Rules, Discretion and the United Kingdom's New Monetary Framework

Andrew G Haldane[*]

November 1995

* Bank of England, Threadneedle Street, London EC2R 8AH. I am indebted to Clive Briault, Matt Canzoneri, Ben McCallum, Charles Nolan and Tony Yates for comments on an earlier draft. This paper was taken at the Bank of England's Inflation Targets Conference in March 1995. Remaining errors are of course mine alone, as are the views expressed within.

Issued by the Monetary Analysis Division, Bank of England, London, EC2R 8AH to which requests for individual copies should be addressed: envelopes should be marked for the attention of the Publications Group. (Telephone: 0171-601-4030.)

ISSN 0142-6753

Contents

Abstract

This paper aims to juxtapose the theoretical and empirical literature on policy rules and targeting procedures alongside the United Kingdom's new monetary framework. For example, how does inflation targeting, as practised in the United Kingdom, compare with the optimal feedback rule for monetary policy? Or, conversely, how does it compare with Friedman's *k*% rule? Is an inflation target akin to an optimal central bank contract - an analogy drawn by Walsh (1995)? Or is it better characterised as giving rise to a (second-best) inflation-averse central bank - such as Rogoff's celebrated 'conservative' central banker?

1 Introduction

An oft-quoted recipe for a successful marriage is to mix 'something old' with 'something new'. This paper follows that recipe. It attempts to marry together the academic literature on rules and discretion and the United Kingdom's new monetary framework.

The 'something old' is of course the rules versus discretion literature, in its various theoretical forms. Fischer (1990) observes that this literature is already over 150 years old. In fact, this literature's basic theme - the authorities' propensity to generate inflation surprises and the search for institutional means of constraining such actions - is certainly much older than this. Kindleberger (1993) discusses how, as early as the twelfth century, businessmen in France, Aragon and Catalonia were entering into financial contracts with the ruling authorities - kings and lords - offering incentives to the latter not to debase the coinage. The kings and lords of yesteryear are today's central bankers - but in all other respects the story remains essentially the same.

The 'something new' is the United Kingdom's new monetary framework, introduced following sterling's suspension from the exchange rate mechanism in September 1992. At its conception, this framework had as its centrepiece a 1%-4% target range for underlying inflation.[1] The framework has subsequently been buttressed in several ways [see King (1994)]. First, by formalising the monetary policy decision-making process. This now takes the form of a set of scheduled monthly meetings between the Governor and the Chancellor and their advisers. Second, through the publication of the Bank of England's *Inflation Report*, the first of which appeared in February 1993. This offers the Bank's independent assessment of incipient inflationary trends in the UK economy, as embodied in the Bank's published inflation projection. Third, through the decision, in November 1993, to give the Bank discretion over the timing of interest rate changes. Fourth, through the publication (with a lag) of the minutes of the monthly meetings between the Governor and the Chancellor, which began in April 1994. And finally, in June 1995, through

---

1 With the intention of being in the lower half of this range by spring 1997.

the updating of the United Kingdom's inflation target, which is now set at 2 1/2% or less beyond spring 1997.

Against this backdrop, it is interesting to juxtapose academic theory and policy practice to identify points at which they overlap - and, indeed, underlap. But to begin, it is worth posing the question:

2 Why have a rule?

In general terms, the existing literature points to two - fairly distinct - motives:

(i) *Friedman's motive*. In a set of papers (*inter alia*, 1959, 1962, 1969), Milton Friedman advocated fixed money-growth rules. His argument had two legs. First, the economy is complicated and we know very little about how policy actions may affect it (the 'long and variable lags'). And second, given this ignorance, active policy is as likely to amplify as offset the effects of shocks upon the macroeconomy. In Friedman's view, policy-makers should be humble to prevent their clumsy actions - however well-intended - not becoming a cause of (rather than cure for) instability. A *k*% money-growth rule could achieve this. Friedman's message is: if uncertainty is pervasive, then ignorance - and a little humility, via a simple rule - can be bliss. This is the case for 'sitting on your hands'.

(ii) *Kydland and Prescott's motive*. Kydland and Prescott (1977) established that the 'optimal' policy rule - that which minimised the variability of output and inflation - was in general time-inconsistent. This notion was popularised in the monetary policy game of Barro and Gordon (1983a). These papers argued that, absent some means of precommiting themselves, policy-makers acting with discretion typically had an incentive to spring a surprise inflation and reap the (transient) output rewards. As agents came to factor such behaviour into their price-setting expectations, a higher equilibrium inflation rate would obtain.[2] In short,

---

2 That is, a higher inflation rate than was a first-best for either the policy-setter or the private sector.

discretion imparted an inflation bias. A policy rule, if credible, could mitigate these incentives for surprise inflation, thereby offsetting the otherwise endemic inflation bias. A Pareto-preferred outcome could then be secured. This is the case for 'tying your hands'.

Both motives are usefully discussed because they cover, for the most part, separate literatures. Moreover, they deal with different aspects of the policy-setting problem - the first 'policy engineering' problems, the second 'policy time-consistency' problems. And each has some read-across to the United Kingdom's new monetary framework.

3 Friedman and policy-making under uncertainty

At its most general level, Friedman's *k%* rule is simply saying something about optimal policy decision-making under uncertainty. This raises issues such as:

(i) what information variables should inform policy choices?
(ii) how many of them should be looked at? and
(iii) how best should policy instruments and policy targets be linked together?

These are clearly questions regarding monetary policy 'engineering'. And Friedman provided engineering-precision answers to them: money, one, and a constant, respectively - a *k%* rule.

Early contributions by Poole (1970) and Benjamin Friedman (1975) provided a very general framework for analysing optimal policy-setting issues, such as those above, in a world of *additive* uncertainty about the model's endogenous variables. This stochastic framework has proved the workhorse for many subsequent contributions. These are summarised in Friedman (1990). One unappealing aspect to this literature is the perception that it yields analytically ambiguous conclusions. Is control of money or interest rates to be preferred? That depends upon the world's stochastic structure, and we are left needing to take the model to the data.

Yet, in truth, this strand of the literature yields reasonably clear answers to the engineering questions we posed above. To take these in reverse order, on (iii) it is well known that there exists an optimal *feedback* rule which strictly

dominates Friedman's fixed growth rule (in the class of models described above). Feedback rules afford flexibility and flexibility enhances stabilisation in most fixed-parameter models with additive uncertainty - whether static or dynamic, backward or forward-looking, with perfect or partial information: see, eg, Friedman (1975), Buiter (1981), Dotsey and King (1986).

On (ii), in general this optimal feedback rule will not feed back from a single variable - such as money - but from a whole set of information variables. To do otherwise is overly restrictive, because in general a wider range of information variables will yield a wider range of information on the goal variable. So a single intermediate or information variable is never the preferred outcome in models of this type - whether it be money or the exchange rate. Moreover, when using an information-variable approach, the causative - structural - significance of a feedback variable is largely irrelevant [Friedman (1975)]; it need only possess leading indicator information. Tobin's (1970) *post hoc ergo propter hoc* fallacy is thus redundant when policy-making using an information-variable approach.

Finally on (i), using an intermediate variable - again, such as money - to guide policy is generally inferior to feeding back from the final target variable directly. For example, targeting nominal income directly is generally superior to targeting it indirectly via money [eg Bean (1983)].[3] This is easiest to see in the case of supply shocks, where nominal income targets automatically induce the 'correct' - accommodating - policy response. Clearly, this contrast between final and intermediate monetary target approaches will be more marked the greater is the variability of money velocity. And on past UK experience, this would push us further in the direction of favouring final over intermediate target approaches.

Taken together, the three results above seem to undermine both the spirit and the letter of Friedman's *k%* rule. But the class of models described accommodates uncertainty of a very specific - additive - variety. And, arguably, Friedman's rule was more a response to *multiplicative* uncertainty: that regarding model parameters rather than model variables. Put differently,

---

3 But see West's (1986) rejoinder to Bean's paper.

Friedman's primary objection to active countercyclical policy was *variability* in the lags of policy, rather than the existence of these lags *per se* [see Cooper and Fischer (1973)].[4] Despite its potency, this aspect of Friedman's proposal seems relatively underexplored - which is the more surprising given the weight subsequently given to it by the Lucas critique. The question is: are these optimal engineering results robust to parameter uncertainty?

The basic answer seems to be 'yes'. But, following the work of William Brainard (1967), parameter uncertainty does raise a whole raft of other issues. Brainard's basic approach is to view optimal policy design as akin to a standard portfolio choice problem. This is a powerful and potentially fruitful analogy. Using it, Brainard derives two important results.

To understand the *first* of these, assume that the authorities have one choice variable - think of it as an instrument or an intermediate information variable - and shoot for a single target. Assume further that they are risk-averse and that the world comprises two types of uncertainty: that regarding shocks to uncontrollable exogenous variables (uncertainty which is systemic and additive); and that regarding the relationship between the central bank's instrument and target variables (uncertainty which is idiosyncratic and multiplicative). Because of the second type of uncertainty, policy changes themselves introduce instability into the target variable. Policy actions have a cost. So optimal policy trades off the costs induced by target misses against the costs induced by policy changes.

Brainard shows that the optimal policy along this trade-off will aim to eradicate only a *fraction* of the deviation between actual and desired values of the target variable. Policy gradualism is optimal. This gradualism will be greater - a smaller proportion of the gap between actual and desired outcomes will be closed - the greater is parameter uncertainty.[5] This is the same as saying that caution implies risk aversion. Here, caution in fact derives precisely from risk aversion.

---

4 Though, as Holbrook (1972) and others have shown, the longer these lags the greater the scope for *instrument* instability.

5 And the smaller is the initial gap between actual and desired values of the target.

Brainard's analysis helps rationalise Friedman's *k%* rule. Parameter uncertainty, according to Brainard, should induce less policy activism, less feedback. The Lucas critique gets us closer to a no-feedback solution. But only in the limiting case of infinite parameter variance will Friedman's strict no-feedback solution actually obtain. In less extreme settings, some degree of policy feedback - however sluggish - will always be optimal. In sum, a feedback rule will continue to dominate a simple rule once multiplicative uncertainty is admitted; but the optimal feedback speed may then be rather slower. Cooper and Fischer (1973) and Kemball-Cook and Levine (1989) offer empirical support for the primacy of feedback rules over simple rules in stochastic-parameter models.

A recent paper by Bertocchi and Spagat (1993) questions the generality of Brainard's - essentially static - finding. If the monetary authorities have an intertemporal setting and seek to 'learn' about how the economy works, then it may be sensible to experiment. Why? Because policy experimentation reveals information about how the world works and thus speeds up the learning process. Convergence to rational expectations might then be quicker. Put differently, if there is 'learning by doing' in policy-setting, then more doing may quicken learning. This offers a rationale for policy activism, provided the authorities are willing to trade off *current* policy objectives for information-gathering which might be valuable in *future* policy-setting.

But how general is this result? *Prima facie*, it seems to underplay the role of learning on the part of the *public,* in particular about the authorities' preferences. Policy experimentation may exacerbate agents' signal extraction problem, as they try to infer policy-makers' true tastes. The very parameter-uncertainty problem which the authorities are aiming to resolve for themselves may then be worsened by their overzealous actions. In these settings, learning and convergence to rational expectations may be *slower* than if policy had followed a more gradualist route. Balvers and Cosimano (1994) have recently formalised this notion. For moderate inflation countries, they find policy gradualism to be optimal, identifying the same basic trade-offs explored above.

There is a second - less rigorous - justification for policy gradualism by central banks. While all policy-making is an experiment, it does not take place in a

laboratory. The patients are alive, and the 'experiment' is surgery rather than a post mortem. As long as the relative merits of policy activism versus gradualism remain open to debate, then erring on the side of policy caution seems sensible.

A *second* important insight from Brainard's work is that Tinbergen's counting rule breaks down once we deviate from certainty-equivalence. The optimal policy portfolio, in general, will comprise as many choice variables - such as information variables - as are available. The reason for this carries across directly from portfolio theory. Policy-makers will wish to diversify their policy portfolio so as to minimise the idiosyncratic risk associated with each of their choice variables: it never pays for the authorities to put all their eggs in one basket.[6] Even when the choice variables themselves are independent of one another, the policy-maker will gain in welfare terms by summing them together in a policy portfolio, with weights dependent (*inter alia*) upon their degree of idiosyncratic risk. Those variables whose relation with the target is least well-defined - greater idiosyncratic risk - will receive a lower portfolio weighting, and *vice-versa*. This is an intuitively appealing result.

Things become more interesting once we allow correlations between the information variables (or, more specifically, their parameters). These correlations can be exploited by the policy-maker for welfare gain, just as can covariances between asset returns. Negative cross-correlations are of particular benefit, since these provide the policy-maker with additional insulation against parameter uncertainties. Whether or not these correlations exist is, of course, an empirical matter. But the very worst outcome of policy diversification[7] must always be at least as good as the single variable Friedman outcome, even with pervasive parameter uncertainty. So our earlier engineering result - that, in general, more information variables are preferable to less - seems fairly robust.[8] Indeed, this conclusion is strengthened by likening policy choice to portfolio choice. And what Brainard's analysis

---

6 Again, assuming they are risk averse.

7 Which obtains when there is perfect positive correlation among the set of policy variables.

8 The analysis is straightforward to extend to accommodate covariances between idiosyncratic risks (parameter shocks) and systemic uncertainties (exogenous variable shocks). These covariances, once normalised, would be analogous to the βetas in standard models of portfolio choice.

provides us with in addition is a means of choosing between these myriad information variables in welfare terms; of optimally weighting them in a policy feedback rule; and of exploiting relations among them.

4 Policy engineering and the United Kingdom's new monetary framework

So how does any of this relate to the United Kingdom's new monetary framework? There would seem to be a number of points of tangency:

First, when setting monetary policy it pays to 'look at everything'. A risk-averse policy-maker choosing among uncertain information variables solves the same portfolio problem as a risk-averse investor choosing among uncertain assets. The optimal policy portfolio is a diversified one. The new monetary framework was conceived as precisely such a 'look at everything' information-variable scheme. This is evident from the detailed disaggregated analysis that makes up the Bank's *Inflation Report*. And it is also apparent from the discussion at each monthly monetary policy meeting between the Bank and the UK Treasury, which is now recorded in the published Chancellor/Governor minutes. We could rationalise this 'look at everything' approach as the welfare-maximising actions of a risk-averse agent: restricting the number of information variables not only constrains the authorities' information set; it also increases the likelihood of the chosen variables suffering an adverse idiosyncratic shock. Better to have a diversified portfolio of indicators which insures against these (additive and multiplicative) uncertainties.

Second, the Bank's inflation projection - or rather the distribution of projections - is its *de facto* intermediate variable. This much is well-known [see, eg, King (1994)]. These inflation projections satisfy all the properties we would require of any intermediate variable: *controllability* - they are a conditional forecast, with the moneary policy instrument as one of the inputs; *predictability* - they are (hopefully) unbiased forecasts; and a *leading indicator* - they are explicitly forward-looking. Because these inflation projections weight together a whole range of information variables, they clearly satisfy the properties of a diversified policy portfolio. And the fact that the Bank feeds back from this projection means that it is clearly a *feedback*

rule it is following: the Bank's monetary policy advice is conditioned on the deviation between expected inflation and the inflation target. As discussed earlier, feedback rules such as these are optimal in most analytical settings we can think of.

Third, the Bank's inflation projection embodies 'off-model' information - from leading indicator models, business surveys, reports from the Bank's agents around the country and, most importantly, policymakers' judgment. This makes sense because, while macro-model forecasts are hamstrung by degrees of freedom, there is a premium on using all useful information variables. So the pure macro-model projection is adjusted in line with 'off-model' information to reflect this. That these off-model variables are sometimes atheoretic - and thus have no legitimate place in a structural macro model - should not be of great concern: we know from Friedman (1975) that structural causality between indicator and target variables is irrelevant using an information-variable approach.

Fourth, monetary policy gradualism - if not a fixed rule - can be optimal. Central banks often have problems justifying their incremental approach to policy changes. This gradualism has been dubbed by some interest rate 'smoothing'. And it may have potentially serious macroeconomic side-effects, inducing non-stationarities in the price level and money stock [Goodfriend (1987)]. Uncertainty about the underlying structure of the world - *à la* Brainard - provides one possible explanation for such smoothing. Gradualism can be optimal in probabilistic settings where the agent is risk-averse. Shooting for goal is all very well. But if the goalposts are shifting and you are unsure how hard you can kick, then it sometimes pays to dribble the ball a bit further.

Finally, it is worth noting that gradualist monetary policy-setting would, in all likelihood, be exactly the outcome of an explicitly probabilistic approach to policy-setting, such are the uncertainties surrounding inflation projections. The Bank has recently moved further in this probabilistic direction. Focus has gradually shifted away from the Bank's central inflation projection towards looking at the distribution of inflation outcomes around this projection. For example, confidence intervals around the central projection are published in the *Inflation Report*. These offer information on the scale of the probable

risks surrounding the central inflation projection; they help 'colour in' the likely distribution of future inflation outturns.

These confidence intervals are derived from estimates of past inflation forecast errors. So, importantly, they encompass both mistakes in projecting the model's endogenous variables (additive errors) and mistakes the model has made (multiplicative errors due, for example, to parameter uncertainty). These confidence intervals thus come quite close conceptually to the measure of uncertainty implied by Brainard's analysis. There is certainly further to go in meshing the Bank's probabilistic approach to policy-setting with the theory of optimal decision-making under uncertainty. But in recognising these uncertainties and their possible sources, the Bank's current approach does at least bear some passing resemblance to Brainard's optimal portfolio analysis.

5 Kydland and Prescott and time-consistent policy-making

Fischer (1990) summarises:

> 'Until 1977 it appeared that discretion dominated rules, since any good rule could be adopted by discretion. The concept of dynamic consistency, brought to macroeconomics in the rules versus discretion context [Kydland and Prescott (1977)], completely changed the debate.'

In fact, Friedman's advocacy of rules had itself been motivated in part by time-consistency concerns; or at least by a perceived need to withstand political pressures upon policy-makers and to increase the transparency of policy to allow effective monitoring of performance [Friedman (1962)]. The time-consistency literature helped make these benefits tangible.

Kydland and Prescott (1977) established three things. First, that the optimal policy - the one delivering lowest output and price variability - was in general time-inconsistent. Second, that the time-consistent outcome of the authorities setting policy in a purely discretionary fashion would imbue the economy with an inflation bias. And third, that by precommitting the authorities to a policy rule this inflationary bias could be offset. By lowering inflation bias, Kydland

and Prescott argued that a rules solution to the time-consistency problem was to be preferred to a discretionary outcome on welfare grounds.[9]

Rogoff (1985) and Canzoneri (1985) provided clearer statements of the trade-offs involved when searching for the optimal point on the rules/discretion spectrum. Credible rules prevented inflation surprises and so minimised inflation bias. But they had a cost. By constraining policy flexibility in the face of shocks, policy rules induced a sub-optimal amount of output stabilisation. Put differently, rules gave rise to a stabilisation bias, which worked against the inflation bias in policy-makers' loss function. Inflation and stabilisation biases were welfare-offsetting. So was established the classic *credibility/flexibility trade-off* in policy-setting.[10]

The rules and discretion solutions marked the boundaries of this credibility/flexibility - or inflation/stabilisation bias - trade-off. But the search was on for interior solutions which might generate preferred welfare outcomes. Attempts at such solutions can perhaps be placed into one of three camps:[11]

(i) *Reputation solutions.* One-shot or finite-horizon games load the dice unduly against discretionary policies. In the last period of the game it is always optimal to cheat - that is inflate - under discretion. And once this is known, the discretionary game will unravel so that the inflation bias obtains from day one. So in finite-life games, eg those with periodic elections, rules are always likely to dominate discretion.

One way around this problem is to give the policy-maker an explicitly intertemporal setting - an infinite life, ideally.[12] An incentive is then provided for the authorities to invest in a reputation for monetary rectitude for

---

9 Though it was still clearly inferior to the (time-inconsistent) first-best.

10 This trade-off is not exclusive to domestic monetary targets; it applies equally to exchange rate targets: see, for example, Cukierman, Kiguel and Leiderman (1994).

11 Bean (1994) provides a useful algebraic and diagrammatic taxonomy of the first two of these solutions. See also King (1995).

12 Another way round the time-consistency problem is to assume the electorate inflict a credible punishment strategy on myopic policy-makers at the time they make voting decisions (see Minford (1995)).

some - maybe all - of their lifetime.[13] Just how great is this incentive will depend upon the authorities' rate of time preference. The more they favour utility today over utility tomorrow, the less likely a reputational, no-cheating, solution becomes: see, for example, Barro and Gordon (1983b). Latterly this area has become a game-theoretic minefield. Reputational solutions very quickly become very complex, often because of a multiplicity of equilibria: see, for example, Backus and Driffill (1985) and Cukierman and Meltzer (1986).

(ii) *Delegation solutions*. The classic central banker's solution here is Rogoff (1985). He shows that a welfare-improving point on the credibility/flexibility trade-off can be attained by delegating monetary policy to a 'conservative' central bank placing a higher relative weight upon inflation stabilisation. That is, the (first-order) gain from eradication of the inflation bias is less than offset by the (second-order) loss from heightened stabilisation bias. Such Pareto improvements will accrue as long as the extra weight placed on inflation stabilisation by the authorities is not too great.[14]

The conservative central banking solution is in many ways analogous to the reputational one. A higher relative weight on inflation stabilisation means forsaking jam today (short-lived output gains) for jam tomorrow and the day after (longer-lived inflation gains) - a change in the rate of time preference. Appointing a conservative central banker effectively lengthens the policy-horizon, inducing less policy myopia. So for practical purposes, the reputation and delegation solutions to the time-consistency problem can be viewed as essentially one and the same.

Lohmann (1992) presents a hybrid delegation solution. Responsibility for monetary policy is delegated to an independent central bank, *pace* Rogoff.

---

13 Assuming the worst-best discretionary outcome obtains in every period after the authorities have first cheated.

14 But Rogoff also demonstrates the case against monomaniacal inflation-fighters. For those placing too high a weight on inflation control, stabilisation bias losses will outweigh inflation bias gains - with a corresponding net welfare loss.

But there is an override clause, whereby government can intervene in monetary policy in the face of large shocks, to secure more effective output stabilisation. The central bank's policy behaviour adapts accordingly to this clause, to minimise the chances of it ever being invoked and the central bank being overridden. And the outcome of this game - delegation with escape clauses - is then a welfare-improving one in terms of inflation and stabilisation biases. The Lohmann model has parallels with New Zealand's monetary constitution, which also specifies escape clauses in the event of 'significant' shocks.

(iii) *Contracting solutions.* Reputation and delegation solutions are only local maxima. They find welfare-improving points on the credibility/flexibility frontier, compared with the boundary solutions of pure rules or discretion. But they do not resolve this trade-off. Walsh (in a set of papers, 1993a,b, 1995) and Persson and Tabellini (1993) have suggested a way of doing just this.

Their basic approach is to design a central bank contract which secures a first-best - minimises inflation and stabilisation biases - but which is still attainable (time-consistent). The second task is the harder. From Kydland and Prescott (1977), the existence of this first-best has been well known. The problem came in designing incentives for the policy-maker to make such a policy practical. Using his framework, Rogoff (1985) discussed contractual solutions which would allow a first-best.[15] He suggested these would need to take the form of a fully state-contingent (Arrow-Debreu) contract. Such a contract, he argued, would be impossible to implement in practice. The innovation in Walsh's work has been to suggest that the optimal contract solution is in fact far simpler.

This simplicity derives from the fact that, in the Barro-Gordon game, the inflation bias is *state-independent.* It depends only upon the liking of the authorities for output gains and their ability to achieve them - both of which are assumed to be deep (taste and technology) parameters. So if a contract is

---

15 Rogoff in fact calls this a second-best, and his own conservative central banking solution a third-best. He defines the first-best as the removal of the distortion which holds the economy at its existing sub-optimal natural rate, and which thus induces an incentive for inflation surprises.

able to raise the marginal cost of inflation by a constant amount, the incentives to spring an inflation surprise can be effectively defused. In fact, if the cost is raised high enough, the inflation bias can be fully offset. But because this cost is independent of the model's state variables, it need not interfere with the authorities' stabilisation effort when responding to shocks.[16] So there is no necessary reason - at least within the narrow confines of the Barro-Gordon paradigm - why credibility and flexibility need then trade off.[17] In the language of Rogoff, inflation biases can be mitigated without any militating stabilisation biases, given a suitably specified contract.

In practical terms, the Walsh contract can be thought of as a linear proportional tax imposed upon the authorities for inflation outturns greater than those desired. To see how this tax works at an intuitive level, think of the arguments entering the authorities' loss function. In a conventional Barro-Gordon world, the loss function comprises two quadratics in output and inflation deviations from their desired levels. Starting from a position of inflation bias, these two terms will exactly offset each other in the incentives they provide to the authorities to inflate or deflate - hence the inflationary-biased equilibrium is maintained.

Consider now supplementing the authorities' loss function with an extra linear cost term in inflation - the Walsh tax. Beginning again from a position of inflation bias, there are now two arguments inducing an incentive to deflate (the linear and quadratic inflation terms) and only one counterbalancing this (the quadratic in output). So the incentives are provided for disinflation. As we deflate towards the desired inflation rate, the two quadratics continue to counterbalance each other. But with the linear inflation tax just tilting the balance, it remains optimal to lower inflation further.

At the desired rate of inflation the arguments flip over. Further deflation would impose a welfare cost from both of the quadratic terms which, at the low inflation equilibrium, now work in tandem. Further inflation would impose a cost from both the linear and quadratic inflation terms and so is

---

16 Indeed, discretionary stabilisation policy will be optimal under the Walsh contract provided the authorities share the public's inflation/output preferences.

17 This is the first of the 'fallacies' of central bank independence discussed by McCallum (1995).

never optimal either. The optimal inflation equilibrium is thus sustainable, care of the Walsh tax.

Walsh (1995) and Persson and Tabellini (1993) discuss a number of ways in which their tax scheme might be made practical. The tax imposed could be *pecuniary* - for example, by having the central bank governor's salary indexed to inflation performance, as was mooted for a time in New Zealand; or by having the central bank's budget fixed in nominal terms, as is the case currently in New Zealand. Equally, however, the tax could be *non-pecuniary* - for example, reflecting damaged central bank prestige at having missed the target. A third option would be to have a penalty clause which was a mix of the first two - for example, by having the central bank governor's reappointment conditioned on inflation performance. Svensson (1995) has recently suggested a fourth way of securing a first-best. He shows that an inflation target is isomorphic to a linear inflation tax, provided this target is set at a sub-optimally low level.[18] This interpretation again exploits the state-independence of the inflation bias, which means that lowering the authorities' inflationary sights by a fixed amount can resolve the credibility/flexibility trade-off.

But all of these options seem to face practical problems. Calibration of the Walsh tax is perhaps the trickiest of these problems [see Canzoneri, Nolan and Yates (1995)]. It is difficult enough to quantify existing inflation biases. But to calculate what proportion of an agent's salary should be deducted for each percentage point of inflation bias is a more difficult problem again. This problem is made worse if the penalties imposed are non-pecuniary. Both the levying of the tax, and the verification of whether the correct 'payments' have been made, would then be highly subjective.[19] And these calibration problems are given added weight if inflation biases are not, in practice, state-independent: again, see Canzoneri *et al* (1995) on this. As for the Svensson inflation target interpretation, while this has a certain intuitive appeal, it would seem to have relatively few real-world analogues at the

---

18 Specifically, the inflation target should be set equal to the difference between the socially optimal rate of inflation and the inflation bias if a first-best is to be secured.

19 Walsh (1993a) discusses how a dismissal rule could secure a first-best, with the expected probability of reappointment linked linearly with inflation. But the contract would then need to be contingent on supply shocks.

moment: inflation targets, in practice, have been set at levels above (conservative estimates of) the optimal rate of inflation, rather than below. And, perhaps more fundamentally, setting the monetary authorities a target which they subsequently never hit raises questions about just how credible - and hence durable - such a regime would prove in practice: see Briault, Haldane and King (1995) on this.

Enforceability of the contract or target, and the statutory accountability that accompanies it, are two further issues of practical import which the contracting solution rather neglects.[20] In effect, the contract approach is a way of transferring the time-consistency problem - from credibly precommitting to a rule to credibly precommiting to a contract - rather than actually resolving it.[21]

6 Time-consistency and the United Kingdom's new monetary framework

Nonetheless, many of the lessons from the above literature are usefully set against the United Kingdom's current institutional framework for monetary policy. Again, there are some clear points of tangency.

First, inflation targetry can be considered an interior solution to the credibility/flexibility trade-off. Both Rogoff (in his advocacy of conservative central bankers) and Walsh (in his advocacy of central bank contracts) saw inflation targets as the practical counterpart of their proposals. And either solution would, of course, be a welfare improvement over a pure rules or discretion solution. It is interesting too to note that the contracting literature further supports the notion of shooting for final rather than intermediate targets [see Persson and Tabellini (1993)]. All the monitoring that is required under the optimal contract is of inflation outcomes, so that the tax can be levied on them. Contracts based on intermediate variables, by contrast, have a non-trivial link with the final goals of policy, and so are much more demanding on the principal's time and information set when enforcing penalties for target misses.

---

20 On the second of these, see Freedman (1993).

21 This is the second of McCallum's (1995) 'fallacies' of central bank independence.

Second, as Canzoneri *et al* (1995) discuss, the Walsh tax and inflation targets - as they currently operate in the United Kingdom and elsewhere - are conceptually quite different beasts. The Walsh contract is better thought of as a tax/subsidy scheme: above-target inflation outcomes are penalised with a tax, while below-target inflation outcomes are rewarded with a subsidy. By contrast, inflation targets in practice are clearly two-tailed. Misses either side of the target range are 'penalised':[22] there is no presumption that the authorities reap any reward from undershooting their announced targets. In the jargon, inflation targets impose a quadratic penalty, rather than the linear one which is the Walsh tax. Even if we take the Svensson inflation target interpretation of performance contracts, it is difficult to argue that the United Kingdom's current inflation target lies sufficiently below the socially optimal rate of inflation to secure a first-best.[23]

Third, for the above reasons Canzoneri *et al* (1995) prefer to view the United Kingdom's current framework as closer to that envisaged by Rogoff. That is, an inflation target implicitly increases the relative weight on inflation (*vis-à-vis* output) stabilisation in the authorities' loss function. The upshot, as in Rogoff, is more 'conservative' monetary policy-setting: a lower inflation bias and a Pareto-preferred equilibrium - if not quite the Panglossian first-best of the Walsh contract.

The Rogoff analogy can probably be taken a few steps further. Publication of the *Inflation Report* and of the Chancellor/Governor minutes have clearly provided the Bank with an independent voice on monetary policy matters - despite the Bank having no formal (goal or instrument) independence. Likewise, giving the Bank discretion over the timing of interest rate changes has delegated to it further monetary policy responsibility. To borrow some terminology from the banking literature, the Bank has become the 'delegated monitor' of inflationary trends in the United Kingdom economy. The Bank

---

22 Though, in non-pecuniary terms, not necessarily symmetrically.

23 Of course, it is impossible to know exactly where the socially optimal rate of inflation lies. But if this corresponds with the 'optimal rate of inflation' from a theoretical perspective, then it is difficult to argue that this is much different than zero. And this would then mean that a negative inflation target would be needed to secure a first-best. Needless to say, no country has yet sought to target a *negative* inflation rate.

has been delegated the task of monitoring inflation. And recently this monitoring has been made fully transparent to private sector agents through external publications. Such a transparent system severely curtails the ability - and therefore the incentives - of government to spring the sort of inflation surprises that might give rise to an inflation bias. See Briault, Haldane and King (1995) for a formal discussion of such a model.

7 Linking the literatures

Can the policy lessons from these two literatures be linked? As Fischer (1990) and Friedman (1990) discuss, the mapping between the engineering and time-consistency problems is far from clear. But the questions they pose seem similar in spirit: how closely should a rule be followed? versus what should this rule look like?

At one level, the link is trivial. If a Walsh contract were in place, the literatures would be entirely separable. The Walsh contract would always provide exactly the right incentives for the central bank to pursue the most efficient engineering technology for monetary policy. Policy-makers would be punished for incompetence and under-handedness equally. So there would be equal incentive to minimise both. Whether the central bank used an optimal feedback rule or randomised when setting policy would be a second-order concern for the public. That would be an issue for the technocrats. Walsh (1993b) and Persson and Tabellini (1993) illustrate formally how the first-best can be achieved independently of the magnitude of the control error in setting policy, which makes the same point.

But we think that in the United Kingdom we may be some way short of the contracting solution. Incompetence and under-handedness are then no longer punished equally - if indeed they are punished at all. Policy-makers can hide behind one to allow them actively to pursue the other. So the engineering and time-consistency literatures become entwined. Again, recent attempts to bolster the monetary policy framework in the United Kingdom can be viewed as an attempt to come to terms with such an interlinkage.

Delegation of greater monetary policy responsibility to the Bank has again been central in this process. This lessens the likelihood of policy under-handedness. But if the Bank is to serve as an effective delegated monitor for

the public, then some method of monitoring *its* performance is also necessary. After all, the Bank's inflation preferences are themselves little understood - especially as it is a complex (information variable) feedback rule which the Bank is following.

The UK authorities' response to this has been greater transparency when explaining the nuts and bolts of monetary policy management. Monetary policy transparency helps agents solve the signal extraction problem of whether is it incompetence or under-handedness that is driving policy decisions [see Briault, Haldane and King (1995)]. The *Inflation Report* has played a crucial role in this process. The Bank's inflation forecast - and hence its analytical competence - are there to be scrutinised and, if necessary, questioned. This clearly imposes some learning and computation costs upon agents. And, indeed, Levine (1989) has illustrated how, in some settings, simple rules may be preferable to complex ones precisely because they lessen the learning burden on agents. But these learning costs need not be punitive. Indeed, central banks have an active interest in minimising these costs, to prevent suspicious private sector agents factoring inflation biases into their expectations - hence the *Inflation Report* and hence the straightforward language in which it is written.

It is interesting to ask why, if policy transparency affords these benefits, it has not been more widely adopted by other central banks. Garfinkel and Oh (1994) pose just this question of central banks: 'When and how much to talk?' The answer turns on history and credibility. It is optimal for countries with a low accrued stock of credibility to make announcements and foster transparency, so as (hopefully) to influence price expectations. This then assists them in hitting their announced targets. For these countries, talk is 'cheap' [see Stein (1989) on this]. But this incentive to increase transparency does not exist for high-credibility countries. By definition, expectations are already in line with target in these countries. So greater transparency for them serves only to box in the central bank, inhibiting flexibility.

This story seems to have some relevance for countries recently to have adopted inflation targets. Certainly, after sterling's suspension from the ERM, the low credibility scenario was precisely the position the United Kingdom was in when it first came to adopt inflation-targets. A number of other inflation-target countries would probably also fall into this camp. For them,

the time was ripe for greater transparency; talk was cheap. And the introduction of *Inflation Reports* (or variants thereof) in Canada, New Zealand, Spain and Sweden - as well as the United Kingdom - suggests central banks have actively pursued this transparency route in recent years. The German Bundesbank, with their good inflationary track record, are the obvious practical counterpoint to inflation-target countries. High credibility means there is rather less for them to gain from greater transparency. Instead they can adequately camouflage themselves behind simple broad money targets, which do not then interfere with policy flexibility.

What all of this tells us is that initial - credibility - conditions are important when deciding upon the optimal institutional setting for monetary policy. No one blueprint is always and everywhere a first-best. For the United Kingdom, greater transparency has run hand-in-hand with a complex rule approach to monetary policy-setting and a low inherited stock of monetary policy credibility. But for the Bundesbank, a different model holds true.

8 What arguments should enter a policy rule?

So far we have largely left to one side the issue of what variables should enter a policy rule - of whatever form and however adhered to - so as to achieve a social optimum. This raises two policy questions: what targets and what instruments? On targets, theory gets us some of the way. Money neutrality is a sufficient condition to require that the price level (or its derivative) be the only term entering the steady-state policy reaction function. And we know from earlier sections that targeting the objective variable directly is generally preferable to going indirectly through some intermediate target.

But we also know, following Rogoff (1985) and Fischer (1994), that monetary policy has a role to play in output stabilisation, as well as price stabilisation. For example, placing too low a relative weight on output stabilisation will lead to a Pareto-inferior welfare outcome [Rogoff (*op.cit.*)]. This would suggest that dynamic output terms might also legitimately enter an optimal reaction function rule.

One way of accommodating both output and price terms in a policy rule would of course be to target nominal spending directly. Nominal GDP targeting would place implicitly equal weight upon both output and prices in the

reaction function. And such a rule has a wide body of empirical and conceptual support: McCallum (1988), Feldstein and Stock (1994) and Hall and Mankiw (1994) are three prominent recent proponents.

Nominal GDP targeting would seem reasonable if, because of our ignorance, we were indifferent about the precise short-run output/inflation split. This ignorance might extend to not knowing whether it was supply or demand shocks which were hitting the system. For example, a prevalence of supply shocks would lead us to favour nominal GDP over inflation targeting, since the former would always induce the 'correct' policy response - monetary accommodation - to a change in the equilibrium price level (Bean (1983)). But if we were confident about knowing the slope of the short-run Phillips curve and the shocks affecting it, then implicitly equal weights on output and prices would seem overly restrictive as a response to each and every type of disturbance. Sometimes we might want to have the output/price terms entering the reaction function separately and with different weights. These weights might reflect, *inter alia*, the stochastic structure of the economy.

Ultimately, however, theory gets us only so far on this issue. It is clear from above that the specific form of the optimal target will depend upon the types of shock to which the system is prone - whether demand or supply, whether real or monetary. And on optimal instruments, theory is likewise often mute. It tells us that the stochastic structure of the economy is the determining factor [see, for example, Friedman (1975)]. So at the end of the day, the choice of an optimal policy rule - the relation between optimal instruments and optimal targets - is an inherently empirical one.

As this has been recognised, there has been a groundswell of recent simulation analyses of competing policy rules and policy frameworks. The recent books by Taylor (1993) and by Bryant, Hooper and Mann (1993) are two high-quality examples. What do these empirical volumes tell us?

The conclusions from Bryant *et al* (1993) are of some interest. In a comparison of four basic targeting rules - for money, the exchange rate, money GDP, and inflation-plus-real-GDP - they conclude, first, that the two intermediate targeting strategies (money and exchange rates) are strictly inferior to final targeting strategies in stabilising inflation and output. This accords with the arguments put forward earlier. And second, they find it very

difficult to distinguish the nominal GDP and inflation-plus-real-GDP rules. As Haldane and Salmon (1995) show, however, either rule is preferred empirically to a pure inflation target. This echoes the results of Rogoff (1985) regarding the optimal weight to place on output versus price stabilisation: rarely will degenerate (0,1) weights be optimal. Indeed, Haldane and Salmon (*op. cit.*) go further than this in suggesting that a nominal GDP target comes close to offering the optimal price/output weighting in the United Kingdom.

Fortunately, most inflation target countries seem to recognise a role for output stabilisation, despite their targets being specified only over prices. The monetary frameworks in these countries set down phased paths for inflation reduction, consistent with the authorities having an 'optimal speed of disinflation'. This approach implicitly recognises that disinflating too quickly might incur prohibitive real costs. Indeed, most central banks condition their inflation projections on measures of the output gap - which means that output enters their reaction function explicitly. Current central bank operating procedures may therefore come closer than first appears to matching the reaction functions which a number of empirical simulation studies have suggested would be optimal.

9 Conclusions

At the end of the *General Theory*, Keynes lamented the lag between the genesis of ideas - good or bad - and their eventual practical implementation. This lag is as apparent in the monetary policy arena as any other. But the last few decades have seen some significant catch-up. Vertical aggregate supply curves, 'independence' of monetary policy decisions and optimal policy contracts are now very much the vernacular of the modern-day central banker. Indeed, it is not too unrealistic to think that, in some areas and in some countries, high theory and policy practice are running in parallel. Those ideas lags may be becoming less 'long and variable' after all.

References

Backus, D and Driffill, J (1985), 'Inflation and Reputation', *American Economic Review*, 75, pages 530-38.

Balvers, R J and Cosimano, T F (1994), 'Inflation Variability and Gradualist Monetary Policy', *Review of Economic Studies*, 61, pages 721-38.

Barro, R J and Gordon, D (1983a), 'A Positive Theory of Monetary Policy in a Natural Rate Model', *Journal of Political Economy*, 91, pages 589-610.

Barro, R J and Gordon, D (1983b), 'Rules, Discretion and Reputation in a Model of Monetary Policy', *Journal of Monetary Economics*, 12, pages 101-22.

Bean, C R (1983), 'Targeting Nominal Income: An Appraisal', *Economic Journal*, 93, pages 806-19.

Bean, C R (1994), 'Credibility Versus Flexibility in Policy-Making', *mimeo*, HMT.

Bertocchi, G and Spagat, M (1993), 'Learning, Experimentation, and Monetary Policy', *Journal of Monetary Economics*, 32, pages 169-83.

Brainard, W (1967), 'Uncertainty and the Effectiveness of Policy', *American Economic Review*, 57, pages 411-25.

Briault C B, Haldane, A G and King, M A (1995), 'Accountability and Independence', paper presented at the Bank of Japan conference, October 1995.

Bryant, R C, Hooper, P and Mann, C L (1993), *Evaluating Policy Regimes*, The Brookings Institution.

Buiter, W H (1981), 'The Superiority of Contingent Rules Over Fixed Rules in Models with Rational Expectations', *Economic Journal*, 91, pages 647-70.

Canzoneri, M B (1985), 'Monetary Policy Games and the Role of Private Information', *American Economic Review*, 75, pages 1,056-70.

Canzoneri, M B, Nolan, C and Yates, A (1995), 'Mechanisms for Achieving Monetary Stability: Inflation Targeting Versus the ERM', *mimeo*, Bank of England.

Cooper J P and Fischer, S (1973), 'Stabilisation Policy and Lags', *Journal of Political Economy*, 81, pages 847-77.

Cukierman, A, Kiguel, M A and Leiderman, L (1994), 'Choosing the Width of Exchange Rate Bands - Credibility Versus Flexibility', *CEPR Discussion Paper No. 907.*

Cukierman, A and Meltzer, A H (1986), 'A Theory of Ambiguity, Credibility and Inflation Under Discretion and Asymmetric Information', *Econometrica*, 54, pages 1,099-128.

Dotsey, M and King, R G (1986), 'Informational Implications of Interest Rate Rules', *American Economic Review*, 76, pages 33-42.

Feldstein M and Stock, J (1994), 'The Use of a Monetary Aggregate to Target Nominal GDP', in N G Mankiw (ed.), *Monetary Policy*, University of Chicago (for NBER).

Fischer, S (1990), 'Rules Versus Discretion in Monetary Policy', in Friedman, B M and Hahn, F H (eds.), *Handbook of Monetary Economics*, North-Holland.

Fischer, S (1994), 'Modern Central Banking', in *The Future of Central Banking*, Capie, F, Goodhart, C A E, Fischer, S and Schnadt, N (eds.), Cambridge University Press.

Freedman, C (1993), 'Designing Institutions for Monetary Stability: A Comment', *Carnegie-Rochester Conference Series on Public Policy*, 39, pages 85-94.

Friedman, B M (1975), 'Targets, Instruments and Indicators of Monetary Policy', *Journal of Monetary Economics*, 1, pages 443-73.

Friedman, B M (1990), 'Targets and Instruments of Monetary Policy', in Friedman, B M and Hahn, F H (eds.), *Handbook of Monetary Economics*, North-Holland.

Friedman, M (1959), *A Program for Monetary Stability*, New York.

Friedman, M (1962), 'Should there be an Independent Monetary Authority?', in Yeager, L B (ed.), *In Search of a Monetary Constitution*, Cambridge, Mass.

Friedman, M (1969), 'The Lag in Effect of Monetary Policy', in Friedman, M, *The Optimum Quantity of Money*, Chicago.

Garfinkel, M R and Oh, S (1994), 'When and How Much to Talk: Credibility and Flexibility in Monetary Policy With Private Information', *Seoul National University Discussion Papers in Economics No. 9405.*

Goodfriend, M (1987), 'Interest Rate Smoothing and Price Level Trend-Stationarity', *Journal of Monetary Economics*, 19, pages 335-48.

Haldane, A G and Salmon, C K (1995), 'Three Issues on Inflation Targets', in *Targeting Inflation*, Haldane, A G (ed), Bank of England.

Hall, R E and Mankiw, N G (1994), 'Nominal Income Targeting', in Mankiw, N G (ed), *Monetary Policy*, University of Chicago (for NBER).

Holbrook, R S (1972), 'Optimal Economic Policy and the Problem of Instrument Instability', *American Economic Review*, 62, pages 57-65.

Kemball-Cook, D and Levine, P (1989), 'Model Uncertainty, the Lucas Critique and Robustness in a Core Inflation Model', *LBS Discussion Paper No. 06/89.*

Kindleberger, C P (1993), *A Financial History of Western Europe*, Oxford University Press.

King, M A (1994), 'Monetary Policy in the United Kingdom', *Fiscal Studies*, 15, pages 109-28.

King, M A (1995), 'Rules and Discretion in Practice: the United Kingdom Experience', paper presented at the Gerzensee conference, Switzerland.

Kydland, F E and Prescott, E C (1977), 'Rules rather than Discretion: The Inconsistency of Optimal Plans', *Journal of Political Economy*, 85, pages 473-91.

Levine, P (1989), 'Should Rules be Simple?', *LBS Discussion Paper No. 08/89.*

Lohmann, S (1992), 'Optimal Commitment in Monetary Policy: Credibility Versus Flexibility', *American Economic Review*, 82, pages 273-86.

McCallum, B T (1988), 'Robustness Properties of a Rule for Monetary Policy', *Carnegie-Rochester Conference Series on Monetary Policy*, 29, pages 172-203.

McCallum, B T (1995), 'Two Fallacies Concerning Central Bank Independence', *American Economic Review*, Papers and Proceedings, May, pages 207-11.

Minford, P (1995), 'Time-Inconsistency, Democracy and Optimal Contingent Rules', *Oxford Economic Papers*, 47, pages 195-210.

Persson, T and Tabellini, G (1993), 'Designing Institutions for Monetary Stability', *Carnegie-Rochester Conference Series on Public Policy*, 39, pages 53-84.

Poole, W (1970), 'Optimal Choice of Monetary Policy Instrument in a Simple Stochastic Macro Model', *Quarterly Journal of Economics*, 84, pages 197-216.

Rogoff, K (1985), 'The Optimal Degree of Commitment to an Intermediate Monetary Target', *Quarterly Journal of Economics*, 100, pages 1,169-90.

Stein, J (1989), 'Cheap Talk and the Fed: A Theory of Imprecise Policy Announcements', *American Economic Review*, 79, pages 32-42.

Svensson, L E O (1995), 'Optimal Inflation Targets, 'Conservative' Central Banks, and Linear Inflation Contracts', *mimeo*, Stockholm University.

Taylor, J B (1993), *Macroeconomic Policy in a World Economy*, Norton, W W.

Tobin, J (1970), 'Money and Income: Post Hoc Ergo Propter Hoc?', *Quarterly Journal of Economics*, 84, pages 301-17.

Walsh, C E (1993a), 'Is New Zealand's Reserve Bank Act of 1989 an Optimal Central Bank Contract?', *mimeo*, University of California.

Walsh, C E (1993b), 'Optimal Contracts for Independent Central Bankers: Private Information, Performance Measures and Reappointment', *mimeo*, University of California.

Walsh, C E (1995), 'Optimal Contracts for Central Bankers', *American Economic Review*, 85, pages 150-67.

West, K D (1986), 'Targeting Nominal Income: A Note', *Economic Journal*, 96, pages 1,077-83.

Bank of England Working Paper Series

Publication date in italics

1	Real interest parity, dynamic convergence and the European Monetary System *(June 1992)*	Andrew G Haldane Mahmood Pradhan
2	Testing real interest parity in the European Monetary System *(July 1992)*	Andrew G Haldane Mahmood Pradhan
3	Output, productivity and externalities—the case of banking *(August 1992)*	R J Colwell E P Davis
4	Testing for short-termism in the UK stock market *(October 1992)*	David Miles
5	Financial deregulation and household saving *(October 1992)*	Tamim Bayoumi
6	An investigation of the effect of funding on the slope of the yield curve *(January 1993)*	D M Egginton S G Hall
7	A simple model of money, credit and aggregate demand *(April 1993)*	Spencer Dale Andrew G Haldane
8	Bank credit risk *(April 1993)*	E P Davis
9	Divisia indices for money: an appraisal of theory and practice *(April 1993)*	Paul Fisher Suzanne Hudson Mahmood Pradhan
10	The effect of official interest rate changes on market rates since 1987 *(April 1993)*	Spencer Dale
11	Tax specific term structures of interest rates in the UK government bond market *(April 1993)*	Andrew J Derry Mahmood Pradhan
12	Regional trading blocs, mobile capital and exchange rate co-ordination *(April 1993)*	Tamim Bayoumi Gabriel Sterne
13	Temporary cycles or volatile trends? Economic fluctuations in 21 OECD countries *(May 1993)*	Gabriel Sterne Tamim Bayoumi
14	House prices, arrears and possessions: A three equation model for the UK *(June 1993)*	F J Breedon M A S Joyce

15	Tradable and non-tradable prices in the UK and EC: measurement and explanation *(June 1993)*	C L Melliss
16	The statistical distribution of short-term libor rates under two monetary regimes *(September 1993)*	Bahram Pesaran Gary Robinson
17	Interest rate control in a model of monetary policy *(September 1993)*	Spencer Dale Andrew G Haldane
18	Interest rates and the channels of monetary transmission: some sectoral estimates *(September 1993)*	Spencer Dale Andrew G Haldane
19	The effect of futures trading on cash market volatility: evidence from the London stock exchange *(December 1993)*	Gary Robinson
20	M0: causes and consequences *(December 1993)*	F J Breedon P G Fisher
21	An empirical analysis of M4 in the United Kingdom *(December 1993)*	P G Fisher J L Vega
22	A model of building society interest rate setting *(June 1994)*	Joanna Paisley
23	Deriving estimates of inflation expectations from the prices of UK government bonds *(July 1994)*	Mark Deacon Andrew Derry
24	Estimating the term structure of interest rates *(July 1994)*	Mark Deacon Andrew Derry
25	Potential credit exposure on interest rate swaps *(August 1994)*	Ian Bond Gareth Murphy Gary Robinson
26	New currencies in the Former Soviet Union: a recipe for hyperinflation or the path to price stability? *(September 1994)*	C L Melliss M Cornelius
27	Inflation, inflation risks and asset returns *(November 1994)*	Jo Corkish David Miles

28	The construction of RPIY *(February 1995)*	R Beaton P G Fisher
29	Pricing deposit insurance in the United Kingdom *(March 1995)*	David Maude William Perraudin
30	Modelling UK inflation uncertainty: the impact of news and the relationship with inflation *(April 1995)*	M A S Joyce
31	Measuring core inflation *(April 1995)*	Danny T Quah Shaun P Vahey
32	An assessment of the relative importance of real interest rates, inflation and term premia in determining the prices of real and nominal UK bonds *(April 1995)*	David G Barr Bahram Pesaran
33	Granger causality in the presence of structural changes *(May 1995)*	Marco Bianchi
34	How cyclical is the PSBR? *(May 1995)*	Joanna Paisley Chris Salmon
35	Money as an Indicator *(May 1995)*	Mark S Astley Andrew G Haldane
36	Testing for convergence: evidence from nonparametric multimodality tests *(June 1995)*	Marco Bianchi
37	Wage interactions: comparisons or fall-back options? *(August 1995)*	Jennifer C Smith
38	The microstructure of the UK gilt market *(September 1995)*	James Proudman
39	Valuation of underwriting agreements for UK rights issues: evidence from the traded option market *(September 1995)*	Francis Breedon Ian Twinn
40	Rules, discretion and the United Kingdom's new monetary framework *(November 1995)*	Andrew G Haldane