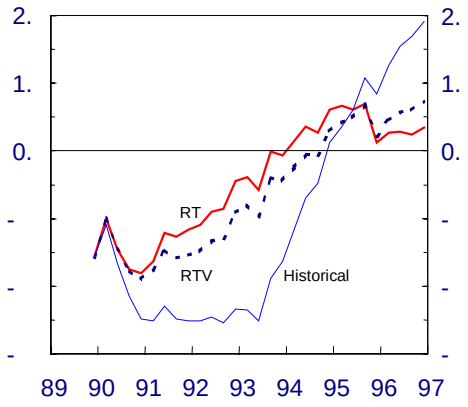
Chart 3a shows actual (marked *Historical* in the chart) developments in capacity utilisation (the output gap), and what the output gap would have been had the interest rate been set on the basis of a Taylor rule. The output gap is measured as percentage deviation from trend. The impact of the interest rate on the exchange rate is highly uncertain. Two alternatives are shown in the Chart: *RT*, where the exchange rate is not affected, and *RTV*, where discretionary monetary policy causes a weakening of the exchange rate. Model-based simulations show that it would have been possible to "build bridges" over the extended recession in 1990-1993.

Chart 3b shows historical inflation and the two simulations. Interest rate setting in accordance with the Taylor rule would not have produced substantial deviations from the historical inflation rates if the exchange rate had remained unchanged. If the setting of interest rates had led to a weakened exchange rate, the rate of inflation would have been considerably higher for a period, but it would have converged towards the actual observed rate of inflation after a few years. Clearly, this is a counterfactual experiment, see Eitrheim and Qvigstad (2001). The costs of the fixed exchange rate regime in 1990-1993 may equally be viewed as the necessary price for restoring confidence in a credible nominal anchor, which had been eroded in the decade of devaluation from 1976 to 1986. The price would have been even higher if it had not been possible to conduct an expansionary fiscal policy in this period.

[23] Interview in *Dagens Næringsliv*, 22 September 1989.

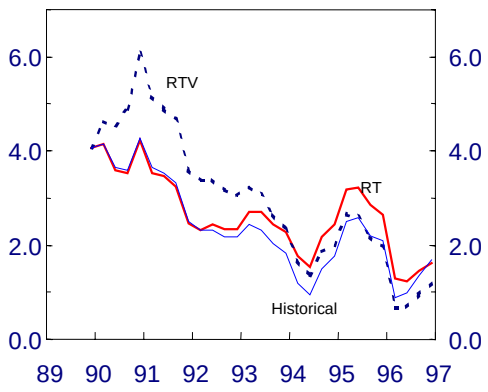
Charts 3a and 3b. Economic developments in the early 1990s with a Taylor interest rate

Chart 3a. Output gap



Source: Eitrheim and Qvigstad (2001)

Chart 3b. Inflation



Source: Eitrheim and Qvigstad (2001)

The episode at the beginning of the 1990s in Norway in which the cyclical upturn did not materialise is an example of changes in the preconditions for monetary policy which are not ascribable to revisions of economic data as in the two examples above, but primarily to new information ("German reunification").

How accurate were Norges Bank's forecasts?

Norges Bank draws up its own forecasts that are published in the *Inflation Report*.[24] The estimates in the *Inflation Report* serve as the basis for Norges Bank's conduct of monetary policy. It is therefore important that the forecasts are reliable. But how accurate are they?

Madsen (1996) studied this for the period 1987-1994. He compared Norges Bank's forecasts with those of other forecasters. Even though there are some minor differences between the forecasters, Madsen's analysis shows that Norges Bank's projections were just as accurate as those of the OECD, the Ministry of Finance and the Norwegian Bankers' Association. With the exception of general government consumption and variables that are influenced by developments in the petroleum sector, the forecasts of the four institutions provided a better picture of economic developments than "naive" forecasts based on the assumption that growth in the following year would be the same as growth this year. The forecasts are measured in relation to national accounts figures. Madsen points out that the size of the forecast errors must be seen in the light of the uncertainty associated with preliminary national accounts figures.[25] He found that the average absolute error for Norges

[24] The Inflation Reports are published on www.norges-bank.no

[25] The final "answer" is not known until May in year t+3. But even in year t+3 we do not know what the ultimate answer will be inasmuch as main revisions to the national accounts are made. National accounts were established in Norway in the mid-1930s. The last main revision was the fourth to be carried out. More than 20 years had passed since the previous main revision. Earlier main revisions took place at approximately ten-year intervals. The last main revision resulted in a marked upward revision of service sectors. This will probably also be the case for future main revisions. Today, the national accounts are based on a system that is best suited to goods-producing industries. This is particularly problematic for measuring value added in financial industries. This is the subject of considerable debate and ongoing efforts in international national accounts circles. One would think that similar problems will increasingly apply to the IT industry. According to Fløttum (1995), the frequency of future main revisions will be evaluated on the basis of the experience of the last main

Bank's forecasts for growth in mainland GDP was 1.3 percentage points. Preliminary national accounts figures, which are normally published in February the year following the forecast year, were off the mark by an average 0.9 percentage point compared with final national accounts figures.

Norges Bank's forecasts for 2000 have been subject to fairly extensive revisions

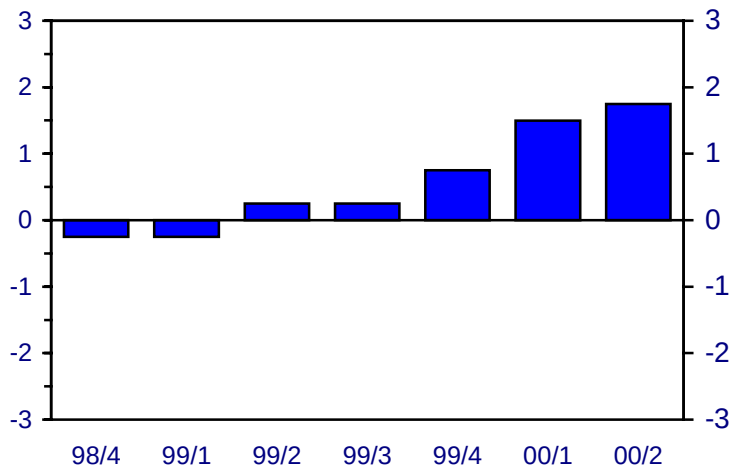
The relationship between monetary policy and forecasts can be exemplified by a recent episode: Norges Bank's forecasts for 2000. The forecasts were revised fairly extensively through 1999 and the first quarter of 2000. When the basis for monetary policy has changed, does that mean monetary policy was inappropriate in 1999? We will show that Brainard's principle from 1967 indicated that this was not the case.

But let us start with a quick glance at the macroeconomic situation at the beginning of 1999.

The Norwegian economy expanded at a brisk pace from the early 1990s to mid-1998. At the end of this cycle, wage growth was very high, fiscal policy was not sufficiently tight, international financial markets were turbulent and oil prices were low. The prospects for the Norwegian economy were highly uncertain. A cooling of the economy was necessary in order to avoid overheating. Norges Bank's key rate was raised to 8 per cent in August 1998 in order to contribute to nominal stability, and economic growth started to slow. Norges Bank anticipated a growth pause, or even negative growth, for a period. This was the picture of the Norwegian economy presented in the December 1998 *Inflation Report* and in the March 1999 *Inflation Report*.

The forecasts for the Norwegian economy remained more or less unchanged from the December 1998 *Inflation Report* to the March 1999 *Inflation Report*, but thereafter they were subject to a series of upward revisions up to June 2000. Chart 4 shows developments in the estimates for mainland GDP in the period mentioned.

Chart 4. Norges Bank's estimates for mainland GDP for 2000 at variouspoints in time



revision. There are many indications that revisions should be carried out more frequently than every ten years.

Between the December 1998 *Inflation Report* and the June 2000 *Inflation Report*, the forecast was revised upwards by 2 percentage points. A revision of this magnitude is greater than the average forecast error[26] and substantially greater than the average error in the preliminary national accounts in relation to the final national accounts.[27]

We will not take an in-depth look here at why the forecasts have been so extensively revised, but this episode is probably ascribable to the following three factors: revisions of economic data, new information and a change in perceptions.

- *Revisions of economic data*: short-term statistics gave a mixed picture through the year. For example, the retail sales index did not indicate that growth in private consumption would accelerate through the year. A different picture emerged on 14 January 2000 when the retail sales index for the period from May to November 1999 was revised up substantially, particularly the August figures which were revised up by 1.8 per cent. The average volume index for this seven-month period has since been revised up by 1.2 per cent. The upward revision provided a different picture of developments in consumption through the year. In the December 1999 *Inflation Report*, some indicators showed that the pause in growth was over, although the overall available data did not indicate this. The basis was provided by the quarterly national accounts published in February 2000. The accounts showed that the growth pause came to an end in the summer of 1999, and that growth through the second half of 1999 and into 2000 had picked up considerably.
- *New information*: international growth prospects have changed substantially. At the beginning of 1999, the Asian crisis was still not behind us. It was unclear how fast these economies would recover. International financial turbulence after the collapse of the financial system in Russia, the crisis in Brazil and LTCM[28] had still not been resolved. The projection for GDP growth among Norway's trading partners for 2000 was 2¼ per cent in December 1998. In March 2000, the estimate was 3 per cent. Furthermore, the balance of risks had shifted. In December 1998, there was a substantial downside risk, while in March 2000 there was an upside risk.
- *A change in perceptions*: in the autumn of 1998 and the spring of 1999, Norges Bank placed considerable emphasis on supply-side mechanisms. Capacity utilisation in the Norwegian economy was so high that it would hardly have been possible to increase production to any extent. The production ceiling had been reached. High capacity utilisation would thus lead to deteriorating competitiveness and spill over to demand by reducing investment and market shares in both export markets and the home market. It now appears that the ceiling has not been reached. The perception is that it is still possible for the Norwegian economy to expand by about 2 per cent after the growth pause was over in the summer of 1999.

[26] The average forecast error is 1.3 percentage points, cf Madsen (1996).
[27] The Bank of England publishes a confidence interval for the projections in its inflation report. The confidence interval for GDP growth 1–2 years ahead is about 3½% (90% interval), see shaded area in Chart 4. If the final accounts for mainland GDP growth in Norway are in line with the forecast in the June 2000 *Inflation Report*, the forecast in the December 1998 issue will show an error that is outside the confidence interval of the Bank of England.
[28] Long Term Capital Management

The monetary policy objective in Norway

A presentation of the monetary policy management system in Norway will shed light on the relationship between Norges Bank's forecasts and monetary policy management.

The political authorities have assigned a mandate to Norges Bank for the conduct of monetary policy. The mandate is laid down in the Exchange Rate Regulation adopted by Royal Decree of 6 May 1994. Section 2 of the Regulation states:

> *"The monetary policy to be conducted by Norges Bank shall be aimed at maintaining a stable exchange rate against European currencies, based on the range of the exchange rate maintained since the krone was floated on 10 December 1992. In the event of significant changes in the exchange rate, monetary policy instruments will be oriented with a view to returning the exchange rate over time to its initial range. No fluctuation margins are established, nor is there an appurtenant obligation on Norges Bank to intervene in the foreign exchange market."*

The first sentence in the Regulation implies a managed float. Instruments shall be oriented towards stability in the krone exchange rate against European currencies. Since 1 January 1999, Norges Bank has defined the reference *"European currencies"* as the euro. The Regulation does not stipulate a central rate with fluctuation margins. Norges Bank understands the concept "*initial range*" to mean a broadly defined central rate around which the krone is permitted to fluctuate. The second sentence in the Regulation refers to "*significant changes*" in the exchange rate in relation to the initial range. The concept "*significant changes*" is not quantified. "*Significant*" must thus be given an economic content. A reasonable interpretation is that a "significant change" is a change that influences expectations concerning price and cost inflation to the extent that a change in the exchange rate becomes self-reinforcing.

The expressions "*with a view to*", "*over time*", "*oriented towards*", and "*based on*" show that the Exchange Rate Regulation provides Norges Bank with scope to exercise discretion. In doing so, Norges Bank focuses on three fundamental preconditions for exchange rate stability:

- In order to achieve exchange rate stability against the euro, monetary policy instruments must be oriented towards reducing price and cost inflation to the level aimed at by the European Central Bank (ECB).
- At the same time, Norges Bank must prevent monetary policy from contributing to deflationary recessions as this may weaken confidence in the krone.

Implementation of monetary policy in 1999 and 2000

Norges Bank's *Inflation Report* provides an overview of developments in prices and factors that influence price and cost inflation. It contains a presentation of the prospects for the Norwegian economy and provides Norges Bank's best professional assessment of price inflation two years ahead. The projections in the report serve as the basis for Norges Bank's execution of monetary policy.[29]

[29] In the 1990s, it has become increasingly common for central banks to publish an inflation report. Since the summer of 1994, Norges Bank has also published such reports, cf Holmsen and Qvigstad

Between the spring of 1998 and August 1998, Norges Bank raised its key rate from 3½ per cent to 8 per cent in order to promote nominal stability. This put a brake on economic growth and Norges Bank projected a pause in growth, or even negative growth, for a period ahead.

At the beginning of 1999, the situation had stabilised and on 27 January 1999 the key rate was lowered by half a percentage point. In this connection, Central Bank Governor Svein Gjedrem stated:

> *"A tight government budget for 1999 and high interest rates over the last five months are curbing pressures in the economy. Price and wage inflation will gradually be reduced. (…) In view of the appreciation of the krone and the prospect of reduced pressures in the economy, it is now appropriate to lower interest rates."*

Norges Bank reduced interest rates by a further half a percentage point on 3 March 2000. Three weeks later, the March 1999 *Inflation Report* was published (25 March 1999). The Governor wrote:

> *"Market participants expect a substantial reduction in interest rates over the next year. Such expectations may also find support in the assessment of the Norwegian economy that is presented in this report."*

In 1999, Norges Bank reduced interest rates on several occasions, with the last reduction made at the meeting of the Executive Board on 22 September 1999 when the key rate was set at 5.5 per cent.

After each meeting of the Executive Board at which interest rates were on the agenda (once a month), a press conference was held. The general sentiment through 1999 was that a reduction in interest rates was likely, cf leader in the March 1999 *Inflation Report* entitled "Gradual Fall in Interest Rates".

At the meeting of the Board in February 2000, the formulation was changed to the following:

> *"In the light of recent trends in the economy and the balance of risks, the probability that the next change in interest rates will be a reduction is equal to the probability of an increase."*

At the Board meeting in March 2000, the formulation was:

> *"In the light of recent trends in the economy and the balance of risks, the probability that the next change in interest rates will be an increase is greater than the probability of a reduction."*

At the Board meeting on 12 April, the Executive Board decided to raise the key rate by 0.25 percentage point. At the meeting on 14 June, the Board decided to increase the key rate by a further 0.50 percentage point, bringing Norges Bank's sight deposit rate to 6.25 per cent. In this connection, the Governor stated:

(1999). The report is an important instrument for the Bank's economic policy advisory role and plays an essential part in enabling the Bank to satisfy the statutory requirement of informing the general public.

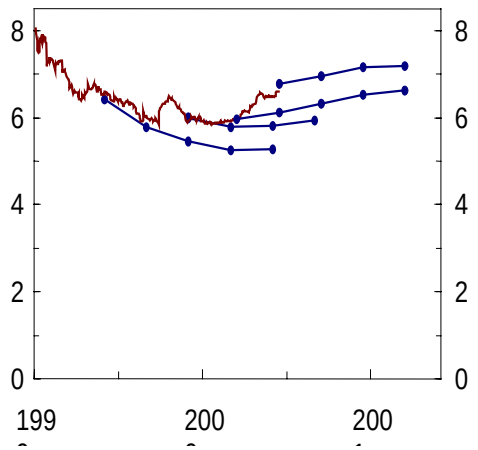
> *"The risk of a downturn in the economy appears to be limited. In the light of recent trends in the economy and the balance of risks, the probability that the next change in interest rates will be an increase is greater than the probability of a reduction."*

Changes in the outlook for interest rates are also reflected in market rates. FRA rates are agreements on future rates that are traded in the market. Chart 5 shows developments in actual, observed 3-month money market rates and FRA rates between January 1999 and June 2000. Chart 6 shows developments in the same money market rates and estimated forward rates converted into 3-month rates.

Between January and March 1999, money market rates fell from 8 per cent to 7 per cent. The market anticipated a further drop in rates. In March 1999, the market estimated that the money market rate would range between 4½-5 per cent one year ahead. The actual money market rate in March 2000 turned out to be 6 per cent.

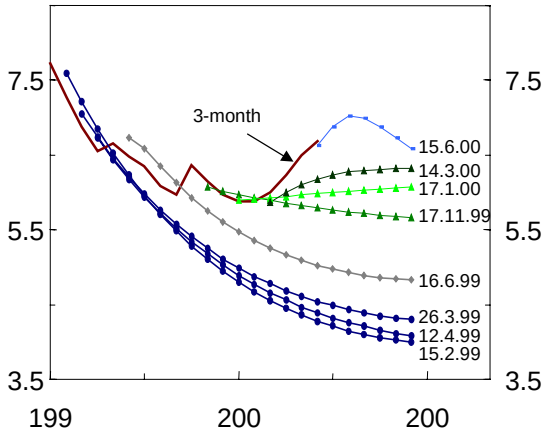
Throughout 1999, market participants expected a further fall in rates. Interest rate expectations were gradually raised (see chart). At the beginning of 2000, interest rate expectations were neutral and in March 2000 the market expected interest rates to rise in the period ahead. We see that market expectations changed in line with the Central Bank Governor’s statements.

Chart 5. Actual 3-month rate and FRA rates since January 1999



Source: Norges Bank

Chart 6. Actual 3-month rate and forward rates since January 1999



Source: Norges Bank

In the spring of 1999, the market expected interest rates to fall below 5 per cent because of the trends and balance of risks in the Norwegian economy prevailing at that time.

Why did Norges Bank not reduce interest rates immediately to the level the market considered appropriate? Norges Bank and the market had access to the same economic data. Norges Bank's analyses in the *Inflation Report* were based on market expectations concerning interest rates. The *Inflation Report* presented a path for inflation and a general macroeconomic situation that was fairly balanced. The answer is that the central bank followed Brainard's principle:

- Developments were uncertain
- There was uncertainty as to how interest rates affected the Norwegian economy

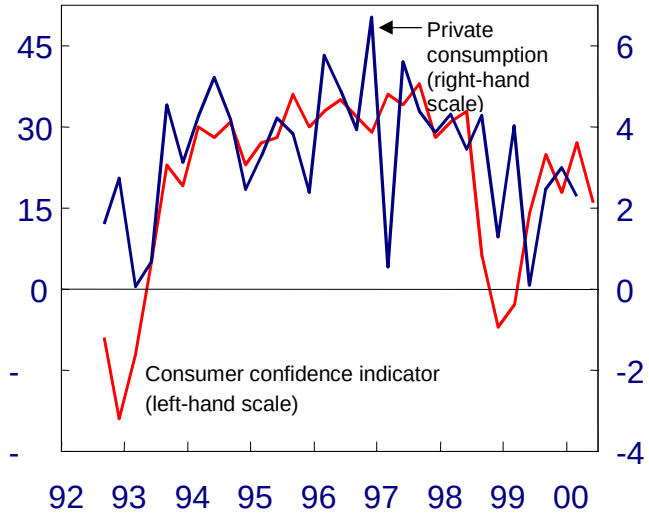
By adopting a gradual approach, Norges Bank gained knowledge about both points.

Given Norges Bank's mandate, the prospects for the Norwegian economy and the balance of risks form the basis for the interest rate outlook. In 1999 and into 2000, there was a fairly substantial change in the prospects for the Norwegian economy and the balance of risks.

We have short-term statistics that measure expectations (general business tendency survey and the consumer confidence indicator). The international trend is towards increased emphasis on these types of survey ("Market waiting for IFO survey" in Germany). It is probably important to continue along this path. Maybe Norges Bank should feel a special responsibility since the central bank in its conduct of monetary policy is particularly dependent on forward-looking analyses?

Chart 7 shows the consumer confidence indicator. It seems that the indicator captures actual changes in retail sales 1-2 quarters before the index changes. This index can serve as a good example of modern confidence indicators that reflect changes in agents' behaviour at an early stage.

Chart 7. Consumer confidence indicator (level) and private consumption (four-quarter rise, percentage)



Source: Statistics Norway and Norsk Gallup Institutt

What would the interest rate path have been if the central bank had conducted an extremely active policy and reduced the interest rate immediately to the level the market expected in the course of a year? Charts 5 and 6 show that the market systematically expected interest rates to move to a lower level than actual developments. The chart shows that if Norges Bank had lowered the interest rate in line with market expectations, the central bank would have set the interest rate too low. This shows that it is important to refrain from placing excessive emphasis on market expectations when Norges Bank forms an opinion as to the appropriate interest rate level.

By taking a measured approach, abrupt changes in interest rate policy are avoided. Forecasts for the Norwegian economy will always be shrouded in uncertainty. We have discussed episodes where substantial changes in the figures are due to revisions of data, new information and changes in perceptions. If one were to have a fairly sound basis for conducting an "appropriate" monetary policy, monetary policy should have been conducted three years after the fact.

Lessons to be learned

One lesson to be learned from this review is that the concept "real-time data" should perhaps be used to a greater degree in economic analyses. Most economists are aware of the problem, but perhaps some have not taken this sufficiently into account. Central banks may be criticised for mistakes they make when they change their perceptions. However, they cannot be blamed for incorrect data or new information – only for carrying out unsound analyses on the basis of the information available.

It goes without saying that no effort should be spared in producing high-quality short-term statistics, good national accounts and accurate forecasts. Perhaps more attention should be devoted to producing short-term statistics that measure expectations?

Monetary policy must be forward-looking. Simple rules are simple, and it is difficult to say that one should disregard all available information. However, simple rules may serve as useful "cross bearings". One advantage of simple rules is that they require less data, and there is therefore less scope for error.[30]

There are strong arguments for adopting a gradualist approach to setting interest rates, but from time to time it may be necessary to show a willingness to use the interest rate instrument forcibly if nominal stability itself is threatened (or if there is a risk of a recession).

There is also a trend towards greater transparency. The mandate is clarified, and there is transparency surrounding decisions. The basis for decision- making is made public (eg in inflation reports), and there is transparency as to the economic model used.

It is important that Norges Bank's monetary policy is subject to critical analysis. However, a fair assessment takes into account that monetary policy is conducted in real time.

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[30] The European Central Bank has a two-pillar strategy. The first pillar is based on a very simple rule, namely that nominal GDP must grow in pace with the money supply in the long term. This is not a rule that is particularly operational on a month-to-month basis, but it can provide a certain degree of guidance for a horizon of several years. The second pillar is based on using all available information, cf Blinder's general approach.

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