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THE NEW UK MONETARY ARRANGEMENTS: A VIEW FROM THE LITERATURE*

Charles Bean

This paper considers the likely operating characteristics of the new UK monetary arrangements introduced in May 1997. The paper first argues that the time inconsistency of policy is not an issue provided the Bank of England is properly independent. However, the current inflation remit from the Chancellor to the Bank specifies a numerical target for the inflation rate, but does not specify how quickly deviations from the target are to be corrected. It is thus an incomplete contract, and there is a danger that the Bank may choose to stabilise inflation at the cost of excessively volatile movements in output, or *vice versa*. We estimate the optimal policy frontier for the UK economy and show that in practice it is close to rectangular. Consequently all the Bank needs to assume is that the government's preferences are 'reasonable' in order to know approximately where to locate on this frontier; the incompleteness of the remit therefore need not be a cause for concern.

1. The New UK Monetary Arrangements

In May 1997, the Chancellor announced that henceforth responsibility for the setting of interest rates would pass to the Bank of England. The model chosen for the new arrangements is one of instrument independence, but goal dependence, in that politicians are still responsible for setting the objective(s) of monetary policy – currently in the form of a target for inflation – whilst the Bank is then left free to set interest rates so as to achieve it. This arrangement is most similar to that currently in operation in New Zealand. It is in marked contrast to, say, Germany, where the Bundesbank is constitutionally obliged to maintain the value of the currency, but within that broad remit has considerable latitude in deciding the precise objective of monetary policy; the same is true of the new European Central Bank, the statutes of which are modelled on the Bundesbank.

Under the new arrangements the Chancellor of the Exchequer gives an annual remit to the Bank describing relatively precisely the objectives that the Bank is expected to pursue. As presently specified that remit is a target for the annual growth rate of the Retail Prices Index (excluding mortgage interest payments) of $2\frac{1}{2}\%$[1], although over an unspecified time horizon. Without prejudice to this target, the Bank is expected to set monetary policy so as to support the general economic policies of the government. It is explicitly recognised that the target will not be hit exactly, because of shocks and similar

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[1] Reasons for preferring a small positive number rather than zero, include the possibility that nominal wages and/or prices may be more rigid downwards than upwards (see Akerlof, Dickens and Perry, 1996), the need to ensure adequate variability in real interest rates in the face of the natural floor of zero to nominal interest rates, and possible upward biases in measured inflation due to inadequate allowance for quality change and new goods.

unavoidable control errors. However, it is expected that inflation will average $2\frac{1}{2}\%$ over a reasonably long time period.

If the annual inflation rate deviates more than 1% point either side of the $2\frac{1}{2}\%$ target, then the Governor of the Bank of England is expected to write an Open Letter to the Chancellor explaining the reasons for the divergence from the target, what actions the Bank's nine-member strong Monetary Policy Committee (MPC) is taking to bring inflation back to target, and how long the divergence is expected to last; subsequent letters will be sent quarterly until inflation is within 1% point of the target. The associated $1\frac{1}{2}\%$–$3\frac{1}{2}\%$ band is explicitly *not* intended as a target range, but rather as defining the points at which this Open Letter is triggered. The Chancellor can also override the Bank's decisions *in extremis*, but only in an open way, although the Chancellor and the government's views as to the appropriate direction that monetary policy should take can be transmitted to the Bank through the Treasury's (non-voting) representative on the MPC.

The new regime is supposed to ensure that monetary policy is conducted in an open and transparent fashion. Such transparency in both objectives and *modus operandi* should help to anchor private sector expectations, and is also a prerequisite for effective accountability. Transparency in objectives is achieved via the publication of the Chancellor's remit to the Bank. Transparency in policy formulation is achieved by: publication of the minutes of the MPC (with a maximum of a six-week delay); publication of a quarterly *Inflation Report* providing a fuller statistical picture behind MPC decisions; and regular appearances of the Governor and other members of the MPC before the Treasury Select Committee at which the rationale for interest rate decisions can be exposed to critical scrutiny. As far as accountability is concerned, the Governor and the MPC are accountable to: a reformed Court of the Bank of England, who are charged with the responsibility of ensuring that the MPC operates in an efficient manner, taking full account of available sources of information; to the Chancellor, through the aforementioned Open Letter; and to the Treasury Select Committee.

2. Is There a Credibility Problem?

A, if not *the*, central question about these arrangements is whether they will satisfactorily resolve the time inconsistency problem that is identified in the academic literature as the main reason for delegating monetary policy to an independent central bank. According to this literature, policymakers, although liking low inflation, and saying so, will nevertheless be susceptible to exploiting any short-run trade off between inflation and activity so as to generate more output. Knowing that the policymaker faces this temptation, private agents will then expect, and build into their wage and price decisions, a sufficiently high inflation rate to negate this temptation. The consequence is an inefficiently high inflation rate, with no gain in output.

The canonical model of this time inconsistency problem is due to Kydland

and Prescott (1977) and Barro and Gordon (1983). Output, y, is given by the 'surprise' supply function

$$y = \alpha(\pi - E\pi) + \varepsilon, \quad (1)$$

where π is inflation (the authorities control variable), ε is a zero mean i.i.d. supply disturbance, and $E\pi$ is the private sector's expectation of inflation, which are formed both before the supply disturbance is realised and before π is set. The authorities loss function is[2]

$$L = \pi^2 + \beta(y - y^*)^2, \quad (2)$$

where the target rate of activity, $y^* > 0$, is higher than the natural rate of output. The authorities observe the supply shock, ε, before setting inflation. In the absence of a 'commitment technology', the first-order condition associated with minimising (2) subject to (1) is

$$\pi(1 + \alpha^2\beta) = \alpha^2\beta E\pi + \alpha\beta(y^* - \varepsilon). \quad (3)$$

Under rational expectations it follows that the equilibrium inflation rate is

$$\pi = \alpha\beta y^* - \alpha\beta\varepsilon/(1 + \alpha^2\beta), \quad (4)$$

with $E\pi = \alpha\beta y^*$. This is dominated by the first-best policy

$$\pi = -\alpha\beta\varepsilon/(1 + \alpha^2\beta), \quad (5)$$

which generates zero inflation on average, but leaves the variability of output and inflation unchanged. Unfortunately in the absence of a suitable commitment technology, this first-best policy is not credible because once expectations have been formed, the authorities will have an incentive to deviate from it by following (3) instead.

In practice it would be difficult to legislate into law a contingent feedback rule like (5), especially when the shock is multidimensional in character. Furthermore the authorities may observe only a private and imperfect indicator of the shock, in which case it would also be difficult to police. The literature has therefore sought other ways of improving on (4), in particular by delegation to an independent central bank. The two main strands in this line of thought have been Rogoff's (1985) '*conservative*' *central banker*, and the *principal-agent* approach of Persson and Tabellini (1993) and Walsh (1995). In the former, delegation to a central banker with a loss function of the general form (2), but with a lower weight on output, produces a lower expected loss for the government (although it is still higher than under the first-best policy, essentially because a sub-optimal degree of stabilisation is the price of reducing the inflation bias). The principal-agent approach, by contrast, suggests that the government (the principal) should make the reward to the central bank (the

[2] We shall assume the bliss level of inflation is zero. More generally, the bliss level may be a small positive number (see Footnote 1). The rest of the paper will then still go through with π interpreted as the deviation of inflation from this bliss level.

agent) contingent on the inflation rate; this increases the marginal cost of inflation, offsetting the inflation bias term, $\alpha\beta y^*$, in (3)[3].

While this strand of thought has been extremely influential, and has served (for central bankers) the useful purpose of buttressing the case for independence in monetary policy making, it is not without its shortcomings. From an empirical perspective, the most important prediction of the model, namely an inverse correlation across countries between inflation and various indices of the degree of central bank independence is well established both for developed and developing countries (see, e.g. Alesina and Summers, 1993; Cukierman, 1992; Grilli *et al.*, 1991). However, it does *not* seem to be the case that countries with more independent central banks have achieved lower inflation at the cost of suffering greater variability in output as is suggested by Rogoff's solution to the time inconsistency problem, although Alesina and Gatti (1995) have suggested that this is because delegation simultaneously eliminates another source of volatility in the economy, namely that due to political uncertainty, which can offset the sub-optimal degree of stabilisation implied by Rogoff's solution.

An alternative explanation for this lack of an inverse correlation between the variability of output and the degree of independence is that the world approximates to that envisaged by the principal-agent approach, in which the elimination of the inflation bias is indeed a free lunch. However, explicit performance-related pay for central bankers is nowhere observed, even in New Zealand which has come closest. At best the relation between outcome and reward must be implicit, e.g. in terms of an increased likelihood of renewal of appointment, but in that case, as McCallum (1995) notes, this merely relocates the time inconsistency problem as there is no way of ensuring any implicit contract is honoured. Furthermore in countries characterised by goal independence, such as Germany, the central bank is effectively both principal and agent, since it determines the goals of monetary policy (within the broad rubric of preserving the value of the currency) as well as how that goal is to be achieved by varying interest rates. At best one might argue that in this case the principal is the general public, rather than the government, but then any performance-related implicit contract is surely so tenuous as to be irrelevant.

As I see it, the problem lies in the interpretation of the loss function (2), and the assumption that a loss function of this form (possibly with a different weight on output) also characterises the central bank. The key property of this loss function is that the target rate of output, y^*, is higher than the equilibrium, or natural, rate of output. In the canonical model the rationalisation given is that y^* corresponds to the Walrasian equilibrium of the economy, but

[3] With a linear payment schedule γ-$\delta\pi$ the loss function becomes

$$L = \pi^2 + \beta(y - y^*)^2 - \gamma + \delta\pi.$$

The first-order condition is then

$$\pi(1 + \alpha^2\beta) = \alpha^2\beta E\pi + \alpha\beta(y^* - \varepsilon) - \delta/2.$$

Under rational expectations, the first-best policy (5) then achieved if $\delta = 2\alpha\beta y^*$.

the natural rate is lower than this because of imperfections in goods and/or labour markets (resulting from monopolistic competition, the activities of unions, the disincentive effects of unemployment benefits, etc.). Standard microeconomic analysis would then ensure the magnitude of the deadweight losses from these inefficiencies would be proportional to the square of the gap between output and the Walrasian level, as in (2).

This is very much a 'social planner' rationalisation of the objective function. However, it is doubtful that this provides a plausible justification for a tendency to overinflate. A far more plausible explanation as to why governments are inclined to push output above the natural rate is that they are expected to deliver a high level of output through the *whole range* of their policies (monetary, fiscal, structural, etc.), and are rewarded by the electorate if they achieve this, and punished if they do not. The level of economic activity thus becomes a signal of government competence. Furthermore the natural rate is not known with any certainty, and the beneficial output effects of monetary policy expansion typically show through a year or so ahead of their effects on inflation. Thus governments, particularly near election time, may be prepared to risk a more expansionary monetary policy than is really prudent, arguing that such a policy is not likely to be inflationary, but rather is consistent with their successful effects to raise the output potential of the economy. Under this interpretation, then, one might rewrite the government's objective function (2) with $y^* = 0$, but with an *additional* term reflecting the potential electoral reward from expanding output so as to signal competence:

$$L = \pi^2/2 + \beta y^2/2 - \zeta y \qquad (6)$$

This generates a first-order condition identical to (3), and an inflation rate the same as (4), except with y^* replaced by $\zeta/\alpha\beta$.

The significance of this change in the interpretation of the loss function is that it becomes entirely appropriate to assume that under delegation to a (genuinely independent) central bank the final term in (6), reflecting the electoral gains from attempting to signal economic competence, disappears since such a bank has no reason to overinflate. Consequently the inflationary bias disappears, without having to worry about introducing additional performance-related pay or other mechanisms. In other words *it is the act of delegation itself that solves the time inconsistency problem.* This view that independent central bankers will not also be tempted to indulge in 'surprise' inflation (as implied by the Rogoff model) seems to coincide with those such as Blinder (1997) who have been actively involved in setting interest rates in the US.

The key then in judging the likely effectiveness of the new UK arrangements is whether they will sufficiently insulate the Bank and the MPC from short-term political pressures. A good case can be made that this would be facilitated by making the term of appointment of the members of the MPC longer than the present three years. However, the model of goal dependence is likely to help rather than hinder, as by setting the Bank a precise objective for inflation, for the achievement of which it will be held to account, rather than simply giving it an ill-defined goal of pursuing 'price stability', it will be easier for the Bank to withstand the occasional political pressure to lower interest rates for short-term reasons. I conclude that the new arrangements are likely to go a long way towards ensuring there is no credibility problem.

3. Inflation Targets and the Incompleteness of the Remit

As noted in the introduction, the remit given to the Bank does not require the MPC to aim to achieve $2\frac{1}{2}\%$ inflation within a given time period (say, of two years), but does expect this to be achieved on average over the medium term. In addition the Bank is explicitly charged with supporting the government's other policies of fostering growth and employment, whilst a breach of the $1\frac{1}{2}\%-3\frac{1}{2}\%$ range is *not* supposed to lead to automatic censure. The remit thus leaves undefined how quickly inflation should be returned to target when it is off course, leaving the MPC with the responsibility of that decision ('constrained discretion'). Thus, the remit has the character of an *incomplete contract.* The question is whether this incompleteness in the specification of objectives is something to worry about. This section presents a formal model of inflation targets, and argues that in practice the failure (inability?) to specify the relative importance of inflation and output in the remit is not a problem since a wide range of weights should lead to rather similar outcomes.

3.1. *A Simple Model of Inflation Targets*

Our development follows that of Ball (1997) and Svensson (1997). To make the analysis slightly more realistic than in the last section, we introduce: (a) lags both in the impact of monetary policy on demand and the impact of demand on inflation; and (b) assume a degree of inertia in the inflation process. Specifically demand is given by the equation

$$y = -\mu r_{-1} + \lambda y_{-1} + \eta \tag{7}$$

where r is the real interest rate[4] and η is an i.i.d. demand disturbance with zero mean and variance σ_η^2, whilst supply is given by the following equation

$$\pi = (1-\omega)E\pi + \omega\pi_{-1} + \alpha y_{-1} + \varepsilon \tag{8}$$

where ε is again an i.i.d. supply (inflation) disturbance with zero mean and variance σ_ε^2. Equation (8) is a variant of the Buiter-Jewitt (1981)-Fuhrer-Moore (1995) version of Taylor's overlapping contracts model, containing both backward and forward-looking[5] elements in wage formation. For simplicity we

[4] The monetary authorities instrument is obviously the nominal interest rate, but since inflation responds to changes in monetary policy only with a lag, there is no problem in treating them as effectively setting the short-term real interest rate.

[5] It might seem more natural to write this equation as:

$$\pi = (1-\omega)E\pi_{+1} + \omega\pi_{-1} + \alpha y_{-1} + \varepsilon$$

so that the wage/price inflation equation becomes genuinely forward-looking. This turns out to complicate the algebra significantly, but not to change the essential lessons of the analysis.

assume the supply and demand disturbances are uncorrelated, whilst expectations must be formed before the realisations of the shocks.

Note first that equation (8) implies that $E\pi = \pi_{-1} + (\alpha/\omega)y_{-1}$ so that (8) may be reduced to a conventional 'accelerationist' Phillips curve:

$$\pi = \pi_{-1} + (\alpha/\omega)y_{-1} + \varepsilon \tag{8'}$$

In this model interest rates affect output with a lag, and output affects inflation with a lag; given the empirical evidence on these lags it is sensible to think of a period in this model as corresponding to roughly a year. Consequently next period's inflation is beyond the authorities control and they must treat $E\pi_{+1}$, which is essentially the only state variable in the system, as given. The best they can do is to affect inflation in two periods time by choosing the expected level of output next period, Ey_{+1} $(= -\mu r + \lambda y)$ through their current interest rate decision. We can then write the law of motion for inflation as

$$\pi_{+2} = E\pi_{+1} + (\alpha/\omega)Ey_{+1} + (\alpha/\omega)\eta_{+1} + \varepsilon_{+2} + \varepsilon_{+1} \tag{9}$$

where the composite error is unforecastable.

In light of the discussion of the previous section, we ignore time consistency issues altogether in formulating the objective function of the authorities, so that the within-period loss function is still given by (2), but with $y^* = 0$. Ignoring discounting, the objective of the authorities is then simply to minimise a weighted sum of the variances of inflation and output, with weights unity and β respectively. Given the linear-quadratic structure, the optimal rule must then be of the form

$$Ey_{+1} = -\rho E\pi_{+1} = -\rho[\pi + (\alpha/\omega)y] \tag{10}$$

where ρ is a (positive) parameter that depends on β. Below we solve for the relationship between ρ and β. Hence, under the optimal rule, inflation follows the process

$$\pi_{+2} = [1 - (\alpha\rho/\omega)]E\pi_{+1} + (\alpha/\omega)\eta_{+1} + \varepsilon_{+2} + \varepsilon_{+1}, \tag{11}$$

with $E\pi_{+2} = [1 - (\alpha\rho/\omega)]E\pi_{+1}$. If $\alpha\rho/\omega = 1$, this can be thought of as a 'pure' inflation target in which $E\pi_{+2} = 0$, while $\alpha\rho/\omega < 1$ corresponds to a 'generalised' inflation target in which the long-run target level of inflation is approached gradually. Not surprisingly the 'pure' inflation target is only optimal when the authorities give no weight to output in the objective function.

Corresponding to this description of policy in terms of goals, there is also a corresponding description of policy in terms of the instrument of monetary policy, namely the interest rate. From equation (10) the interest rate follows the process

$$r = \{[\lambda + (\alpha\rho/\omega)]y + \rho\pi\}/\mu \tag{12}$$

Note that this is in the form of a 'Taylor rule'. However, it is worth noting that even in this environment not *all* Taylor rules are optimal: the feedback coefficients depend on the parameters of the economy and on ρ which is determined by preferences. Furthermore if, as is likely, there are other variables in the aggregate demand schedule or the Phillips curve relevant to forecasting output or inflation, then the optimal policy will also respond to those variables, and *all* Taylor rules are sub-optimal.

Substituting (12) into (7) then enables us to write the vector stochastic process describing the evolution of inflation and output as:

$$\begin{bmatrix} y \\ \pi \end{bmatrix} = \begin{bmatrix} -\alpha\rho/\omega & -\rho \\ \alpha/\omega & 1 \end{bmatrix} \begin{bmatrix} y_{-1} \\ \pi_{-1} \end{bmatrix} + \begin{bmatrix} \eta \\ \varepsilon \end{bmatrix} \tag{13}$$

Then using standard results[6] the unconditional variances of output and inflation are:

$$\begin{bmatrix} Var(y) \\ Var(\pi) \end{bmatrix} = \frac{1}{[2-(\alpha\rho/\omega)]} \begin{bmatrix} 2 & \rho\omega/\alpha \\ \alpha/\rho\omega & [(\omega/\alpha\rho)+2-(\alpha\rho/\omega)] \end{bmatrix} \begin{bmatrix} \sigma_\eta^2 \\ \sigma_\varepsilon^2 \end{bmatrix} \tag{14}$$

Finally we need to solve for the optimal feedback coefficient, namely the value of ρ that minimises $\mathrm{Var}(\pi) + \beta\mathrm{Var}(y)$. A little algebra gives this as the solution to the quadratic equation $\beta\rho^2 + (\alpha/\omega)\rho - 1 = 0$, i.e.:

$$\rho = \{-(\alpha/\omega) + \sqrt{[(\alpha/\omega)^2 + 4\beta]}\}/2\beta. \tag{15}$$

Note that $\rho \to \omega/\alpha$ (0) as the weight on output, $\beta \to (0)(\infty)$; as stated earlier, a 'pure' inflation target thus corresponds to setting $\beta = 0$ so that $\mathrm{E}y_{+1} = -(\omega/\alpha)\mathrm{E}\pi_{+1}$ and therefore $\mathrm{E}\pi_{+2} = 0$.

3.2. *Calibrating the Policy Frontier*

By varying β from zero to infinity (or equivalently ρ from ω/α down to zero), equation (14) can be used to trace out an efficient policy frontier that trades-off volatility in inflation against volatility in output. Each point on this frontier corresponds to a particular generalised inflation target. In order to calculate this frontier for the UK, we need empirical counterparts to equations (7) and (8′) and the associated supply and demand shock variances. For this purpose we simply report estimates of these two equations on annual UK data for the postwar period. In these estimates y is detrended real GDP at factor cost, where the trend is extracted using the Hodrick-Prescott filter (with the smoothing parameter set to 400); π is the rate of growth of the RPI excluding mortgage interest payments (RPIX – we use the raw RPI before 1975, which is as far back as RPIX has been calculated); r is the Treasury Bill rate, being the short-term interest rate for which a homogenous series is available for the longest time.

We start with the output-inflation (Phillips curve) trade off. In fact a simple equation along the lines of (8′) fits remarkably well, although there is strong evidence of heteroscedasticity, with the residual variance increasing with the (square of the predicted) rate of inflation. The GLS estimates are (t-statistics in brackets):

$$\Delta\pi = \underset{(3.83)}{0.492}\, y_{-1} \tag{16a}$$

[6] Let $X = BX_{-1} + E$, where X is a vector, B is a conformable matrix, and E is a vector white-noise process. Then $\mathrm{Vec}[\mathrm{Var}(X)] = [I - (B \otimes B)]^{-1}\mathrm{Vec}[\mathrm{Var}(E)]$.

Sample: 1950–1996. DW: 2.12. Box-Pierce: $\chi^2(11) = 14.26$.

while the estimated process for the error variance of the supply shock (σ_ε^2) is given by the auxiliary regression

$$\hat{\varepsilon}^2 = \underset{(0.61)}{0.983} + \underset{(7.15)}{0.0926}\hat{\pi}^2, \tag{16b}$$

Sample: 1950–1996. DW: 2.50. Box-Pierce: $\chi^2(11) = 7.21$.

where $\hat{\varepsilon}$ is the residual, and $\hat{\pi}$ is the predicted rate of inflation, from equation (16a). As an aside it is worth noting that on empirical grounds the lagged output gap is preferred to the current output gap, which is statistically insignificant when included in (16a).

As far as the aggregate demand equation goes, we need to take cognisance of the fact that the effect of a change in interest rates on activity should be greater under floating exchange rates than under fixed exchange rates, since under the former an increase in interest rates should lead to an appreciation of the currency which will further dampen demand over and above any direct effects on domestic spending. We do this by allowing for both intercept and slope shifts in 1972. The OLS estimates are:

$$y = \underset{(2.07)}{1.119d_1} + \underset{(3.80)}{4.39d_2} - \underset{(2.78)}{0.259d_1r_{-1}} - \underset{(4.15)}{0.466d_2r_{-1}} + \underset{(7.81)}{0.729y_{-1}} \tag{17}$$

Sample: 1953–1996. Standard error: 1.55%.

DW: 1.35. Box-Pierce: $\chi^2(11) = 17.49$.

Here d_1 takes the value unity before 1972 and zero afterwards, while d_2 takes the value zero before 1972 and unity afterwards. Theoretical considerations of course suggest that it should be the expected real interest rate, rather than the nominal interest rate that should appear in the aggregate demand equation, but experimentation with a variety of expected inflation terms failed to generate any improvement in fit. There is also no evidence for any contemporaneous effect of interest rates on output, and no evidence of heteroscedasticity. Finally the correlation coefficient between the residuals in (16a) and (17) is only −0.08, suggesting that the assumption that demand and inflation shocks are uncorrelated that underlies the theoretical analysis is reasonable.

We need three pieces of information to construct the policy frontier between the variance of output and the variance of inflation: the slope of the Phillips curve, (α/ω), which we take to be 0.492 from equation (16a); and the standard deviation of the demand and supply shocks, σ_ε and σ_η respectively. For the latter we adopt two different approaches. First we take the values implied by the empirical estimates above, so that from equation (17) the standard deviation of demand shocks is taken to be 1.55%, whilst from equation (16b) the standard deviation of supply shocks, evaluated at the government's target rate of inflation of 2.5%, is taken to be 1.25%.

However, it might be objected that the authorities have considerably more information to them available when forecasting output and inflation over a two-year horizon than is contained in the simple empirical models estimated here. As an alternative way of calibrating the required standard deviations, we look at historical forecasting errors, using the data on the Treasury's forecasting record contained in Melliss (1997). This suggests that over 1971–92 the standard deviation of the one-year ahead forecast error for GDP was 1.99%[7] and over 1979–92 for RPIX was 1.43%; the corresponding figures for the more recent past, 1985–92, which excludes the impact of the second oil price shock were 1.67% and 1.08%. *Faut de mieux* we take these latter two numbers as our alternative estimates of σ_η and σ_ε respectively.

Estimates of the efficient policy frontier for these two alternative estimates of the underlying error variances are given in Figure 1. For every admissible value of the weight on output volatility, β, there will also be an indifference map (not shown), comprising a set of ellipses centred at the origin, with the optimal policy for that β characterised in the usual way by a point of tangency between an indifference curve and the policy frontier; all points on the frontier are optimal for some β. Asterisks are used to mark these optimal

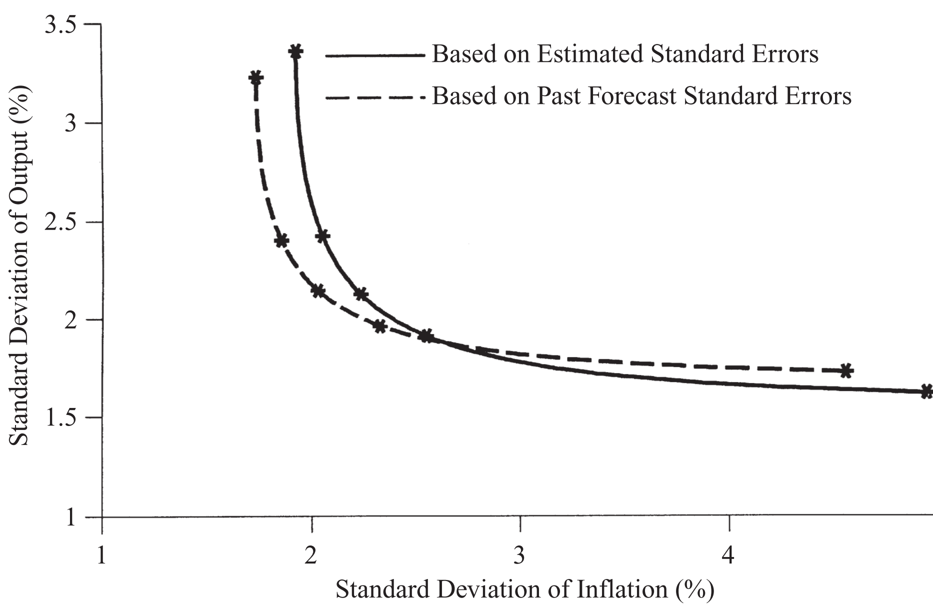

Fig. 1. *Policy Frontiers*

[7] That the Treasury's record on forecasting GDP is apparently worse than even our rather simple model is not too surprising once one remembers that our measure of the output gap is based on the Hodrick-Prescott filter which is a two-sided filter that uses future information on output in constructing the current value of the output gap. This information is, of course, not available for real-time forecasts. For this reason the standard error of equation (17) might understate the true error variance, rather than overstate it as argued in the text.

points for values of β of 0, 0.33, 1, 3 and 99; in each case $\beta = 0$ (a pure inflation target) is at the upper end of the frontier, and $\beta = 99$ is at the right-hand end of the frontier.

The most striking thing about these frontiers is how sharply curved they are – indeed they are almost rectangular – and how close together are the optimal points for weights in the range [0.33, 3]. This has an important implication: a rather wide range of possible weights on output *vis-a-vis* inflation lead to the selection of rather similar points on the policy frontier. Hence little is lost by the government being able to write only an incomplete contract with the central bank, which does not explicitly prescribe the relative weight the central bank is supposed to place on output volatility versus inflation volatility – the central bank only needs to know that preferences are not 'extreme' in order to be able to pick an appropriate policy.

Another perspective on this result is provided by Figure 2, which plots the percentage increase in the value of the objective function implied by picking a sub-optimal point on the policy frontier. Since every point on the frontier is optimal for some β – call it β^* – this is tantamount to choosing the 'wrong' β in calculating the feedback coefficient ρ. The figure then shows this excess loss function for each of the three intermediate values of β, namely 0.33, 1 and 3, as β^* is varied between 0.25 and 4. Thus for a true value of $\beta = 1$ (equal weights on output and inflation volatility), the increase in the loss is less than 10% for all β^* in the range [0.25, 4].

It is also useful to ask how quickly inflation is brought back to target under

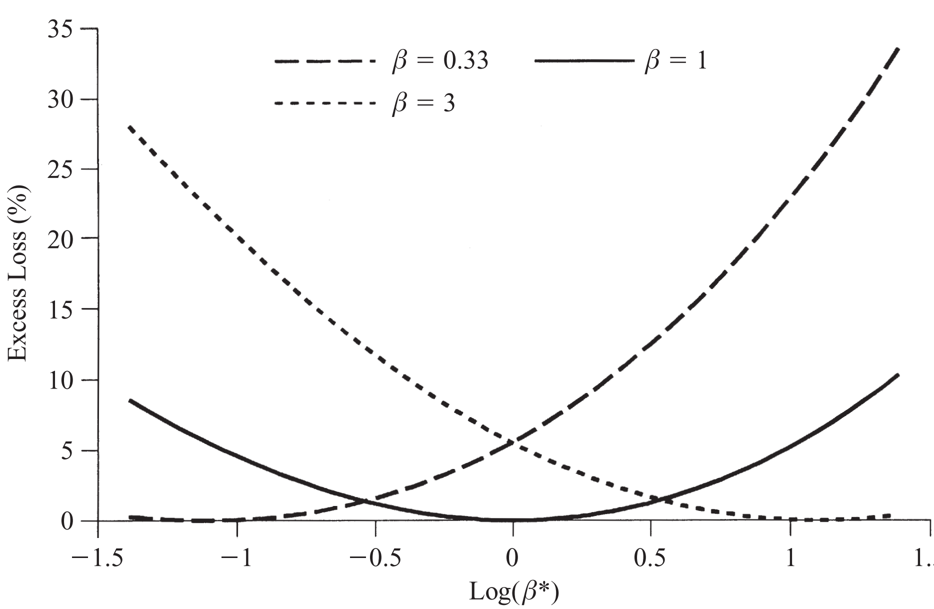

Fig. 2. *Excess Loss*

these policy rules. We know from our earlier analysis that $E\pi_{+2} = [1 - (\alpha\rho/\omega)]E\pi_{+1}$, so $[1 - (\alpha\rho/\omega)]$ is an indicator of the speed at which inflation is brought under control. The respective values of $[1 - (\alpha\rho/\omega)]$ for the five values of β are respectively: 0 (pure inflation target), 0.44, 0.61, 0.75 and 0.95, so that the intermediate values of β generate a fairly narrow range for this adjustment coefficient[8].

How robust is the result that exact knowledge of β is unnecessary for satisfactory policy making? This is something that can only really be answered by analysing what happens in the universe of possible competing models of the economy, and for the universe of possible objective functions. However, we can at least note that if monetary policy affects inflation exclusively through its impact on excess demand/supply, then elaboration of the aggregate demand side of the model, e.g. by introducing the real exchange rate explicitly, adding intertemporal substitution effects, etc., should not affect the conclusion. For in this case it is the characteristics of the supply-side that exclusively pins down the trade off between the volatility of output and the volatility of inflation (note that the parameters of the aggregate demand schedule do not appear in equation (14)). What is less clear is the impact of introducing a direct effect of monetary policy on inflation, say by introducing the real exchange rate into the Phillips curve. One modification that does not seem to alter the conclusions, however, is introducing expected future inflation into the aggregate supply schedule (see footnote 5). In addition this rectangular quality to the policy frontier also emerges in the work of Batini and Haldane (1998).[9]

Of incidental interest are the associated optimal Taylor Rule coefficients, as given by equation (12); these are plotted in Figure 3. In computing these coefficients we need to use the estimates of the aggregate demand equation; here we employ the coefficients applying under floating exchange rates as these are presumably the ones most appropriate to the immediate future. Once again asterisks mark the coefficients for β equal to 0, 0.33, 1, 3 and 99; the coefficients for $\beta = 0$ are at the top right-hand end of the locus of optimal coefficients.

3.3. *The Frequency of Open Letters*

Our results can also be used to address the question of how often we can expect inflation to lie outside the $1\frac{1}{2}$–$3\frac{1}{2}$% band and thus trigger an Open

[8] An alternative way to see the insensitivity of the optimal policy to the value of β is to calculate the elasticity of the key coefficient, $\alpha\rho/\omega$, with respect to the value of β. With $\alpha/\omega = 0.5$ this elasticity turns out to be $1 - 32\beta/[1 + 64\beta + \sqrt{(1 + 64\beta)}]$, which for $\beta = 1$ is 0.56, a relatively small number.

[9] They calculate policy frontiers obtained by changing the horizon over which inflation is expected to return to target in a calibrated six-equation model of an open economy model in which inflation depends on expected future inflation as well as past inflation. Strictly speaking this is not quite the same as calculating the optimal policy frontier, but it seems likely that their findings would carry over to the optimal policy frontier had they calculated it.

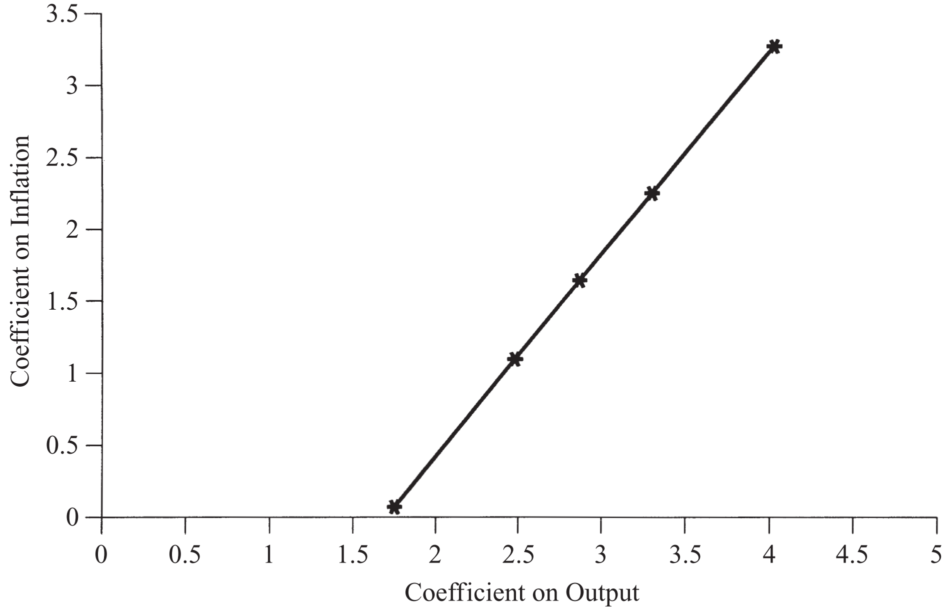

Fig. 3. *Taylor Coefficients*

Letter to the Chancellor. Assuming that the Bank of England selects a point on the sharply curved part of the efficient policy frontier, we would expect that the standard deviation of inflation around the central target should be about 2% points. With normally distributed shocks this would imply that outturns will lie more than ±1% point away from target about 60% of the time. If, by contrast, the MPC were to pick a point at the upper end of the frontier, corresponding to $\beta = 0$, the standard deviation of inflation would be reduced to 1.7% (past forecast errors calibration) implying an Open Letter a little over half the time.

However, this may be a somewhat pessimistic evaluation. We have already noted the heteroscedasticity in the estimates of the Phillips curve, and evidence across countries, as well as for the UK over time, suggest that high mean inflation is positively correlated with highly volatile inflation. One possible source of the inflation shocks in equations (8)/(16) is exogenous volatility in the inflation expectations of wage setters. This source of shocks is likely to be less prevalent in a low inflation economy, and where the monetary regime is likely to ensure that inflation stays both low and reasonably stable. It is thus quite plausible to suggest that the variance of inflation shocks might be even lower than that used in calibrating the efficient policy frontiers. For instance if the standard deviation of inflation shocks were to fall to 0.5% (with the standard deviation of demand shocks unchanged) then the standard deviation for inflation outturns in the sharply curved region of the new efficient policy frontier would be around 1.5% points. This corresponds to an

Open Letter being triggered slightly less than half the time. However, even if inflation shocks were to disappear entirely, the continued presence of demand shocks would imply that Open Letters would still be triggered more than 40% of the time. Open Letters would be a rarity[10] only if aggregate demand also becomes significantly less volatile, and there seems no particular reason for expecting this to happen.

It should be noted that Sgherri and Wallis (1997) in their critique of Haldane and Salmon (1995) come to a somewhat more optimistic view about the likelihood of Open Letters. Following Haldane and Salmon they use a small estimated rational expectations macroeconometric model, with the shock variances, like here, calibrated to recent data. They then simulate the model under an inflation-targeting regime; their results imply that inflation should lie inside the $1\frac{1}{2}$–$3\frac{1}{2}$% band about two-thirds of the time. This difference seems to be a result of: (i) Sgherri and Wallis analysing a rule that brings inflation back to target quite quickly; i.e. it corresponds to picking a point at the upper end of the efficient policy frontier; (ii) model differences that imply a direct effect of monetary policy on inflation via the exchange rate channel; (iii) the use of a quarterly model that allows monetary policy to react to events with a quarterly, rather than annual, lag. Points (ii) and (iii) suggest that the analysis here may somewhat overstate the likely frequency of Open Letters, although even under the Sgherri-Wallis analysis they will not be rare events.

4. Concluding Remarks

This paper has argued that it does not matter that the inflation remit does not specify the relative weight that the Bank of England should place on output volatility *vis-a-vis* inflation volatility. However, it is worth noting that there are other mechanisms that may help to ensure that the Bank behaves in a 'sensible' fashion. These include: the presence of a (non-voting) Treasury representative on the MPC who can act as a conduit for governmental aspirations; the fact that once Open Letters are initiated by the Bank as a consequence of an overshoot, the Chancellor of the Exchequer will presumably respond by indicating whether he is happy with the speed at which the MPC expects to return inflation to target (such a response would, however, need to be open, and thus should not reintroduce time inconsistency questions through the back door); and the Treasury Select Committee in its role of holding the Bank to account for its actions.

Centre for Economic Performance; London School of Economics;
Centre for Economic Policy Research; and H.M. Treasury

[10] The serial correlation in inflation will mean that the occurrence of Open Letters will also be positively serially correlated. Consequently the probability of an Open Letter being written, conditional on there being no Letter in the previous period, will of course be lower than these frequencies might appear to suggest.

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