Simple monetary policy rules

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This article describes two simple rules, the McCallum rule and the Taylor rule, that could in principle be used to guide monetary policy. It then applies the rules to past UK data. In the United Kingdom, monetary policy decisions are based on a thorough assessment of the prospects for inflation rather than on one simple rule or single indicator. But simple rules can have a useful complementary role alongside all the other information within a pragmatic approach to monetary policy.

Policy rules

There has been a long academic debate about whether monetary policy is better conducted by following predetermined rules or by the exercise of discretion. As a matter of principle, an optimal monetary policy rule depends critically on the relationship between the policy instruments and economic outcomes and on the relationships among the economic variables. In practice, these relationships have not been very clearly understood and it has not been possible to identify rules which are so robust as to eliminate the need for some discretion in monetary policy. Nevertheless, analysis of what a rule-based monetary policy would entail can provide useful guidance in the exercise of discretion. This article discusses recent thinking about monetary policy rules.

Monetary policy rules have a long history, dating back to the Gold Standard. Many academics have proposed operational rules for monetary policy, of various degrees of complexity. One well-known example of a particularly simple rule is Friedman's (1959) *k*% rule—a proposal to keep money growth to a fixed percentage each period; see also Simons (1936). Since then there has been considerable interest in evaluating a variety of policy rules.(1)

In practice, the rules which have been followed by the United Kingdom in the past have often had some flexibility built into them. And the distinction between rules and discretion has been a matter of degree rather than polar opposites. For example, the Gold Standard allowed some flexibility: a country could leave the Gold Standard for a period and return later having pursued corrective policies in the meantime. The Bretton Woods system included an adjustable peg provision to allow for step changes in the parities of currencies. Monetary targets generally have not operated in a rigidly inflexible fashion. And, within the exchange rate mechanism (ERM), sterling could fluctuate by 6% either side of its central parity (though other currencies operated within a narrower band). Sometimes the flexibility contained in the regime was not used—perhaps to avoid damaging the perceived credibility of the regime. However, flexibility has been useful because of uncertainty about whether the rule or regime was the right one to follow under all conditions.

Recently, there has been a revival of interest in the United States in the possible use of simple monetary policy rules as a guide to discretion.(2) A number of authors—including McCallum (1988) and Taylor (1993)—have suggested simple rules which adjust the policy instrument in response to observed deviations of policy objectives from target or trend. For example, the Taylor rule proposes that the level of interest rates should depend on the rate of inflation relative to its target and the level of output relative to trend. These are generally termed feedback rules, as the policy instrument feeds back in response to economic outturns. Taylor's article compares the interest rate path indicated by his rule with the actual path of US interest rates over the period 1987–92 and finds them to have a close correspondence.

The operation of monetary policy in the United Kingdom currently has some of the characteristics of a rule, albeit one which is quite complex and requires the use of judgment. The authorities form a forward-looking assessment of inflation, and then act through monetary policy to offset any deviation between this projection and the stated inflation target. This has something in common with a feedback rule—although the feedback is from a projection rather than an outturn. One of the benefits of such an approach is that policy can take account of a wide range of indicators—real and monetary, quantitative and qualitative. And such an approach has the attractive feature that monetary policy feeds back from all those variables which affect the path of the final objective.

Even under this approach to monetary policy, simple policy rules can still have a role to play. Simple rules based on data outturns can offer a straightforward summary of the main macroeconomic influences on policy—and one which can be monitored in a timely and objective fashion. They

(1) See, for example, Levine and Currie (1985) and Bryant, Hooper and Mann (1993).
(2) Alan Blinder's remarks to the Senior Executives Conference of the Mortgage Bankers Association, New York, 10 January 1996; Janet Yellen's remarks to National Association of Business Economists, Washington DC, 13 March 1996.

provide information which complements—but does not substitute for—the information from the wide range of other variables which enter the authorities' forward-looking inflation assessment. With this in mind, this article considers the rules proposed by McCallum and Taylor to assess their usefulness in this role.

The McCallum and Taylor policy rules

The McCallum and Taylor rules for the setting of the monetary policy instrument have a number of technical differences, but are fundamentally similar. The policy instrument in the McCallum rule is base money, whereas in the Taylor rule it is short-term interest rates. Although the policy instrument in the United Kingdom is short-term interest rates, both rules can provide useful information—for example, the McCallum rule could be interpreted as a dynamic monitoring range for base money. Both rules allow for feedback. The McCallum rule feeds back from deviations in *nominal income* from an assumed target path and the Taylor rule feeds back from deviations in *inflation* from target and *output* from trend. The feedback rule suggests that monetary policy should be tighter than 'a neutral stance' when output is above trend and inflation is above target, and easier than 'neutral' in contrary circumstances. In that way monetary policy 'leans against the wind'.

The inclusion of feedback also illustrates that the appropriate monetary stance is by no means static. For example, if the rate of inflation changes then, according to the rules, the appropriate level of policy instrument will also change: otherwise, for example, leaving nominal interest rates unchanged in an environment of rising inflation would constitute a loosening of monetary policy.

The McCallum rule

The McCallum rule derives the nominal growth of base money (M0 for the United Kingdom) which is consistent with delivering a nominal GDP target. The feedback rule is specified in terms of deviations of nominal income growth from target.

$$m = k^* - v_{t-1} + \lambda(x^*-x)_{t-1}$$

where $x_t^* = x_{t-1} + k^*$ is the nominal income growth target.(1)

In this formulation m is the quarterly growth of the monetary base; x is the log of money GDP and a * denotes a target value. The rule has three terms. First, the constant term k^* fixes the path for steady-state nominal income growth—it is akin to the k% in Friedman's rule. Second, v_{t-1} is an adjustment for changes in the velocity trend of the monetary base. The velocity trend is measured by a 16-quarter moving average so that only long-lasting changes rather than cyclical factors are captured.

Third, the feedback term $(\lambda(x^*-x)_{t-1})$ allows for monetary policy to be tightened or loosened from a 'neutral stance' according to the deviation of nominal income from the assumed target. The larger the value set for λ, the greater the speed with which deviations between actual and target nominal income are offset by policy actions. The feedback term is defined here in terms of nominal income *growth* (rather than levels) and so it gives equal weight to *changes* in the output gap and deviations of inflation from target. This makes the feedback term similar, but not identical, to that in the Taylor rule. In the Taylor rule, the feedback term is set up as the *level* of the output gap and the deviation of inflation from target; and different weights can be applied to the output and inflation terms.

The Taylor rule

The Taylor rule indicates a nominal interest rate (i) which reflects movements of a real interest rate (r) away from equilibrium according to a reaction function which gives weight to deviations of output from trend and of inflation from target. The Taylor rule is consistent with an inflation target: it is designed in such a way as to dampen deviations of output from trend in achieving the inflation target. Taylor's original specification used current levels of inflation and the output gap, but, in practice, outcomes for the current inflation rate and output gap are known only with a lag. In the specification below, the inflation and output data are included after a lag of one quarter.

$$i = p_{t-1} + w1((Y-Y^*)/Y^*)_{t-1} + w2(p-p^*)_{t-1} + r^*$$

Where p is the annual inflation rate (using RPIX rather than the GDP deflator which is used in the McCallum rule), p^* is the inflation target, r^* is the equilibrium real interest rate and $(Y-Y^*)/Y^*$ is the output gap. $w1$ and $w2$ are the weights given to deviations of output and inflation from their respective trend and target.

Assessing the performance of the rules

Assessing the rules depends on the purpose for which they are to be used. Previous studies have investigated how well monetary policy based on the rules would have performed if the rules had been operational over history, using counterfactual simulations.(2) However, our interest here is not in re-running history but in assessing whether the rules would have provided useful information about the policy stance in particular episodes. This is done by looking at whether past policy errors can be identified by observing the divergence of actual policy from the paths implied by the rules based on historical data (rather than simulations). This

(1) In his work McCallum used a number of different formulations for the nominal income target including a levels target, a mixed levels and growth target, and a growth target. A levels target ensures that any lapse from the target in previous quarters is fully recovered. However, such a rule was not used here because it is difficult to apply it to UK historical data. The cumulative divergence of the price level from a target path, induced by high inflation in the 1970s and late 1980s, means that it is unrealistic to assume that this overshoot might be clawed back.

(2) The results are then dependent on the underlying models which are used for the purposes of the comparison. Therefore, studies have looked at rules in relation to a wide set of different macroeconomic models. McCallum (1988, 1990a, 1993) found that the McCallum rule would have performed favourably in stabilising prices and GDP in the United States and Japan. A recent *Bank of England Working Paper,* 'Base money rules in the United Kingdom', by Haldane, McCallum and Salmon (1996) assessed the McCallum rule for the United Kingdom against a number of other models and concluded that the rule appeared to perform well across a range of macro-models.

is an imprecise exercise because policy objectives and regimes will have varied over the period.(1) This means it is more useful to look at the broad trends of the rules compared to the trend in actual policy rather than to compare point estimates. Notwithstanding these problems, how do the rules track UK policy and can they identify policy errors?

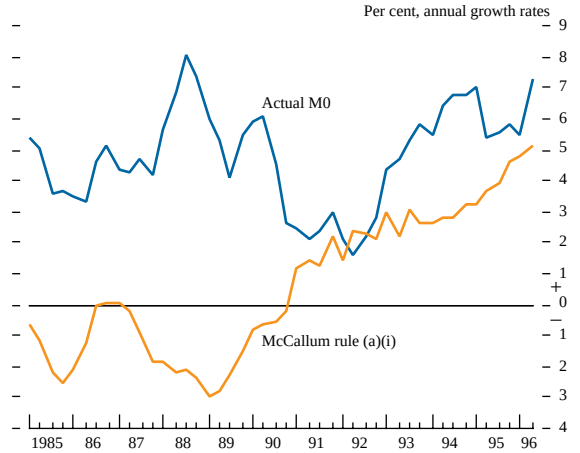
The rules based on historical data

The charts show what the McCallum and Taylor rules would have signalled for monetary policy applied to UK data since 1985, based on the following assumptions:

- The inflation target is taken to be 2.5% and trend output growth is calculated as the average rate of output growth from peak to peak over the latest three cycles, which is around 2.2%.
- The weights (λ, $w1$ and $w2$) given to the feedback terms are all assumed to be 0.5. These were the weights used by Taylor in his illustration of the Taylor rule for the United States and they fitted well when applied to historical data, while applications of the McCallum rule have generally used a value of around 0.5 in simulations.
- In the Taylor rule, the equilibrium real interest rate (r^*) is calculated as a two-year moving average of the yield on ten-year index-linked bonds; this was generally close to 3½% over the sample period. This is assumed to proxy a long-run average of short-term real interest rates.

Chart 1 shows a wide excess of actual M0 growth over the McCallum rule between 1985 and the end of 1989. This widened from the beginning of 1987. The annual growth rate of M0 picked up from a trough at the beginning of 1986 and rose to a peak of 8% in 1988 Q3. But the McCallum rule suggested that M0 should have been falling at that time.(2) And the rule indicated a tightening about a year earlier than the first upward movement in UK interest rates in the middle of 1988.

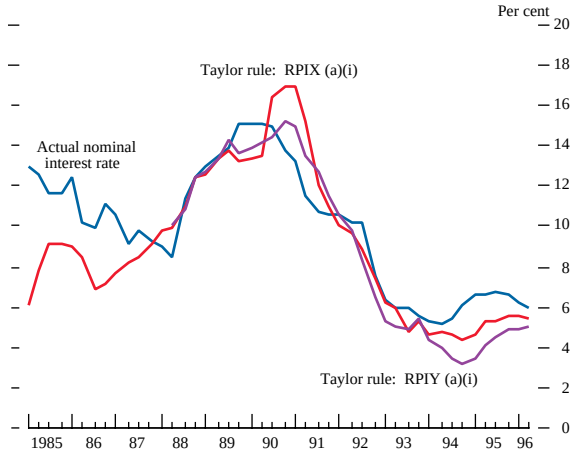
Chart 1
Illustrative McCallum rule for M0



(a) Output gap calculated as long-term growth, average over latest three cycles.
(i) Weight on feedback rule 0.5.

The Taylor rule, shown in Chart 2, like the McCallum rule, indicated an earlier tightening of policy than actually occurred in the mid to late 1980s. While actual nominal interest rates continued to decline until the middle of 1988, the Taylor rule suggested a trough in interest rates in 1986 Q3.

Chart 2
Illustrative Taylor rule for nominal interest rates



(a) Output gap calculated as long-term growth, average over latest three cycles.
(i) Weights on feedback rule: output 0.5, inflation 0.5.

The McCallum and Taylor rules gave varying messages about monetary policy during the United Kingdom's membership of the ERM and immediately afterwards. Actual M0 growth was fairly close to that implied by the McCallum rule during 1990–92, though the rule suggested that M0 should be accelerating. By the middle of 1992, M0 implied by the McCallum rule was growing faster than actual M0. This perhaps suggests that actual policy had become a little tighter. Thereafter, actual M0 growth picked up once more but McCallum rule growth remained steady, suggesting that policy had eased. The Taylor rule tracked actual interest rates fairly closely throughout the United Kingdom's membership of the ERM and continued to do so during 1992 and 1993.(3)

Currently, both the McCallum and Taylor rules are fairly close to actual policy. According to the McCallum rule, policy (measured by monetary base growth) has been on the easy side over the past few years, but has been closer to the position implied by the rule since the middle of 1995 (the acceleration of actual M0 in 1996 Q2 may be temporary and related to the Euro '96 football tournament). The pick-up in

(1) One further potential criticism of the Taylor rule is that it may be purely descriptive and describe the Fisher equation, where nominal interest rates equal real rates plus expected inflation. If that were the case, the Taylor rule would track nominal interest rates irrespective of whether policy was on or off track.
(2) The negative rates of growth of M0 implied by the rule probably indicate that the authorities' objectives were in practice different during the late 1980s from the assumptions made above. If the level of the output gap had also been included in the rule, this may have increased the McCallum rule growth.
(3) The introduction of the Community Charge in 1990 and the changes to VAT which came into effect in April 1991 had an impact on RPIX, which caused part of the movement in the Taylor rule over that period. Therefore, the chart shows the Taylor rule based on RPIY—which excludes indirect taxes—as well as RPIX. The peak in the rule was lower using RPIY.

M0 growth implied by the McCallum rule partly reflects the slowdown in M0 velocity which began in the early 1990s and which is captured in the rule by the velocity adjustment (v_{t-1}). The shift in velocity may be explained by a slowdown in the pace of financial innovation and the move to a low inflation environment which may have increased the demand for cash.(1) According to the Taylor rule, policy (as measured by interest rates) has been on the tight side over the past couple of years, but again is now closer to the rule.

The retrospective evidence suggests that the McCallum and Taylor rules might have provided useful information about the policy stance. However, the signals provided by the rules would have been less clear if they had been monitored at the time, because the output data included in the feedback terms are subject to substantial revision after first publication. In this context it is interesting to consider the period 1986–88 because the output data for these years have been substantially revised and the rules indicated policy actions different from those actually taken. Charts 3 and 4 show the policy which the rules indicated using the first published estimate of GDP for each quarter and the final (revised) GDP data.

Chart 3
Illustrative McCallum rule for M0 1986–88 using GDP first and latest estimates

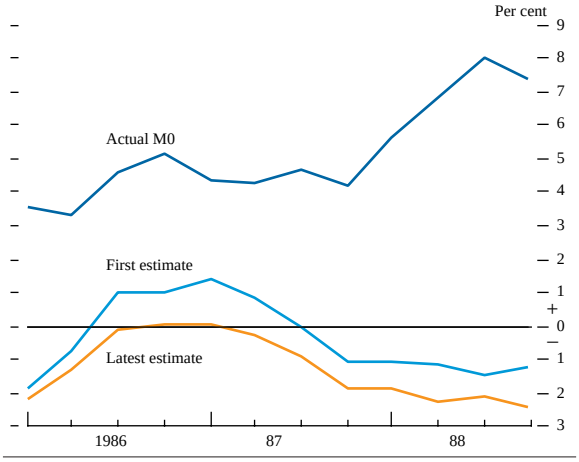
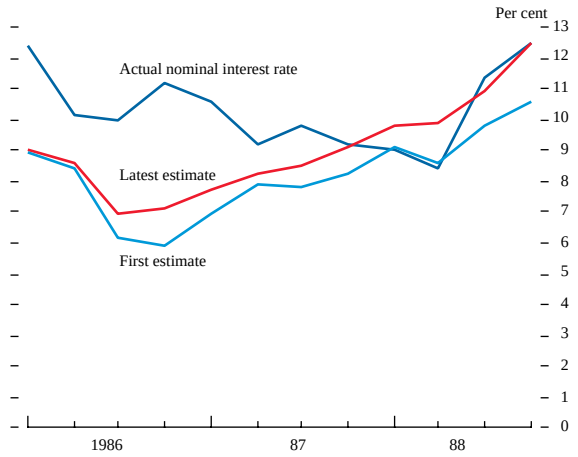


Chart 4
Illustrative Taylor rule for nominal interest rates 1986–88 using GDP first and latest estimates



Both rules still indicate a policy tightening earlier than 1988. However, in early 1988 the Taylor rule, based on the first estimate of GDP, indicated a level of interest rates very close to the actual level. Thereafter, the Taylor rule indicated interest rates lower than actual interest rates—the latter rose more quickly than those indicated by the rule. However, the same rule based on the (revised) data available today indicates a level of interest rates around 100 basis points higher than the first estimate during 1988.

These historical comparisons illustrate both the uses and limitations of the two rules. The rules are sensitive to the assumptions on which they are based—though this is true of any model of the economy. And, as a robustness check, it is informative to examine the assumptions underlying the rules.

Assumptions underlying the rules

The output gap

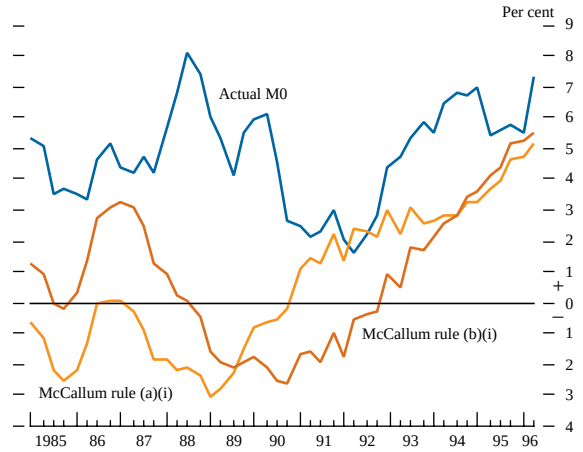
Both rules require knowledge of the size of the output gap. The output gap concept is theoretically appealing, but in practice is hard to measure.(2) First, there is considerable uncertainty about the potential or trend growth rate of output. Second, even if the potential growth rate was known, actual output statistics are subject to substantial revision.

The trend output growth used in Charts 1–4 was based on an atheoretical calculation which results in trend growth of around 2.2%. One alternative—which is also an atheoretic approach—is to calculate the trend growth of output as a centred moving average of output growth over 16 quarters. Other more sophisticated and structural methods of measuring potential output growth could be used—for example, using measures of capacity utilisation or using an explicit production function. However, the two simple, atheoretical measures are sufficient to illustrate the sensitivity of the rules to the measurement of the output gap.

The two measures result in very different values for the output gap and consequently for the M0 growth and nominal interest rates implied by the policy rules under consideration (see Charts 5 and 6). For example, a difference of ½% in the annual trend rate of growth cumulates to a difference in the output gap of 2½% over five years—which translates into large differences in the policy indications of the rules (exactly how large depends on the weights attached to the feedback rule).

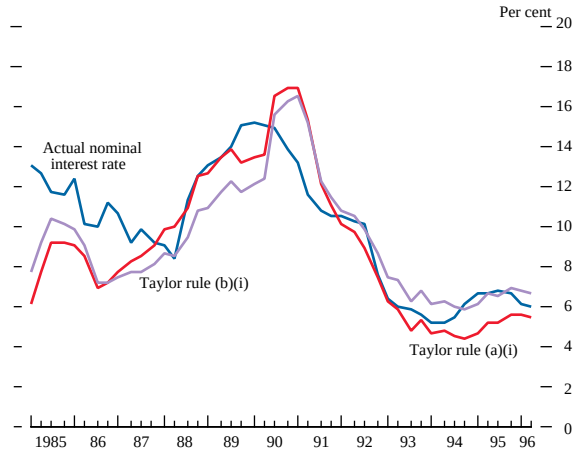
(1) This was discussed in detail in the article by Janssen, N (1996), 'Can we explain the shift in M0 velocity? Some time series and cross-section evidence', *Bank of England Quarterly Bulletin*, February, pages 39–50.
(2) The problems involved in measuring the output gap were discussed in the *Inflation Report*, August 1994, pages 25–27. The issue was also covered by the Treasury's Panel of Independent Forecasters: 'How fast can the economy grow? A special report on the output gap', June 1996. In this report, the forecasters' measurement of the short-term output gap ranged from -1/4% to 3% and measurement of the long-term output gap ranged from 0%–7%.

Chart 5
Illustrative McCallum rule for M0 using different output gaps



(a) Output gap calculated as long-term growth, the peak-to-peak average over the latest three cycles.
(b) Output gap calculated as moving average, long-term growth.
(i) Weight on feedback rule 0.5.

Chart 6
Illustrative Taylor rule for nominal interest rates using different output gaps



(a) Output gap calculated as long-term growth, the peak-to-peak average over the latest three cycles.
(b) Output gap calculated as moving average, long-term growth.
(i) Weights on feedback rule: output 0.5, inflation 0.5.

The equilibrium real interest rate

Another difficulty, which applies solely to the Taylor rule, is determining the appropriate level for the equilibrium short-term real interest rate. Theory suggests that the equilibrium real interest rate should be similar to the long-term trend growth rate. Taylor uses 2% in his work for the United States, which is close to trend growth. However, direct calculations of the real interest rate for the United Kingdom observed from the yield on ten-year index-linked bonds (which might be expected to represent a proxy for a long-run average of short-term real rates) have averaged around 3½% since 1982—higher than most estimates of long-term trend growth. In addition, over the past 15 years *ex post* calculations of the long-term real interest rate in G10 countries, which might be expected to be a little higher than real short rates, have averaged close to 4%.(1) Changes in the equilibrium real interest rate have a one-for-one impact on the level of the nominal interest rate generated by the Taylor rule. Thus, different assumptions about the appropriate equilibrium real interest rate result in very different indications about the stance of monetary policy.

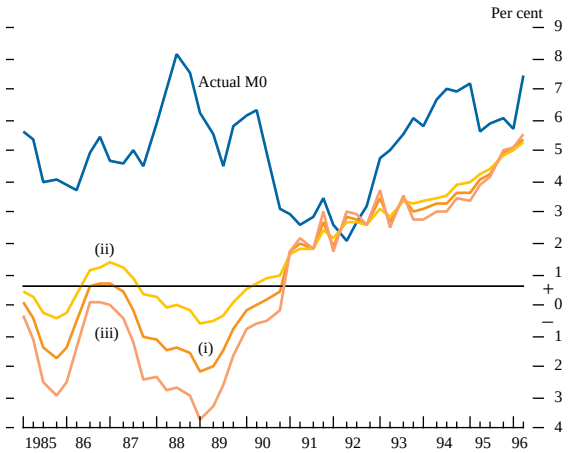
Specification of the feedback rules

The feedback rules incorporate a target for inflation, as well as an assumption about the trend growth of output. The charts are based on the current inflation target of 2.5% or less. But it is clear that over the past 30 years UK policy has not always been aimed at this objective. This means that historically the rules may be off-track simply because the policy objective was different.

The weights (λ in the McCallum rule, $w1$ and $w2$ in the Taylor rule) in the feedback rules are a simplified representation of the way in which monetary policy reacts to economic developments. They can be thought of as a description of a three-way trade-off among the speed and cost of offsetting deviations of inflation from target and output from trend, and inducing volatility in the monetary policy instrument. It is not clear what the ideal weights should be. In a model consisting of a reduced-form system of equations including a short-run Phillips curve trade-off, a Taylor rule which achieved an inflation target might well have higher weights on the feedback rule than Taylor applied.(2)

For illustrative purposes, a small range of arbitrarily chosen values for the feedback weights λ in the McCallum rule, and $w1$ and $w2$ in the Taylor rule, are used to show the sensitivity of the rules to different weights (Charts 7 and 8).

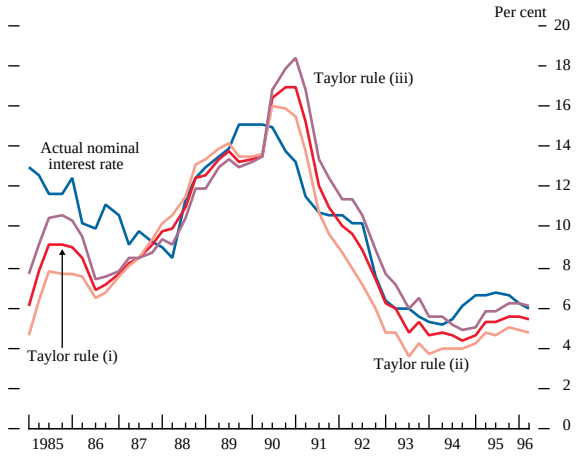
Chart 7
Illustrative McCallum rule(a) for M0 using different weights for λ



(a) Output gap calculated as long-term growth, the peak-to-peak average over the latest three cycles.
(i) Weights on feedback rule 0.5.
(ii) Weights on feedback rule 0.25.
(iii) Weights on feedback rule 0.75.

(1) The article 'Saving, investment and real interest rates', by Jenkinson, N (1996), in the *Bank of England Quarterly Bulletin*, February, pages 51–62, discusses the findings of the G10 Deputies Report and some Bank research on real interest rates in more detail.
(2) However, in simulations some studies have found that a weight of one or more in the McCallum rule causes deviations of nominal GDP from the reference path to oscillate explosively. See 'Base money rules in the United Kingdom', Haldane, McCallum and Salmon (1996).

Chart 8
Illustrative Taylor rule[a] for nominal interest rates using different weights for *w*1 and *w*2



(a) Output gap calculated as long-term growth, the peak-to-peak average over the latest three cycles.
(i) Weights on feedback rule: output 0.5, inflation 0.5.
(ii) Weights on feedback rule: output 0.75, inflation 0.25.
(iii) Weights on feedback rule: output 0.25, inflation 0.75.

In the Taylor rule, the weights of deviations of inflation from target and output from trend are also constrained to sum to one—though this restriction is not necessary and could easily be lifted. In the McCallum rule, changing the weight on the feedback term λ from 0.25 to 0.75, reduced M0 growth implied by the rule by 1.1 percentage points on average over the period 1985–95. In the Taylor rule, changing the weight *w*1 from 0.75 to 0.25 and *w*2 from 0.25 to 0.75 raised the level of interest rates implied by the rule by around 130 basis points on average.

Limitations of the rules in a forward-looking framework

Monetary policy has to be forward looking since policy actions affect inflation only with a lag. Therefore, the authorities form a forward-looking assessment of inflation over the next two years and set monetary policy accordingly. However, the McCallum and Taylor rules incorporate only a subset of the information available about the current and likely future path of inflation and output.

Thus, one of the limitations of the rules as guides to policy is that they ignore useful information about the prospects for inflation and activity from other forward-looking indicators. The other limitations of simple rules are comparable to the limitations of other approaches to monetary policy formulation—for example, the susceptibility to data revisions, and the problems of measuring the output gap and equilibrium real interest rate. The simple rules do not eliminate the need for some discretion in monetary policy—or the formulation of a more complex approach based on a thorough assessment of the prospects for inflation, as in the United Kingdom. However, the simple rules provide information which can usefully be taken into account alongside all other relevant information in the formulation of monetary policy.

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