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ABSTRACT

Monetary Policy and Stagflation in the UK*

The volatile data for inflation, output, and interest rates in the United Kingdom prior to the 1990s, and the relative macroeconomic stability associated with inflation targeting, provide a rich basis for discriminating between rival explanations for the outbreak of stagflation. We examine alternative hypotheses with a New Keynesian model of aggregate demand and inflation determination, estimated on quarterly UK data for 1959–2000. Our model features IS and Phillips curves based on optimizing behaviour, and fully incorporates the distinction between detrended output and the output gap stressed by optimizing analysis. Using simulations of our model as well as information on the 'real-time' views of policymakers, we test alternative explanations for the outbreak of inflation in the United Kingdom in the 1960s and 1970s. We find that inaccurate estimates of the degree of excess demand in the economy contributed significantly to the outbreak. But we also find a major role for the failure at the time to recognize the importance of monetary policy, as opposed to nonmonetary devices, in controlling inflation.

JEL Classification: E31, E52 and E58
Keywords: great inflation, monetary policy rules, output gap and stagflation

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1 Introduction

On November 17th, 1965, Iain Macleod, the spokesman on economic issues for the United Kingdom's Conservative Party, spoke in the House of Commons on the state of the UK economy:

> "We now have the worst of both worlds—not just inflation on the one side or stagnation on the other, but both of them together. We have a sort of 'stagflation' situation. And history, in modern terms, is indeed being made." (17 November 1965, p. 1165).[1]

With these words, Macleod coined the term "stagflation."[2]

As of the year 2002, there has been close to a decade of low and stable inflation in countries such as the United Kingdom, the United States, Canada, and Australia, along with generally satisfactory economic growth. In the wake of this relatively favourable outcome, many recent studies have revisited the period from the mid-1960s to the early 1980s in an attempt to isolate why that period saw the "Great Inflation" or "Great Stagflation"—stagnant or declining output alongside high inflation (see e.g. DeLong, 1997; Mayer, 1999; Sargent, 1999; Christiano and Gust, 2000; Clarida, Galí, and Gertler, 2000; Orphanides, 2000, 2001; Barsky and Kilian, 2001; and Lansing, 2001). A satisfactory explanation of this epoch would help today's policymakers avoid the likelihood of similar episodes in the future.

As discussed below, several different hypotheses have been advanced to explain this period. But all the studies mentioned have concentrated on the experience of the United States. The United States had neither the most severe nor the most prolonged stagflationary episodes, so the evidence it provides is more limited than that from other countries. In particular, the United Kingdom provides a richer source of evidence on stagflation, since the problem was identified earlier—as the above quote from Macleod attests—and ended later: double-digit inflation alongside recession was last experienced by the United Kingdom in 1990, compared to 1980 for the United States. The much more severe inflation experience of the United Kingdom is demonstrated in Chart 1, which plots the four-quarter percentage change in the United Kingdom's Retail Price Index. The "twin peaks" of inflation in the mid-1970s and 1980 are roughly double the corresponding peaks in the US

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[1] Many of the statements quoted in this paper are those by UK policymakers in Parliament, as given in the House of Commons" *Official Report* (also known as *Hansard*). These quotations are indicated by the date of the speech and the page from the *Hansard* volume from which the quotation is taken.
[2] Macleod used the term again in a speech to Parliament on 7 July 1970 and confirmed that he had invented the word. From then on, the term was common parlance in UK economic policy debate, being used, for example, in an article in *The Economist* of 15 August 1970. Some sources (e.g. Hall and Taylor, 1997) attribute the term to Paul Samuelson (1975). But the earliest occasion on which we have found Samuelson used the word was in a *Newsweek* column of March 19, 1973, entitled "What"s Wrong?," reprinted in Samuelson (1973, pp. 178–180).

data. Inflation was in double digits in 29 of the 40 quarters from 1973 to 1982, and again broke into double digits in 1990 Q3.

It would also be desirable, in analysing the UK experience, to have an optimization-based empirical model of aggregate demand and inflation behavior. This has been the approach of several recent studies of US inflation (e.g. Rotemberg and Woodford, 1997; Galí and Gertler, 1999; McCallum and Nelson, 1999a) and the euro area (e.g. Galí, Gertler, and López-Salido, 2001; Smets and Wouters, 2002). Empirical models of UK inflation have generally not been derived from optimization. Hendry and Mizon (1993), for example, use a loosely restricted VAR, while Matthews and Minford (1996) have rational expectations but not optimizing behavior.[3]

This paper redresses the above imbalances with an analysis of UK inflation behavior from the perspective of modern macroeconomic theory, using the tools of monetary policy rules and dynamic stochastic general equilibrium modelling.

Specifically, Section 2 presents estimates of a small, optimization-based model of aggregate demand and inflation for the UK. The parameters, dynamics, and definition of natural levels of output and interest rates in this model are all rigorously based on optimizing behavior. This model, estimated on quarterly data for 1959–2000, is suitable for monetary policy and business cycle analysis. The particular application of the model pursued in this paper is to the Great Inflation in the United Kingdom. We supplement the quantitative analysis with documented statements by UK monetary policymakers. This approach has been used to inform analysis of the US experience (see DeLong, 1997; Hetzel, 1998; Chari, Christiano, and Eichenbaum, 1998; Mayer, 1999; and Orphanides, 2000, 2001).

Our analysis emphasizes other causes of the Great Inflation than those stressed in other studies. In particular, Sargent (1999), Clarida, Galí, and Gertler (2000), and others have advanced for the United States what Christiano and Gust (2000) label the "Phillips curve hypothesis." This is the claim that the Great Inflation arose from a belief by policymakers that a rise in the steady-state inflation rate could lead to a permanent movement of output above potential; and that the disinflation that followed was a policy reaction to the seeming disappearance of a stable inflation/output gap trade-off. For the UK, this hypothesis lacks appeal, because it presupposes that policymakers accepted that monetary policy had powerful effects on inflation, and so regarded higher inflation as the price of an expansionary monetary policy. The evidence presented in Nelson (2001), using policymakers' statements, indicates instead that UK policymakers did not accept the Phillips curve

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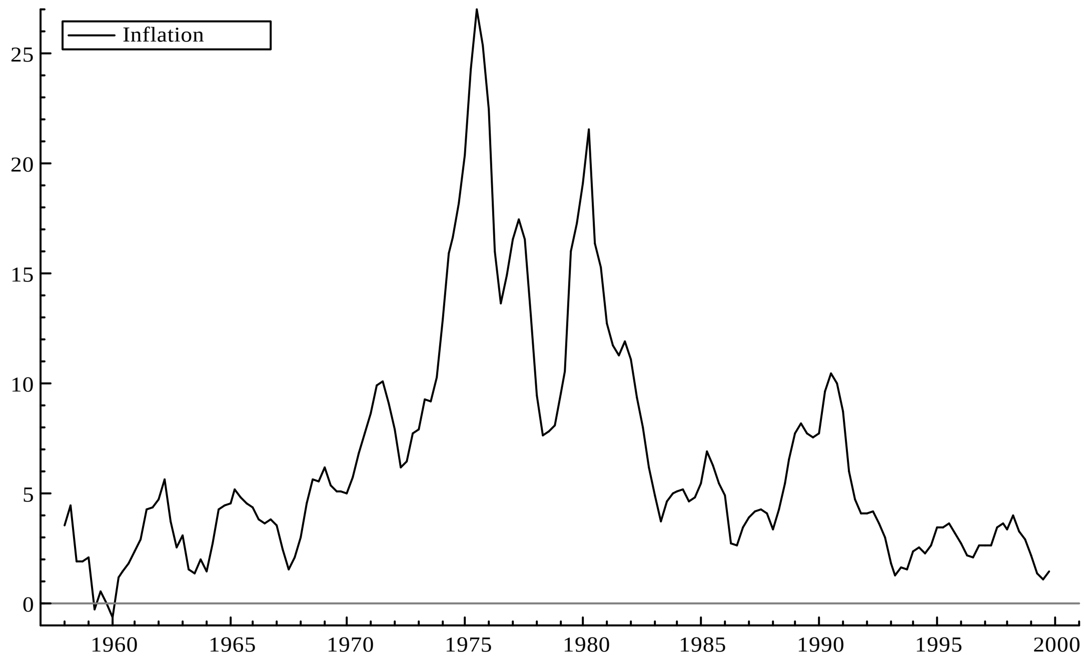
[3] Exceptions include Balakrishnan and López-Salido (2001) and Neiss and Nelson (2001).

Chart 1: UK inflation
Annual per cent change in Retail Price Index, 1958 Q1–1999 Q4



as a model of inflation or as a guide to policy,[4] and so we do not pursue the Phillips curve hypothesis in this paper.[5]

Rather, the evidence we present here suggests an alternative hypothesis: that "monetary policy neglect"—the failure in the 1960s and 1970s to recognize the primacy of monetary policy in controlling inflation—is important in understanding the Great Inflation in the United Kingdom. Evidence from policymakers' statements (detailed in Section 4) as well as the policy reaction function for the 1970s (given in Section 5) are consistent with inflation control being delegated to devices beside monetary policy. Our simulations in Section 5 suggest that the inflation outcomes of the 1970s can be understood as a combination of monetary policy neglect—which implied that policymakers did not let interest rates respond strongly to the take-off of inflation—and mismeasurement of the degree of excess demand in the economy. The latter factor is stressed by Orphanides (2000) for the United States, and implies that policymakers were slow to recognize the 1970s productivity slowdown, and accordingly used out-of-date and over-optimistic estimates of productive potential when setting policy. For the United Kingdom, this

[4] This conclusion is the opposite of that of Haldane and Quah (1999). But the conclusion in Nelson (2001) is based on actual UK policymakers" statements from the 1950s to the 1980s, while Haldane and Quah analyze no statements earlier than 1992.
[5] Space does not permit us to analyze several other proposed explanations of the United States" Great Inflation by Ireland (1999), Christiano and Gust (2000), and Beyer and Farmer (2002). These hypotheses have similar drawbacks to the Phillips curve hypothesis as explanations of the United Kingdom"s Great Inflation.

measurement problem was, if anything, larger than in the United States (see Nelson and Nikolov (2001), and Section 3 below).

Our counterfactual simulations in Section 5 suggest different conclusions from previous diagnoses of the 1970s inflation. Some earlier work, such as Brown (1985), suggests that the pattern of cost-push shocks in the 1970s was so unfavourable that a sharp rise in the secular inflation rate was largely unavoidable—in the absence of an extremely contractionary monetary policy reaction. Our findings are very different. According to our simulations, even with the sequence of cost-push shocks observed in the 1970s, all but 0.6% of the 9.3% rise in mean annual inflation in the United Kingdom in the 1970s could have been avoided if monetary policy had been different and information regarding the degree of excess demand in the economy been accurate. Moreover, the monetary policy required to deliver this outcome is not one drastically different from that observed historically, but rather, a policy reaction function of the form used after the introduction of inflation targeting in 1992. Our results therefore provide support for the ability of monetary policy to deliver stable inflation, even in the face of very large shocks, provided policy follows an inflation-targeting framework.

2 An estimated, optimization-based model of the UK economy

This section presents econometric estimates, based on 40 years of UK data, of a standard New Keynesian model of aggregate demand and inflation behavior. The resulting estimated model provides a compact tool for analysis of actual UK inflation outcomes and, because its parameters are designed to be policy-invariant, is also suitable for the analysis of alternative monetary policies. Section 2.1 describes the IS equation estimates, Section 2.2 the Phillips curve estimates, and Section 2.3 provides a summary.

2.1 An optimizing IS equation for the United Kingdom

We use a simple version of an optimization-based IS equation to describe aggregate demand in the United Kingdom. It can be derived from household optimization in a general equilibrium model and is valid for a wide variety of assumptions about price setting, including price flexibility. To avoid imposing assumptions about price setting in the estimation of the IS equation, we estimate the IS equation by single-equation instrumental variables, estimating a Phillips curve separately below.
The specific form of the IS equation is (see e.g. McCallum and Nelson, 1999b, eq. (23), or Woodford, 2000, eq. (1.3)):

$$y_t = b_0 + \mathrm{E}_t y_{t+1} - \sigma(1-s_g)(R_t^q - \mathrm{E}_t\pi_{t+1}) + s_g(g_t - \mathrm{E}_t g_{t+1}) + \sigma(1-s_g)\lambda_t, \qquad (1)$$

where y_t is log real GDP, R_t^q is the nominal interest rate expressed as a quarterly fraction, π_t is quarterly inflation, g_t is log government spending, s_g denotes the steady-state share of government consumption in GDP, and λ_t is an exogenous IS shock. At first sight, this equation would appear to omit open-economy influences; but as shown in Neiss and Nelson (2001), the effects of the exchange rate and foreign output on aggregate demand can be regarded as being incorporated, provided the real interest elasticity σ, and shock λ_t, are interpreted broadly.[6]

Setting s_g equal to 0.23 (its sample average in the United Kingdom over 1957–2000), and expressing interest and inflation rates at annualized rates, equation (1) can be written:

$$y_t = b_0 + E_t y_{t+1} + b_1(R_t - E_t\pi_{t+1}{}^a) + 0.23(g_t - E_t g_{t+1}) + v_t \quad (2)$$

where $b_1 = -¼\,(1-s_g)\sigma$, R_t and $\pi_t{}^a$ denote annualized interest and inflation rates respectively, and $v_t \equiv \sigma(1-s_g)\lambda_t$.

We estimate (2) by instrumental variables on UK data for 1957 Q1–2000 Q4. Results are reported in Table A.

Table A indicates that the specification delivers a well-defined, precisely estimated negative real interest rate elasticity of aggregate demand, of –0.09; the *t* value for this estimate is 4.0. In Table A we also report tests for residual autocorrelation. Serially uncorrelated shocks are not required by the underlying optimization theory, but do validate the use of lagged endogenous variables as instruments. Strong patterns in the residuals might also suggest that richer dynamics in the underlying model is a high priority. The Durbin Watson and LM test statistics indicate no signs of residual serial correlation in the equation.

The estimated interest elasticity of aggregate demand in Table A implies a value of $(1 - s_g)\sigma = 0.34$ in the IS equation (1). In Table B, we compare this value to those in previous empirical estimates of the optimizing IS equations. These studies have

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[6] This argument is based on the fact that in optimizing models, consumption and net exports have similar relationships to the real interest rate. The consumption Euler equation is of the form $E_t(1-\boldsymbol{F})c_t = -\sigma^c r_t$ + exogenous shock, where $-\sigma^c$ denotes the interest elasticity of consumption and $\boldsymbol{F}$ the lead operator. A real form of the uncovered interest parity condition implies $E_t(1-\boldsymbol{F})q_t = -r_t$ + exogenous shocks, where q_t is the log real exchange rate. But then if a log-approximation of the net export demand function takes the form $nx_t = \psi q_t$ + shocks, where $\psi > 0$, total private aggregate demand may be written as $E_t(1-\boldsymbol{F})[s_c c_t + (1-s_c)nx_t] = -\sigma'' r_t$ + shocks, where $\sigma'' \equiv s_c\sigma^c + (1-s_c)\psi$.

Table A

Estimates of the optimizing IS equation

$\boldsymbol{y_t = b_0 + E_t y_{t+1} + b_1(R_t - E_t p_{t+1}^{a}) + 0.23(g_t - E_t g_{t+1}) + v_t}$

UK data, 1957 Q1–2000 Q4

	Coefficient	t value
Constant	–0.004	4.5
b_1	–0.086	4.0
DW	1.86	
Residual standard error	0.0076	
LM test for residual autocorrelation	$\chi^2(1) = 0.8$ [p value = 0.36]	

Note: Estimation is by instrumental variables. Instruments are lags 1–3 of y, π^a, g, and R, and the dummy variables used in Section 2.2.

used datasets other than the United Kingdom. The table indicates that the studies that have used standard econometric estimation procedures such as IV or maximum likelihood have produced values of $(1–s_g)\sigma$ that are positive but below 1. The less standard impulse response function based estimator first used in Rotemberg and Woodford (1997) has delivered much larger values, but the properties of this estimator are not yet well understood. Our estimate of $(1–s_g)\sigma$ is close to those for other economies. The fact that our estimate is slightly higher than most in Table B is consistent with the greater openness of the UK economy than the US or euro-area economies; openness tends to justify a larger value of σ in equation (1), as the interest-elastic net trade channel "flattens" the IS curve.

The IS equation (2) has been compared empirically to "backward-looking" models of aggregate demand determination, such as that of Rudebusch and Svensson (RS) (1999). Estrella and Fuhrer (2000) argue that backward-looking equations of the RS type describe US data better than equation (2), and have more empirically constant parameters. UK data can shed light on the choice between the forward-looking IS equation and the RS specification. The RS equation specifies aggregate demand as a function of two lags of itself and one lag of a backward-looking measure of the real interest rate, $r_t^b = ¼(S_{i=0}^{3} R_{t-i}) – \log(P_t / P_{t–4})$. Measuring aggregate demand by the detrended output series (y_t^d) used in Table C below, estimation of the RS specification on UK data for 1957 Q1–2000 Q4 produces:

$y_t^d = –0.0002 + 0.873 y_{t–1}^d + 0.018\, y_{t–2}^d + 0.010\, r_{t–1}^b$.

(t = 0.3) (t = 11.3) (t = 0.2) (t = 0.5)

$R^2 = 0.79$, SEE = 0.0101,

Table B: Existing estimates of the IS slope coefficient $(1 - s_g)\sigma$ in equation (1)

Study	*Data*	*Estimation method*	*Estimate of* $(1 - s_g)\sigma$
Rotemberg and Woodford (1997)	US, quarterly data, 1980 Q1–1995 Q4	Impulse response based	6.0
McCallum and Nelson (1999a)	US, quarterly data, 1955 Q1–1996 Q4	IV	0.16
Amato and Laubach (2002)	US, quarterly data, 1980 Q1–1997 Q4	Impulse response based	3.9
Estrella and Fuhrer (2000)	US, quarterly data, 1966 Q1–1997 Q4	IV	0.22
Fuhrer (2000)	US, quarterly data, 1966 Q1–1995 Q4	Maximum likelihood	0.16
Ireland (2001)	US, quarterly data, 1980 Q1–1999 Q2	Maximum likelihood	0.22
Smets (2000)	Euro area, annual data, 1974–1998	IV	0.24
Boivin and Giannoni (2002)	US, quarterly data, 1980 Q1–1995 Q4	Impulse response based	1.72
Table A Estimates	UK, quarterly data, 1957 Q1–2000 Q4	IV	0.34

Note: Reported estimates have been expressed in comparable units to allow for the different conventions across papers in measuring the interest rate (i.e., as annualized or quarterly). Fuhrer's estimates use consumption as the activity variable; Fuhrer and Boivin-Giannoni allow for nonseparable utility, while Smets has a combination of lagged and expected future output in the IS relationship.

The coefficient on the real interest rate is incorrectly signed (positive) and insignificant.[7] The RS specification fails to deliver an interpretable real interest rate elasticity on UK data. Our forward-looking IS specification gives a highly significant negative interest elasticity, and therefore seems preferable.

2.2 A New Keynesian Phillips curve for the United Kingdom

We turn now to the price-setting side of the model. We will be estimating a version of the standard New Keynesian Phillips curve (Roberts, 1995). Expressed in terms of annualized quarterly inflation, this takes the form:

$$\pi_t^a = \beta E_t \pi_{t+1}^a + \alpha(y_t - y_t^*) + u_t, \tag{3}$$

where y_t^* is the log of potential output (so $y_t - y_t^*$ is the output gap) and u_t is a shock term, which we assume is white noise. As discussed in Roberts (1995), equation (3) is suggested by several alternative models of staggered price setting.

[7] Moreover, if only post-1979 data are used, the real rate coefficient becomes significantly positive. See Nelson (2001) for more analysis of the performance of the Rudebusch-Svensson specification on UK data.

Of these, the Calvo (1983) setup, in which a typical firm is only permitted to change its price at random intervals, is the most common rationalization (e.g. Rotemberg and Woodford, 1997). The u_t shock can be interpreted as a pricing error or possibly as arising from rigidities in input markets (see Erceg, Henderson, and Levin, 2000).

Studies such as Roberts (1995) and Estrella and Fuhrer (2000) have estimated equation (3) on US data using detrended log output as the measure of the output gap. While these two particular studies have found a correctly signed estimate (i.e., $\alpha > 0$), Galí and Gertler (1999) find a wrongly signed estimate of α when the gap is measured by detrended output, while Estrella and Fuhrer (2000) and Roberts (2001) stress that lagged inflation terms are highly significant if allowed to enter the equation, apparently rejecting specification (3).

An alternative interpretation of these results is that the forcing process in (3) is misspecified. Sbordone (2002) and Galí and Gertler (1999) note that the original first-order condition for the firm's price setting decision that underlies the micro-foundations of equation (3) has (log) real marginal cost mc_t rather than the output gap as the forcing variable; that is an equation like

$$\pi_t^a = \beta E_t \pi_{t+1}{}^a + \alpha_\mu mc_t + u_t, \tag{4}$$

where $\alpha_\mu > 0$, is suggested by firm optimization under staggered price adjustment. The output-gap form (3) of the New Keynesian Phillips curve then follows by substitution. But it is possible that marginal cost is easier to measure empirically than the output gap, so estimates of equation (4) might give more reliable parameter estimates as well as being more suitable tests of the validity of the New Keynesian Phillips curve. Sbordone (2002) and Galí and Gertler (1999) on US data, and Galí, Gertler, and López-Salido (2001) on euro-area data, find empirical support for equation (4).

Turning now to UK data, the study by Chadha, Masson, and Meredith (1992), one of the earliest empirical studies of the New Keynesian Phillips curve, stated that "preliminary results revealed large outliers in the residuals for the United Kingdom, [so] it was excluded from the pooled sample" (p. 408). That study measured the output gap as the log-deviations of GDP from a slowly-changing filter. There are, however, three studies that have, in the spirit of the Sbordone and Galí-Gertler papers, estimated variants of formulation (4) of the New Keynesian Phillips curve. These are Amato and Gerlach (2000) for 1971 Q4–1999 Q4, Batini, Jackson, and Nickell (2000) for 1972 Q3–1999 Q2, and Balakrishnan and López-Salido (2001) for 1970 Q1–1999 Q3. There are four key drawbacks of these studies that we address in our own modelling of UK inflation:

(i) None uses the inflation series actually targeted in the United Kingdom, namely the Retail Price Index excluding mortgage interest payments (RPIX), or the closely related Retail Price Index (RPI) series. Therefore, to convert the predictions of the existing estimated Phillips curves into predictions for the inflation concept that is of central interest to monetary policymakers, these equations would need to be supplemented by a relationship linking retail price inflation to the inflation series used in the studies.[8]

(ii) None of the sample periods in the studies include 1960s data. Since, as we noted in the Introduction, "stagflation" was diagnosed in the United Kingdom as early as 1965, 1960s data should add to our knowledge about the interaction of monetary policy, inflation, and the output gap.

(iii) None of the studies allow for the distortion to measured UK inflation due to the price controls in force during 1972–74. More generally, they do not try to isolate the effects on the inflation series of sharp one-time jumps in the price level that are not related to excess demand conditions.

(iv) Most importantly, the most these studies provide is a model of price setting conditional on marginal cost—not a direct model relating inflation to a measure of excess demand.

The first and last of the above drawbacks mean that for the existing estimated New Keynesian Phillips curves to be suitable for monetary policy analysis in the United Kingdom, they would need to be supplemented by *two* extra relationships: an equation or set of equations relating the output gap to marginal cost, and a relation linking retail price inflation to the modelled inflation rate. Thus, there are considerable costs, in terms of simplicity and comparability, to using these Phillips curves as part of a baseline New Keynesian model. It would be desirable, instead, to have an optimization-based model of aggregate demand and inflation determination that was just as compact as, for example, the non-optimization based model of Rudebusch and Svensson (1999).

Galí, Gertler, and López-Salido (2001) note that a virtue of estimating New Keynesian Phillips curves with wage data is that marginal cost is more directly observable than is the output gap; for optimizing models provide no grounds for believing that detrended output will be a satisfactory measure of the output gap. We strongly concur with this point; indeed, the baseline simulations in Neiss and Nelson (2001) of a New Keynesian model, solved under a policy rule estimated on UK data, suggest that the correlation between detrended output and the output gap is –0.68, vs. the +1.0 assumed in many empirical studies.

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[8] It should also be noted that all the studies cited use the log-change in prices, log (P_t / P_{t-1}) to measure the quarterly percentage inflation rate, $(P_t - P_{t-1})/P_{t-1}$. But for sample periods that include the high double-digit inflation rates of 1973–81 in the United Kingdom, the log-change tends to break down as an approximation of the percentage change. We use the latter measure in our empirical work in this paper.

But it is possible to estimate New Keynesian Phillips curves that fully take into account the distinction between detrended output and the output gap, without any need for the model disaggregation involved in using marginal cost in the Phillips curve. The alternative approach used here imposes some of the structure of the aggregate demand specification in the estimation of the Phillips curve. Consider the setting of IS equation (2) under price flexibility. Assuming that the real government purchase sequence is the same under sticky and flexible prices, (2) becomes:

$$y_t^* = b_0 + E_t y_{t+1}^* + b_1 4r_t^* + 0.23(g_t - E_t g_{t+1}) + v_t, \tag{5}$$

where y_t^* is log potential output and $4r_t^*$ is the annualized natural real interest rate. Subtracting (5) from (2) gives a relationship between the output and interest rate gaps:

$$y_t - y_t^* = E_t(y_{t+1} - y_{t+1}^*) + b_1(R_t - E_t\pi_{t+1}^a - 4r_t^*). \tag{6}$$

Iterating on this equation, one can express the expected-future-output terms in terms of expected future real interest rate gaps,

$$y_t - y_t^* = b_1(E_t \Sigma_{j=0}^{K} [R_{t+j} - E_t\pi_{t+1+j}^a - 4r_{t+j}^*]), \tag{7}$$

where $K = \infty$. This can then be substituted into the output-gap form of the New Keynesian Phillips curve to produce

$$\pi_t^a = \beta E_t\pi_{t+1}^a + \alpha_r(E_t \Sigma_{j=0}^{K} [R_{t+j} - E_t\pi_{t+1+j}^a - 4r_{t+j}^*]), \tag{8}$$

where $\alpha_r \equiv \alpha b_1$. Equation (8) says that inflation depends on its expected future value and an infinite distributed lead of the real interest rate gap. A version of (8)—a Phillips curve with the real-rate gap as the forcing process—is estimated below.

A natural question is why one should not try to estimate equation (3) more directly by constructing empirical counterparts to the real shocks that theory suggests drive cyclical fluctuations in y_t^*, and then producing a theory-consistent estimate of the output gap $y_t - y_t^*$. The reason is that there are strong grounds for believing that an empirical measure of $r_t - r_t^*$ will be more robust to error in measuring real shocks than a corresponding estimate of the output gap. An r_t^* series requires an estimate of the technology shock process (a_t) which, following standard practice, we measure by Solow residuals. As discussed in King and Rebelo (1999), there are many grounds for being doubtful of the accuracy of empirical Solow residuals as a measure of stochastic technology. Theory-consistent measures of potential output are likely to be highly sensitive to the measurement of the technology shock series, and hence to problems with Solow residuals, because technology shocks typically enter the expression for potential output with large coefficients. By contrast, estimates of the real interest rate gap are likely to be little affected by defects of Solow residuals as technology shock measures, because (as shown in Neiss and Nelson, 2001), under reasonable calibrations, the natural rate is quite insensitive to cyclical fluctuations in productivity: technology shocks enter the natural interest rate expression with low coefficients. The results in that paper suggest an additional reason for believing that estimates of the real interest rate gap are likely to be more robust to model specification and measurement errors, than estimates of the output gap. This is that cyclical variation in the actual real rate is considerably larger than that in the unobservable, natural-rate component of the gap. By contrast, there are few theoretical grounds for believing that potential output fluctuations are smaller in magnitude than in those of actual output.

We will, furthermore, approximate the infinite distributed lead ($E_t \, S_{j=0}^{K} [R_{t+j} - E_t\pi_{t+1+j}^{a} - 4r_{t+j}*]$) in equation (8) with low values of K. In other words, we will approximate the real *long-term* interest rate gap that appears in (8) with a low-order moving average of the *short-term* real interest rate gap. The reason why this is likely to be legitimate is that in models where most effects of monetary policy on real variables wear off within one to two years, the effect of policy on future values of the real interest rate, and hence on the real interest rate gap, is limited; that is, $E_t (r_{t+j} - r_{t+j}*) \approx 0$ once j exceeds a small number.

Prior to estimating equation (8) on UK data, we return to point (iii) in our discussion above. In practice, there are always many changes in specific prices, unrelated to excess demand conditions, which produce fluctuations in the measured inflation rate. In the normal course of events, these can usually be regarded as noise, and can be relegated to the disturbance term u_t. There are, however, certain major tax changes which have led to large spikes in measured UK retail price inflation, and are too large to be relegated to the u_t term. These are: the sharp increase in indirect taxes in 1968 Q2; the introduction of value added tax (VAT) in April 1973; a cut in the VAT rate in 1974 Q3, accompanied by increases in government subsidies on food prices; a near-doubling of the VAT rate in 1979 Q3 (which also roughly coincided with the second oil shock); and the introduction in April 1990 of the community charge, or "poll tax."[9] We include intercept dummy variables for each of these events. Of the tax changes, those introduced in 1968, 1973, 1979, and 1990 were announced a quarter in advance, and therefore their impact effect on the retail price index was largely predictable. Accordingly, the dummy variables for these events are allowed to shift both actual and expected next-period inflation up together.

[9] The imposition of the community charge had a large effect on measured RPIX inflation because the Retail Price Index Committee treated the tax unlike a direct tax, and did not take into account relief that was given to taxpayers to cushion the impact of the tax"s introduction. See Thatcher (1993, p. 658).

A dummy variable is also included for the price controls introduced by the Heath Government in November 1972 and continued until 1974. As discussed in Section 4, these controls were imposed in a period of aggressive monetary expansion, so it is likely that the amount of inflation suppressed by the controls increased during the period in which they were in effect. The dummy variable is equal to the number of months in which the controls have been in force. Suppressed inflation is assumed to be fully recorded in the measured inflation rate once the controls are removed.[10]

For econometric implementation, it is useful to rewrite equation (8), with the real-rate gap separated into its nominal interest rate, expected inflation, and natural rate components, and incorporating the dummy variables described above:[11]

$$E_t\,[\pi_t^a\,(1 - d_iD_{it} - \beta \boldsymbol{F} + \beta d_i\boldsymbol{F}D_{it} + 4{*}\alpha_r\boldsymbol{F} + 4{*}\alpha_r\mathbf{F}d_iD_{it})] \quad (9)$$
$$= c_0 + \alpha_rR_t - 4{*}\alpha_r\phi_{11}a_t - 4{*}\alpha_r\phi_{12}v_t + c_2DVAT74_t + c_3DCONTROL_t + u_t,$$

where D_{it} are the intercept dummies for the pre-announced tax changes, $DVAT74$ is a dummy for the VAT change announced and immediately implemented in 1974 Q3, and $\boldsymbol{F}$ is a lead operator that shifts forward all variables by which it is multiplied, but not the expectations operator (so in the above expression, $\pi_t^a\boldsymbol{F}D_{it} = E_t[\pi_{t+1}{}^aD_{it+1}] = D_{it+1}E_t\pi_{t+1}{}^a$). The ϕ_{11} and ϕ_{12} coefficients on the technology and IS shocks, respectively, are those that obtain in an expression for the real interest rate under price flexibility.[12]

Estimates are reported as the first regression in Table C. The real interest rate gap measure enters with the expected (negative) sign and is statistically significant.

The dummy variables' coefficients have correct signs and interpretable magnitudes. The equation indicates that the 1968 and 1973 indirect tax increases produced rises

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[10] Specifically, our dummy variable *DCONTROL* is equal to 1 in 1972 Q4, 4 in 1973 Q1, 7 in 1973 Q2, 10 in 1973 Q3, 13 in 1973 Q4, 16 in 1974 Q1, and –16 in 1974 Q2. Dummy variables for price control episodes are standard in empirical Phillips curves for the United States (e.g. Gordon, 1997).

[11] Our empirical measure of the price index is one that includes imports, while the theoretical Phillips curve used in estimation abstracts from open-economy elements. The basis for this strategy is largely practical: empirically, the relationship between the exchange rate and inflation, given excess demand, is extremely weak (Stock and Watson, 2001), while most optimizing open-economy models imply an extremely strong relationship. The weakness of the exchange rate/inflation relationship in countries like the UK is often rationalized by "pricing to market" behavior. But insofar as this means that sellers of imports set prices as a function of excess demand conditions in the domestic economy, this would legitimize our procedure of describing consumer prices by a Phillips curve that has no explicit open-economy terms.

[12] Following Neiss and Nelson (2001), we obtain these two coefficients by solving for the real interest rate under the assumption that prices are flexible in a dynamic general equilibrium model. This model has equation (2) as its IS curve, a fixed level of government spending, a Cobb-Douglas production function with a labor weight 0.7, and technology having AR(1) parameter 0.87 (the empirical first-order autocorrelation of the a_t series for 1959–2000). Leisure enters utility separably and linearly. The resulting flexible-price model gives an expression for the natural real rate of the form: $r_t^* = \phi_{11}a_t + \phi_{12}v_t$, with $\phi_{11} = -0.164$, $\phi_{12} = 0.450$.

in the price level of between 0.5 and 1 per cent (and so temporary increases in annualized inflation of 2–4 per cent). The intended effect of the fiscal measures in 1974 was to reduce the price level by 1.5 per cent (and so accomplish a one-time drop in inflation of 6 per cent annualized); the point estimate for the impact of these measures on annualized inflation is close to this, at –7.3 per cent. The regression also suggests that the Heath price controls did suppress some inflation, with the price level jumping by 2 per cent upon the controls' removal. By far the most significant dummy variables are those for the 1979 VAT increase and the introduction of the community charge, whose estimated effects on the price level are increases of 5.8 and 2.1 per cent, respectively.

Turning to the residual diagnostics, there is some evidence of residual autocorrelation at the 5 per cent level, though it is quite mild in magnitude (corresponding to a first-order residual autocorrelation coefficient of 0.16). In addition, this statistic is dominated by the residuals for several 1970s observations. Both the explained and the residual variation are large for our equation in the 1970s; it can match the main ups and downs of inflation in the 1970s, but the errors in both directions are larger in absolute value than in the rest of the sample. Supplementary statistics in Table C show that there is no evidence of serial correlation outside the decade 1972–1981.

Chart 2 plots actual inflation against the fitted values from the regression. Quarterly movements in inflation are tracked reasonably closely. The largest error occurs in 1975, when annualized quarterly inflation briefly exceeded 40%. The equation predicts "only" a 23% inflation rate for that data point.[13] More positively, it is capable of accounting for high double-digit inflation rates in the 1970s yet also the low inflation rates of the early 1960s and the 1990s.

The second regression in Table C shows that dropping the dummies has little effect on the estimated coefficient on the excess demand variable, $r_t - r_t^*$; rather, the main effect is a sharp deterioration in the fit of the equation, larger outliers, and a decrease in the precision of the α_r estimate.[14]

[13] Wilson (1984, p. 50) states that increases in non-VAT indirect taxes added 3 per cent to the level of the RPI in 1975. If not offset by other factors, these increases would account for about 12 percentage points of our 17 percentage point residual in mid-1975.

[14] In addition, the hypothesis of serially uncorrelated residuals is not rejected for this equation. As the estimate of α_r remains similar to our earlier one, it appears that any residual serial correlation in the previous equation is not producing serious inconsistency in the parameter estimation.

Table C: Estimates of the New Keynesian Phillips curve in real interest rate gap form:
$$\pi_t^a = c_0 + \beta E_t \pi^a_{t+1} + \alpha_r(r_t - r_t^*)$$
UK data, 1959 Q3–2000 Q4

	Baseline specification		Baseline specification with dummy variables dropped		With detrended output instead of the real interest rate gap	
	Coefficient	*t* value	Coefficient	*t* value	Coefficient	*t* value
Constant	0.005	1.5	0.003	0.7	0.002	0.7
α_r	–0.182	2.2	–0.135	1.3	—	—
Dummy variables for:						
Indirect tax increases, 1968 Q2	0.019	0.9	—	—	0.024	1.1
Heath price controls	–0.005	3.6	—	—	–0.004	3.5
Introduction of VAT, 1973 Q2	0.027	1.3	—	—	0.029	1.3
Cut in VAT, 1974 Q3	–0.072	1.8	—	—	–0.053	1.5
Increase in VAT, 1979 Q3	0.233	10.9	—	—	0.222	10.0
Community charge introduction, 1990 Q2	0.085	4.0	—	—	0.078	3.6
Detrended output (y_t^d)	—	—	—	—	–0.109	0.8
DW	1.68		2.06		1.58	
Residual standard error	0.0300		0.0359		0.0307	
LM test for residual autocorrelation	$\chi^2(1) = 4.1$ [*p* value = 0.04]		$\chi^2(1) = 0.2$ [*p* value = 0.69]		$\chi^2(1) = 7.4$ [*p* value = 0.01]	
Residual autocorrelation test 1959 Q3–1971 Q4	$\chi^2(1) = 0.0$ [*p* value = 0.83]		$\chi^2(1) = 0.0$ [*p* value = 0.88]		$\chi^2(1) = 0.5$ [*p* value = 0.47]	
Residual autocorrelation test 1982 Q1–2000 Q4	$\chi^2(1) = 1.9$ [*p* value = 0.17]		$\chi^2(1) = 4.8$ [*p* value = 0.03]		$\chi^2(1) = 0.0$ [*p* value = 0.89]	

Note: Estimation is by instrumental variables. Instruments are lags 1–3 of y^d, π^a, g, and R, and the current values of the IS and technology shocks, as well as the dummy variables indicated. In the final regression reported, the IS and technology shocks are dropped from the instrument list and lags 1–3 of y^d are added. The restriction $\beta = 0.99$ is imposed in estimation throughout, in line with the restriction on this parameter's value imposed by theory.

In the final regression of Table C, we replace the real interest rate gap as the forcing process in the Phillips curve with detrended log real GDP, y_t^d.[15] If y_t^d is regarded as a measure of the output gap $y_t - y_t^*$ in equation (3), the coefficient on y_t^d in the regression is the wrong (negative) sign. This reinforces the evidence from McCallum and Nelson (1999a) and Galí, Gertler, and López-Salido (2001) on the problems with interpreting detrended output as an output gap measure. Taken together, the regressions in Table C suggest that the (short-term) real interest rate gap measure is a better indicator of the true output gap than is detrended output, in keeping with the analysis in Neiss and Nelson (2001).

The results in Table C are estimates of equation (8) for the $K = 0$ case. They therefore require that the real short-rate gap proxies well the variation in current and expected future short-rate gaps. Table D checks this by giving Phillips curve estimates when more leads of the real-rate gap are included. As the number of leads (K) increases, more endogenous variables need to be modelled, and fewer observations are available for estimation. But point estimates of α_r remain similar to the $K = 0$ case.[16] Therefore, we use the $K = 0$ estimates in Table C.

2.3 *Summary of the results*

There are many possible extensions of our model, in line with those suggested by the recent literature, that could make it more empirically successful while preserving its “New Keynesian” feature of having dynamics and parameters linked to explicit optimizing behavior. For the IS equation, extensions could include habit formation in utility (e.g. Fuhrer, 2000). For the Phillips curve, generalizations include making the degree of price adjustment endogenous (as in Dotsey, King, and Wolman, 1999) and introducing labor market rigidities (e.g. Erceg, Henderson, and Levin, 2000). It would also be desirable to allow for changes in the steady-state value of the natural real interest rate, rather than treat it as constant over our sample period. For this paper we have restricted ourselves to estimating both the IS and Phillips curves on UK data in their plainest and starkest form. The result is a compact (two-equation) optimizing model of UK aggregate demand and inflation behavior. It is notable that the estimated parameters based on more than 40 years of quarterly UK data are plausible and statistically significant. By contrast, approaches that are more standard in empirical work, yet not based on optimizing considerations—such as backward-looking IS equations, or measuring the output gap by detrended output—do not deliver usable estimates on UK data, because estimates of key coefficients are wrongly signed. This suggests that being explicit

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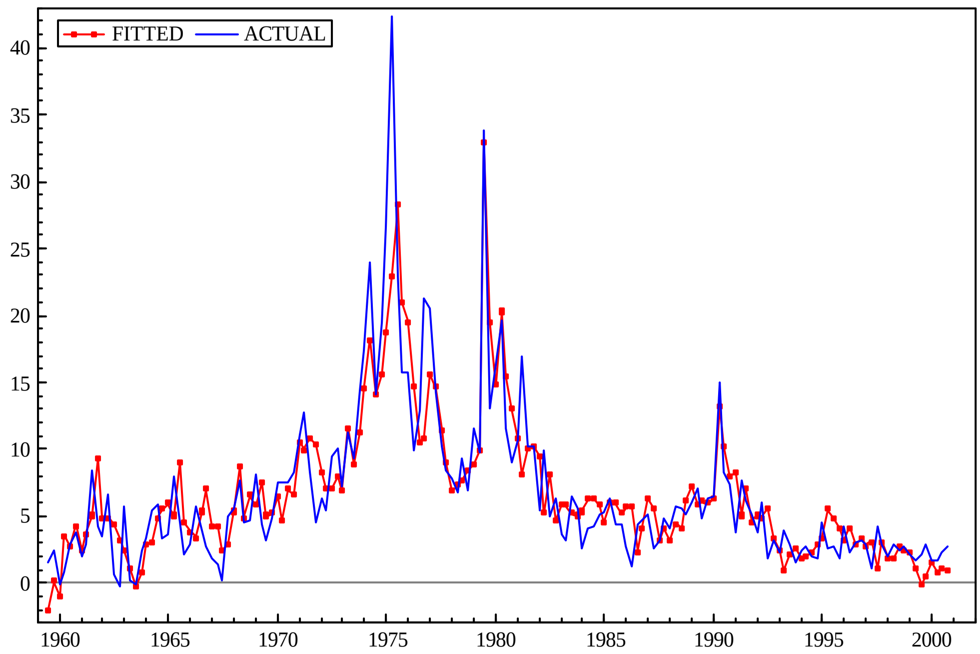
[15] This series is obtained as the residuals from a regression of y_t on a linear trend, with intercept and slope breaks in 1973 Q4 and 1981 Q4. See Nelson and Nikolov (2001) for discussion of these breaks.

[16] In addition, the estimated coefficients on the dummy variables in the regressions underlying Table D are quite insensitive to different choices of K.

Table D: Estimates of the Phillips curve parameter α_r for different choices of K			
K in eq. (8)	Sample period	α_r	t value
0	1959 Q3–2000 Q4	–0.182	2.2
1	1959 Q3–2000 Q3	–0.186	2.2
2	1959 Q3–2000 Q2	–0.189	2.2
3	1959 Q3–2000 Q1	–0.173	2.0
4	1959 Q3–1999 Q4	–0.178	2.1

Note: The $K > 0$ cases use lags 1–2 of y^d, g, R, and π^a, plus the IS and technology shocks, as instruments.

Chart 2: Actual inflation and fitted values from New Keynesian Phillips curve



about the microfoundations of spending and pricing behavior, and tracing fluctuations in potential output to underlying real shocks—both cornerstones of the New Keynesian approach—have real value in the analysis of aggregate UK data.

3 The output gap mismeasurement hypothesis

In the rest of this paper, we provide an application of our New Keynesian model: namely, to test different explanations of the "Great Inflation" in the United Kingdom. We focus in this section on the "output gap mismeasurement" hypothesis of Orphanides (2000).

3.1 *The hypothesis*

Orphanides' (2000) explanation of the Great Inflation blames over-optimistic views about the level and growth rate of potential output in the 1960s and 1970s for what now appears to be excessively easy monetary policy. Under this hypothesis, it is not the case that policymakers failed to take appropriate actions given the available data; rather, output gap estimates became especially unreliable in a crucial period. Orphanides' simulation results for the United States, and those of Lansing (2001), provide evidence that policy errors due to output gap mismeasurement contributed to the Great Inflation.

Note that, as the output gap concept used in policy discussions in the 1970s in both the United Kingdom and the United States corresponded closely to a *detrended output* series, the term "output gap" for this series is a misnomer, for the reasons discussed in Section 2.2. But even had policymakers used the theoretically correct concept in measuring cyclical fluctuations in potential output, errors in measuring the trend in potential could still lead to the type of output gap mismeasurement that Orphanides focuses upon.

We discuss the relevance for the UK of the output gap mismeasurement hypothesis in more detail in Nelson and Nikolov (2001). The main features of UK output gap mismeasurement in the 1970s are as follows. Prior to 1972, errors in measuring the output gap in real time largely reflect inaccurate GDP data rather than errors in measuring potential GDP growth. Initial GDP data greatly overestimated the severity of the early 1970s recession. In 1972–73, this error was compounded by policymakers' belief that the growth rate of potential had increased. A long sequence of growing one-sided errors occur in the real-time gap series, due to the failure of the post-1973 productivity slowdown to be incorporated into estimates of potential. In 1979, policymakers revised downwards their estimate of post-1973 potential growth, eliminating much of the output gap measurement error.

3.2 *Taylor rules on real-time data for the 1970s*

The series labelled *RTAY70s* in Chart 3 is the value of the nominal interest rate that, at each point in time from 1969 Q1 to 1979 Q2, would have been recommended if interest rates had been set according to the Taylor rule formula (Taylor, 1993):

$$RTAY70s_t = 4\pi^* + r^{ss} + 1.5\,(([P_{t-1} - P_{t-5}]/P_{t-5}) - 4\pi^*) + 0.5\,{}_t y^d_{t-1}, \qquad (10)$$

where r^{ss} is the steady-state real interest rate, and $4\pi^*$ a target for annual inflation. The data on the right-hand side of rule (10) are actual, real-time observations on annual inflation and the output gap. $([P_{t-1} - P_{t-5}]/P_{t-5})$ is the annual percentage change in the average of the Retail Price Index (P_t) for the quarter $t-1$, and ${}_t y^d_{t-1}$ is policymakers' estimate in period t of the output gap in t–1. In generating Chart 3, r^{ss} is set to 3% and $4\pi^*$ to 2.5%—a natural reference point since this was the annual inflation target used in the United Kingdom from 1992.

Chart 3 also plots the actual, end-of-quarter nominal Treasury bill rate (*Rend*). Throughout the sample period depicted, this rate closely tracked the interest rates used successively by the Bank of England as its operating instrument. End-quarter values of the bill rate (rather than the quarterly average) are used because this dating of equation (10) corresponds more closely with the availability in real time of the ${}_ty_{t-1}{}^d$ series.

Chart 3 indicates that the interest rate prescriptions from a Taylor rule using real-time data are *well above* the interest rates actually observed in the 1970s. At each point in the mid-1970s, the Taylor rule prescribes a nominal interest rate of between 15% and 20%. Yet the actual nominal interest rate never exceeded 14%—so policy does indeed appear to have been loose.

Use of real-time output gap data *does* make policy look tighter than final data suggest. This is indicated by the Taylor rule prescriptions using final data, also plotted in Chart 4. The real-time Taylor rule prescriptions are consistently below those using final data, confirming that initial data exaggerated the negative size of the output gap. Due to the cumulative effects of this mismeasurement, the difference between the two rule prescriptions exceeds 500 basis points after 1976. But while very large in their own right, the differences are small relative to those with actual interest rates. The failure of interest rates to respond to the very high inflation of the 1970s, which *was* accurately observed in real time, is the dominant feature of the data.

The rest of this paper will treat the deviations depicted in Chart 3 of the short-term interest rate from its Taylor-rule-prescribed value in the 1960s and 1970s as evidence of excessively loose monetary policy, and will investigate the reasons for this policy failure using our New Keynesian estimated model. One objection to this is that the Taylor rule baseline does not incorporate a response to the exchange rate. In practice, the exchange rate has played a role both as a variable that UK monetary policy was concerned with (especially before the exchange rate floated in 1972) and as an influence on output and inflation. But it is valid to treat the interest rate as the monetary policy *instrument* even in periods of managed exchange rates. In addition, even during the 1970–72 period UK monetary policy was largely concerned with domestic objectives, consciously pursuing a policy that ultimately led to abandonment of the exchange rate target. Nor does the Taylor rule baseline ignore the exchange rate; to the extent that variations in the exchange rate are relevant for the output gap and inflation, they alter the Taylor rule's recommended

Chart 3: Actual nominal interest rates and the prescription from a Taylor rule on real-time data, 1969 Q1–1979 Q2

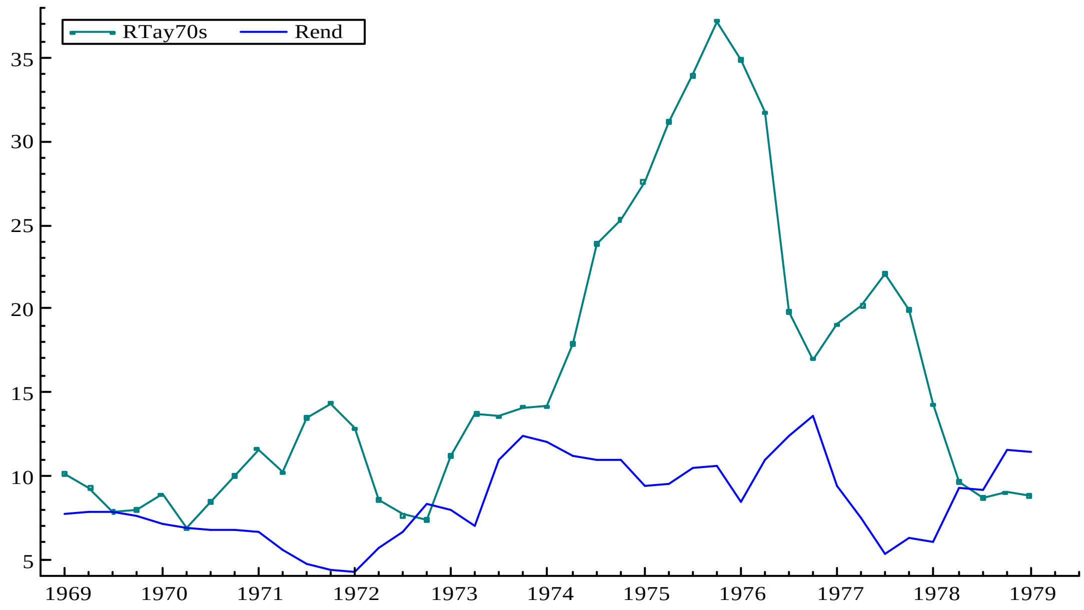
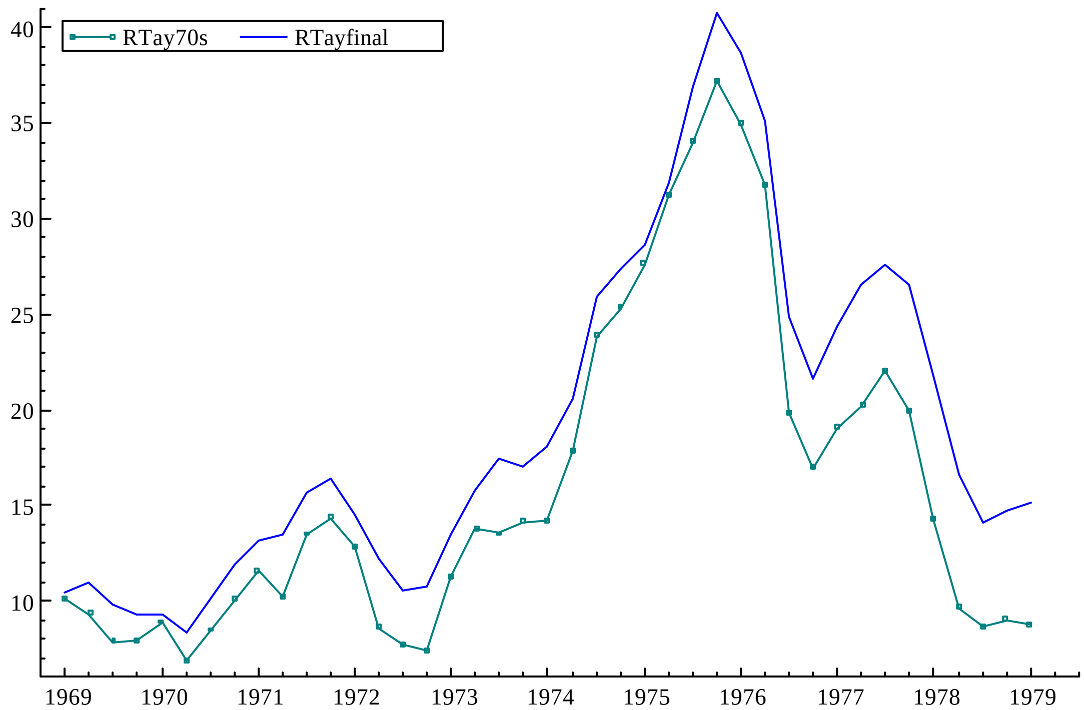


Chart 4: Prescriptions from a Taylor rule on real-time vs. final data, 1969 Q1–1979 Q2



interest rate.[17]

All in all, Charts 3 and 4 suggest output gap mismeasurement provides only a partial explanation for the United Kingdom's inflation record in the 1960s and 1970s. We therefore propose an additional explanation: the "monetary policy neglect" hypothesis.

4 Monetary policy neglect

With the output gap mismeasurement apparently inadequate as a leading explanation of the United Kingdom's Great Inflation, we argue instead that "neglect of monetary policy" is a major explanation of inflation behavior. We outline this hypothesis in this section, as a prelude to quantitative testing in Section 5. [18]

As King (2000) observes, UK policymakers in the 1960s and 1970s were influenced by an "economic establishment that seemed to believe that inflation was always and everywhere a real phenomenon." In terms of an equation like (3), shifts in the mean of the "cost-push" shock u_t were seen as driving inflation. Monetary policy was not seen as essential for inflation control; the latter, instead, was largely delegated to incomes policy (wage and price controls). Such views, we argue, led to a combination of easy monetary policy and attempts to control inflation through other devices, and contributed heavily to the breakout of inflation in the 1960s and 1970s.

Essentially, UK policymakers viewed monetary policy as disconnected from inflation, for two reasons. First, inflation was perceived as largely driven by factors other than the output gap; secondly, policymakers were highly sceptical about the ability of monetary policy to affect aggregate demand or the output gap appreciably. We now proceed to document these statements using "real-time" information of a different kind from that in Section 3: the "real-time data" here are contemporary UK policymakers' statements about the transmission mechanism.

The views of UK policymakers as of the 1960s on the role of monetary policy are described by Alec Cairncross, who was an influential policy adviser, first as a member of the Radcliffe Committee on the Working of the Monetary System in 1957–59, and then in two key Treasury positions. Cairncross (1996, p. 16) observes that "[i]n the effort to limit inflation there was little reliance on monetary policy, much less *exclusive* reliance… The prevailing view was that of the Radcliffe

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[17] Similar remarks apply to changes in fiscal policy or in long-term interest rates. Since fiscal policy and long-term rates tend to influence the components of the Taylor rule—the output gap and inflation—they would change the appropriate setting for the short-term interest rate, and it would be valid to judge policy according to whether short-term rates had moved to the new Taylor rule baseline.

[18] What we call the "monetary policy neglect" explanation has been stressed for the United States by Hetzel (1998, 2000) and Mayer (1999), but has not so far been examined in quantitative studies.

Committee… [that] monetary policy by itself had limited usefulness in controlling inflation." Similarly, in the late 1960s the Treasury "continued to regard monetary policy as of limited value in demand management and not a very effective weapon to use against inflation." Rather, "from 1961 onwards, incomes policy was regarded as a more appropriate weapon" against inflation (Cairncross, 1997, p. 243).

The 1959 Radcliffe Report, which heavily influenced policymakers' opinions, supported a negative view on the effectiveness of monetary policy. Laidler (1989, p. 1147) argues that the Report's views exemplified "the tradition of postwar British Keynesian economics," whose "defining characteristic" is that inflation is primarily a cost-push phenomenon, and that "monetary policy, if it matters at all, matters mainly for real income and employment, not prices" (1989, p. 1149).[19]

In addition to Treasury staff, leading economic policy advisers in the 1960s downplayed the role monetary policy could play in controlling inflation. This is indicated by the statements by the three key economic advisers to the government during the 1960s: N. Kaldor, T. Balogh, and R.R. Neild. Kaldor argued that the empirical relationship between money and nominal GDP reflected GDP-to-money causation, and that policymakers' actions on the money stock would be offset fully by movements in velocity (Kaldor, 1970).[20] Balogh claimed that monetarism had been tried by UK and US policymakers in the early 1950s, and that it had failed because of "fluctuations in the velocity of money, which offset—more than offset—changes in the volumes of money" (Balogh, 1970, p. 31). Not only were these positions taking the opposite stance of monetarist studies such as Friedman and Schwartz (1963); they were also considerably more hard-line than those of leading Keynesians in the United States, including many who had challenged the views of Milton Friedman and other monetarists. Paul Samuelson, for example, stated, "I cannot agree with Kaldor's belief that velocity of *M* will adjust to offset any induced changes in *M* (a remnant of the Radcliffe Committee heresy)…" (1971, p. 777).

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[19] Some key UK Keynesians denied monetary policy even an effect on real income and employment. For example, Balogh and Balacs (1973, p. 52) claimed that the rapid money growth in the United Kingdom in 1971–72 "rather than stimulating output, simply created an asset boom, especially in land."

[20] This hypothesis regarding velocity behavior follows from the position that nominal money is irrelevant for nominal income determination, so that if the money stock increases, then mechanically, monetary velocity (the ratio of nominal income to money) must fall by the same percentage. This passive or mechanistic view of velocity is so associated with the Radcliffe Report—notably its finding that there was "no reason for supposing, or any experience in monetary history indicating, that there is any limit to the velocity of circulation" (1959, para. 391)—that it is has been referred to as the "Radcliffian" (Rowan, 1980, p. 122) or "Radcliffesque" view (Darby and Lothian, 1983, p. 503). Tavlas (1981) traces "Radcliffian" views on velocity and on inflation to early UK Keynesian writings of the late 1930s, including those of Kaldor and Joan Robinson.

Consistent with their views on the ineffectiveness of money stock changes, leading UK policymakers and advisers downplayed the ability of interest rates to affect aggregate demand. Balogh and Balacs (1973, p. 49) argued that "[a]ll post-war experience" contradicted the notation that "expenditures were markedly interest-elastic." Neild, in a coauthored submission to the Radcliffe Committee, stated that "monetary policy by itself seems rather ineffective in influencing the level of demand in the economy" (p. 164). This submission also argued,

> "very strong claims have been made that, properly used, monetary policy can provide an effective means of maintaining price stability… In our view, such claims are exaggerated, and cannot be supported by the evidence available… In the long run, budgetary policy must be regarded as the exclusive method… of preventing both excesses and deficiencies of aggregate demand…" (Memorandum by I.M.D. Little, R.R. Neild, and C.R. Ross, December 1957, in Radcliffe Committee, 1959, pp. 160, 163).

This quotation shows how far views on monetary policy in the United Kingdom in the 1950s and 1960s were from the inflation-targeting framework of the 1990s. Hetzel's (1998, p. 22) observation for the United States, that "[t]he current consensus that central banks are responsible for inflation would have been impossible to establish in the intellectual environment of the 1970s," is doubly true for the United Kingdom in the Radcliffe era.

In this environment, UK policymakers largely viewed inflation as a nonmonetary phenomenon, to be remedied by nonmonetary measures. A six-month wage and price freeze was imposed in July 1966, more than five years before one was introduced in the United States. But initially these controls were accompanied by monetary and fiscal restriction, which tended to reinforce the controls' intended anti-inflationary effect. Later, however, monetary actions became inconsistent with the announced objective of low inflation. In the first half of the 1970s, 1970 Q1 to 1974 Q4, annual base money growth averaged 8.2%, double its 1960s value. Monetary policy was also extremely loose as judged by nominal interest rates (see Chart 3) and by broader monetary aggregates. The inflation produced by these domestic aggregate demand policies was, of course, compounded by the 1973 OPEC oil shock.

The price controls of 1966–67 and 1972–74 were among many nonmonetary measures intended to reduce inflation—essentially, devices meant to affect the prices of particular products or the costs of production. Such initiatives included attempts to hold down or cut the prices of government sector output (1971–72), subsidies on food prices and cuts in indirect taxation (1974, represented by our *DVAT74* dummy in Section 2), and an agreement between the 1974–79 government and the labor movement on nominal wage growth.[21]

The reliance on incomes policy, and on affecting specific prices, was largely at the expense of aggregate demand restraint. Most notably, the wage and price controls in 1972–74 went alongside an aggressive monetary and fiscal expansion. Indeed, the dummy variable for these price controls in our estimated New Keynesian Phillips curve in Section 2 is highly significant precisely because the aggregate demand policies during the period of the controls generated a great amount of suppressed inflation, which became open inflation once the controls were removed.

Inflation was in double digits throughout 1974–77, and after he left office, the Prime Minister for 1970–74 discussed "the monetary abuses alleged to have been committed by the Conservative Government":

> "[F]rom the second quarter of 1970, when we took over, to the first quarter of 1974—our last quarter in office—the increase in M1... was 42 per cent and the figure for the gross domestic product was 52.3 per cent. There is no justification for the argument that M1—which consists of notes, coins and current account deposits—was the cause of inflation...
>
> "It is constantly forgotten that in the two years 1972 and 1973 the Conservative Government had to deal with a 182 per cent increase in the price of raw materials and foodstuffs. I have never... heard that altering M1, which was already below GDP, could have prevented these increases in prices from coming through to the economy. It is important that this myth should be killed once and for all." (E. Heath, 7 July 1976, pp. 1417–1418).

The above argument rejects the view that monetary policy was responsible for inflation. Rather, it endorses a "cost-push" view of inflation—in this case, with commodity prices the principal driving factor. The above statement also rejects the position that monetary non-accommodation could have restrained the outbreak of inflation. By noting that money growth was below nominal GDP growth, it invokes the "Radcliffian" argument that monetary restraint in the face of inflationary pressure would simply result in a passive increase in velocity.[22]

This is not to say that cost-push theories of inflation have no merit, or that there is a mechanical link between monetary policy changes (however measured) and inflation. However, two key elements of policymakers' views in the 1970s do seem distant from much mainstream macroeconomic analysis today.

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[21] In a television interview on 1 August 1974, Prime Minister Wilson explained his government"s strategy: "we have set out to tackle inflation at the price end—by the rents freeze, by holding mortgages down, by food subsidies, by a much tighter control over food prices in the shops" (quoted in Day, 1993, p. 115).

[22] It should be noted that these numbers for money growth would be decidedly higher if Sterling M3 rather than M1 was used to measure money. Many monetarists would, however, accept the M1 definition but reject the conclusion regarding its irrelevance for inflation (e.g. Meltzer, 1981).

First, the Radcliffian view of monetary policy implies that cost-push inflation can continue indefinitely even in the absence of monetary accommodation; standard analysis today (e.g. Lipsey and Chrystal, 1995, p. 788), and indeed, much analysis in the United States in the 1960s and 1970s, [23] would say that cost-push inflation is self-limiting in the absence of monetary accommodation.

Secondly, incomes policy was seen as a *substitute* for aggregate demand restraint in the control of UK inflation. Incomes policy was viewed as a separate "instrument" of policy against inflation—a substitute for demand measures. Indeed, UK policymakers believed that aggregate demand expansion could contribute to inflation if output was above potential, but not if (as was believed to be the case in 1972) output was below potential. [24] By contrast, US advocates of incomes policy (e.g. Samuelson, 1973, p. 43) usually contended that incomes policy could not be a substitute for restricting aggregate demand; it was seen as *complementing* restrictive policies, by hastening the adjustment to a lower inflation rate, and containing the short-run cost in output and employment.

From late 1973, there was some policy reaction to growing criticism of rapid money growth. However, there remained an unwillingness to accept the increases in nominal interest rates associated with monetary tightening. Consequently, the Government gave an instruction to the Bank of England that the growth rate of broad money (Sterling M3) was to be reduced—but not by any policy that involved increasing interest rates (Goodhart, 1997, p. 403). The Bank of England's response in December 1973 was to impose a direct quantitative control on M3, the "Corset," which involved penalties if banks' deposits exceeded a specified limit. While the Corset did accomplish a reduction in observed M3 growth, it largely did so by encouraging the growth of deposit substitutes, weakening the relationship of M3 with future inflation.

In testimony to a Parliamentary committee in mid-1974, David Laidler argued, "The influence of monetary variables on aggregate demand has been, and continues to be, greatly underestimated in the conduct of economic policy in this country." [25] Formal targets were introduced for Sterling M3 in July 1976. However, genuinely restrictive monetary policy was largely avoided. Indeed, monetary base growth averaged 12.2% during the early years of M3 targeting (1977 Q1–1979 Q4), essentially identical to the rate for 1974–76. And nominal interest rates were cut all the way to 5% in 1977. Thus, monetary targeting became, like incomes policy, an intended weapon against inflation that did not genuinely restrict aggregate demand. Not until mid-1979 were interest rates allowed to rise decisively above the inflation

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[23] See Chari, Christiano and Eichenbaum (1998) and Hafer and Wheelock (2001) for discussions.
[24] Policymakers" statements on this issue are available in the appendix to Nelson (2001).
[25] June 26, 1974 testimony, in House of Commons (1974, p. 48).

rate, and this disinflation brought annual inflation below 5% by 1983, for the first time since early 1970.

We now use our estimated New Keynesian model to quantify the above argument and to compare the relative importance of "output gap mismeasurement" and "monetary policy neglect" in generating the United Kingdom's Great Inflation.

5 Simulation of the model

In this section we simulate our estimated empirical model of aggregate demand and inflation determination, together with a policy rule and shocks generated from UK data for the 1970s. This provides a quantitative application of our model that tests competing explanations for the Great Inflation.

To characterize monetary policy in the 1970s, we estimated the following interest rate equation for 1970 Q1–1979 Q1 on real-time data:

$$R_t = \underset{(t\,=\,3.0)}{0.035} + \underset{(t\,=\,7.3)}{0.860}\, R_{t-1} - \underset{(t\,=\,2.6)}{0.326}\, R_{t-3} + \underset{(t\,=\,2.0)}{0.242}\, {}_t y^d_{t-2} + \underset{(t\,=\,2.6)}{0.147}\, \pi_{A\,t-3} + \underset{(t\,=\,1.3)}{0.011} D76_t + e_{Rt} \qquad (11)$$

$R^2 = 0.737$, s.d. $(e_{Rt}) = 0.0142$,

where $\pi_{At} = (RPI_t - RPI_{t-4})/RPI_{t-4}$, RPI is the Retail Price Index, and (as in Section 3) ${}_t y^d_{t-2}$ denotes policymakers' real-time view in period t of the output gap—which they measured as the deviation of measured log GDP from a trend—in period t–2. This equation was obtained by starting with a three-lag specification, then omitting regressors with highly insignificant and wrongly signed coefficients. The absence of significant responses to either inflation or output at lag 1 is consistent with a policy responding only belatedly to economic information. The long-run solution of the equation is:

$$R_t = 0.075 + 0.517\, {}_t y^{d\ \ realt}_{t-2} + 0.315\, \pi_{A\,t-3} + 0.023\, D76_t\ ,$$

and thus implies a long-run response of the nominal interest rate of 0.517 to output (relative to trend) and of 0.315 to annual inflation. The inflation response coefficient is well below unity, and is consistent with anti-inflationary policy being delegated to nonmonetary devices. The response to GDP, on the other hand, is quite strong, suggesting an acceptance of monetary policy's role in the stabilization of real variables. These results are consistent with the "monetary policy neglect" interpretation of the UK Great Inflation.

The dummy variable $D76_t$ allows for a modest increase in the average nominal interest rate from July 1976, once monetary targeting was introduced. The estimated long-run responses to inflation and output are virtually identical if the sample period is truncated at 1976 Q2. As argued in Section 4, monetary targeting initially had a limited effect on interest rate behavior because non-interest rate devices were used to restrain measured monetary growth.

Some studies (e.g. Clarida, Galí, and Gertler, 2000) examine the long-run solution of estimated policy rules by partitioning them as:

$$E(R) = 4r^{ss} + E(\pi_A) + \phi_\pi[E(\pi_A) - 4\pi^*] + \phi_y E(y^d),$$

where $4\pi^*$ is the target for annual inflation, $4r^{ss}$ the steady-state natural real rate. On the assumption that inflation and the inflation target are on average equal, and that detrended output is zero on average, the equation delivers an estimate of $4r^{ss}$. But applying this analysis to our estimated rule for 1970–79 is problematic, for three distinct reasons: (i) inflation is likely to have exceeded target on average in this period, and moreover nonmonetary devices were typically relied upon to achieve the target; (ii) policymakers have considerable leverage in determining the average real interest rate over the medium run, and during the 1970s appear to have kept realized real rates well below reasonable values of the average natural real rate; and (iii) measured in real time, policymakers' estimate of the output gap was strongly negative on average in the 1970s.

The interpretation of policy rules thus becomes more difficult in periods where the inflation is out of control ($E(\pi_A) \neq 4\pi^*$) and monetary policy is not, in any case, viewed as the main weapon for controlling inflation. To attempt an interpretation, let us examine the form of the above equation that would hold *if*, as intended, nonmonetary devices such as incomes policy were successful in keeping inflation on target. In that case, the $[E(\pi_A) - 4\pi^*]$ term vanishes. Then the rule becomes one of setting real rates in response to movements in detrended output. A more appropriate formulation of the long-run solution to (11) is then:

$$E(R - \pi_A) = (r^{ss} - d_0 - 0.023^*D76) + 0.517E({}_t y^{d}_{t-2}{}^{realt}),$$

where d_0 is any average difference between the average real rate and r^{ss} that the central bank tries to create in the long run, over and above that dictated by its response to detrended output fluctuations. The above equation implies:

For 1970–76: $E(R - \pi_A) = -0.043 = (0.03 - d_0) + 0.517^*(-0.048) \Rightarrow d_0 = 0.048$.
For 1976–79: $E(R - \pi_A) = -0.031 = (0.03 - d_0') + 0.517^*(-0.107) \Rightarrow d_0' = 0.006$.

Under our interpretation, for a given output gap response, monetary policy forced real rates 4.8% below their average natural level in 1970–76, and 0.6% below it in 1976–79. The intercept term in the monetary policy rule was, under this interpretation, set at a value incompatible with price stability. In our historical simulations, we attempt to integrate this "intercept misalignment" into our policy rule specification.

To make our structural model suitable for historical simulations, we first write the estimated IS equation in the form (see equation (7) above):

$$\tilde{y}_t = -s_c\sigma\,\tilde{r}_t + E_t\tilde{y}_{t+1}, \tag{12}$$

where $\tilde{y}_t$ is the output gap $y_t - y_t^*$ and $\tilde{r}_t$ is the real interest rate gap $r_t - r_t^*$. And we write our estimated Phillips curve in terms of quarterly inflation, expressing it relative to an initial steady-state inflation rate π_0:

$$(\pi_t - \pi_0) = \beta E_t(\pi_{t+1} - \pi_0) - \alpha_r\,\tilde{r}_t + u_t. \tag{13}$$

We enter the estimated 1970–79 policy rule (11) as:

$$\begin{aligned} R_t = {} & \rho_1 R_{t-1} + \rho_2 R_{t-2} + \rho_3 R_{t-3} + (1-\rho_1-\rho_2-\rho_3)\,0.315(S_{j=0}^{3}\,\pi_{t-j\text{-}3}) \\ & + (1-\rho_1-\rho_2-\rho_3)0.517\,(\tilde{y}_{t-2} - \eta_{t-2}) - (1-\rho_1-\rho_2-\rho_3)d_{0t} + e_{Rt}\,, \end{aligned} \tag{14}$$

where $\rho_1 = 0.86$, $\rho_2 = 0$, and $\rho_3 = -0.326$. The term d_{0t} is an "intercept misalignment" term resulting from policymakers attempting to target a real interest rate on average below the natural rate. In line with our analysis above, d_{0t} is assumed to have mean 0.048 before 1976 Q3 and 0.006 thereafter.[26] In the long run, the model as a whole implies that targeting too low a real rate produces only more inflation, not lower real rates.

A difference between the simulated rule (14) and our estimated rule (11) is that policy in our simulated model would, in the absence of measurement error η_t, respond to the correct output gap concept $\tilde{y}_t = y_t - y_t^*$ rather than detrended log output y_t^d. This assumption should not affect our estimate of the contribution made by monetary policy to the secular rise in inflation, since the average difference between $\tilde{y}_t$ and y_t^d is zero by construction.[27]

The measurement error obeys an AR(1) process estimated over 1970 Q1–1979 Q1:

$$\eta_t = (1-0.879)E(\eta) + 0.879\eta_{t-1} + e_{\eta t}\,, \tag{15}$$
$$(t = 10.3)$$

where $E(\eta) = 0.09905$, s.d.$(e_{\eta t}) = 0.0201$.

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[26] In the simulations below, d_{0t} assumes its value of 4.8% in two steps, taking the value 2.4% in 1970 Q1 and 4.8% from then on until 1976 Q3.
[27] This form of (14) allows the model to be written conveniently in terms of interest rate gaps alone with no output or potential output level terms.

Measurement error is highly persistent with an estimated unconditional mean of 9.9%, well above zero and reflecting the one-sided errors that exaggerated the size of the reported output gap in the 1970s.

If there were not this one-sided measurement error in the output gap, a policy response to the output gap, as in rule (14), would be beneficial for inflation control. Indeed, a sizable response to the gap can compensate for a low policy response to inflation, due to the Phillips curve relation between inflation and the gap (see Woodford, 1999, p. 27). But when there is bias in the estimate of the gap, responding to the observed gap produces a source of policy error, and contributes to inflation. And with the low response to inflation in rule (14), there is little monetary policy attempt to rein in inflation once it takes off. Hence, both the large gap response and the low inflation response in equation (14) can be considered contributors to the rise in inflation in the 1970s.

The model that we simulate is close in structure to that used by Clarida, Galí, and Gertler (CGG) (2000) in their analysis of the Great Inflation; and, like them, we attribute the inflation of the 1970s to an inappropriate monetary policy rule. There are, however, three key differences between the analysis here and CGG's.

First, CGG motivate their estimated (US) pre-1979 monetary policy rule by appeal to policymakers' belief in a long-run exploitable Phillips curve, while we do not see the Phillips curve as a motivation for UK policymakers' behavior. Our "monetary policy neglect" hypothesis claims policymakers seriously underestimated the effect of monetary policy on nominal variables, while the Phillips curve explanation relies on policymakers believing that monetary policy has strong permanent effects on both nominal and real variables. Secondly, CGG focus exclusively on an inappropriate inflation response in the monetary policy rule, and abstract from an inappropriate intercept; in our account, intercept misaligment is a crucial defect of pre-1979 policy. Thirdly, we do not use the channel that CGG argue is the one through which an inflation response coefficient (ϕ_π) below 1 produced inflation in the 1970s. In backward-looking models, a policy response below 1 to inflation can produce an unbounded inflation outbreak; but in forward-looking models (such as ours and CGG's), $\phi_\pi < 1$ by itself produces multiple, dynamically stable equilibria, all of which have a common, low steady-state inflation rate. Multiple stable solutions seem implausible as a source of a rise in the secular inflation rate. Instead, we focus on one of the solutions associated with the $\phi_\pi < 1$ case, namely the minimal state variable (MSV) solution. Our simulation of this solution then asks whether the interaction of the estimated rule with two sources of nonzero mean policy error (namely, intercept misalignment and output gap mismeasurement) is capable of reproducing the rise in the secular rate of inflation observed in the United Kingdom in the 1970s.

We now simulate the solution of our model (12)–(14),[28] using as inputs our estimates for 1970 Q1–1979 Q1 of the IS shock v_t, technology innovations (the innovations to the a_t series), Phillips curve shocks u_t, policy shocks e_{Rt}, and output gap measurement error innovations $e_{\eta t}$. We set $\pi_0 = 0$ in equation (13), thus suppressing all constants beside those appearing in the definitions of the η_t and d_{0t} shocks in the policy rule. In plotting simulated inflation against actual inflation, we additively normalise the simulated series so that the initial (1970 Q1) simulated value of inflation is equal to the 1960s average of 3.7%. Successful stabilization of inflation would then imply a mean of inflation for 1970–79 of 3.7%.

Chart 5 plots actual annualized inflation against the historical simulation for 1970 Q1–1979 Q1. The model tracks actual inflation quite well for 1970–72 and 1976–79. For 1973–75, the model generates high double-digit inflation, but not as great as that observed in the data. As Chart 2 showed, our estimated Phillips curve is capable of explaining most of the inflation in this period, when simulated as a single equation. The reason why the simulated series in Chart 5 does not give as close a match is that our model as a whole cannot reproduce real interest rate gaps as negative as those observed in the United Kingdom in the mid-1970s. In Chart 2, actual observations on real interest rates in the 1970s were, essentially, taken as inputs and led to very high inflation predictions. In our simulated model, the negative real interest rate gaps have to be generated endogenously. The "intercept misalignment" term in our simulated policy rule is only able to approximate crudely and imperfectly the idea that policymakers tried to keep real rates down in the 1970s. Future extensions could improve the model's ability to account for major changes in the real interest rate's mean.

The average simulated value of inflation for 1970 Q1–1979 Q1 is 11.5%, compared to 13.0% in the data. Thus the model is able to account for 7.8 points of the 9.3 percentage point rise in inflation compared to the 1960s. We now attempt to decompose this increase into that which would have occurred given the output gap mismeasurement even in the presence of a stabilizing monetary policy, and that which is due to "monetary policy neglect." This takes two steps:

1. We simulate the model for 1970–79 under a rule, previously used in Neiss and Nelson (2001), estimated on UK data for 1992–97. The 1992–97 period was associated with inflation being close to target. Therefore, the 1992–97 policy rule is probably best described as one featuring no intercept misalignment as well as one with response parameters with inflation-stabilizing properties. The output gap response for 1992–97 is 0.47, very close to that we found above for 1970–79, so the

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[28] The solution assumes, in line with Section 2, white noise IS and Phillips curve shocks; white noise policy shocks; the same 0.87 AR coefficient for the technology shock assumed in estimating our Phillips curve; and the estimated law of motion (15) for the measurement error.

main difference in the long-run policy responses for 1992–97 is the inflation response, which at 1.27 for every 1 percentage point increase in inflation, is almost 100 basis points stronger than the 1970–79 rule.[29] Simulation of this rule provides an estimate of how much inflation in 1970–79 there would have been in the absence of both monetary policy neglect and output gap mismeasurement.

2. We re-simulate the 1992–97 rule, but with the output gap assumed to be mismeasured, the degree of output gap mismeasurement being that observed over 1970–79. This gives us an estimate of the contribution to inflation of errors by policymakers in measuring excess demand, when the formulation of monetary policy was otherwise appropriate.

Chart 6 plots the 1992–97 rule simulated over 1970–79 both with and without output gap mismeasurement. Regardless of whether gap mismeasurement is present, the policy clearly delivers lower inflation than either the simulated 1970–79 rule or actual, observed 1970s outcomes.

With the 1992–97 rule used and no output gap mismeasurement, the mean of inflation for 1970–79 is only 4.3%, just 0.6pp above the 1960s average.[30] So if neither monetary policy neglect nor output gap mismeasurement had been present during 1970–79, secular inflation in our model would have risen 0.6pp rather than 7.8pp.[31]

With output gap mismeasurement, the 1992–97 rule delivers average inflation of 6.6%, or 2.9pp above the 1960s average. So the predicted effect of the output gap mismeasurement of the 1970s, if policy had actually followed a rule such as that of 1992–97, is a rise of 2.3pp in secular inflation. Inflation would have been nearly double its 1960s level, but well below that observed in practice in the 1970s.

The simulation breaks down the rise in UK inflation in the 1970s as follows:

Rise in UK inflation, 1970 Q1–1979 Q1, over 1960s:		9.3pp
Of which:		
	Output gap mismeasurement:	2.3pp
	Monetary policy neglect:	4.9pp
	Other factors in model:	0.6pp
	Other factors, not in model:	1.5pp

[29] In full, the 1992–97 rule is $R_t = (1-\rho_R)1.27\ E_{t-1}(\Sigma_{j=0}^{3} \pi_{t-j+1}) + (1-\rho_R)0.47\ E_{t-1}\ \tilde{y}_t$, where $\rho_R = 0.29$.

[30] This rise is mainly due to the positive mean of the estimated Phillips curve shocks over 1970–79.

[31] The peak in nominal interest rates with this rule is about 17% in 1975, similar to, but earlier than, the actual peak observed in the United Kingdom (in 1979). The average 1970s level of nominal rates under the counterfactual rule is below that observed in practice because expected inflation is lower.

Chart 5: Quarterly UK inflation (annualized) 1970 Q1–1979 Q1, Actual vs. model simulation

Per cent

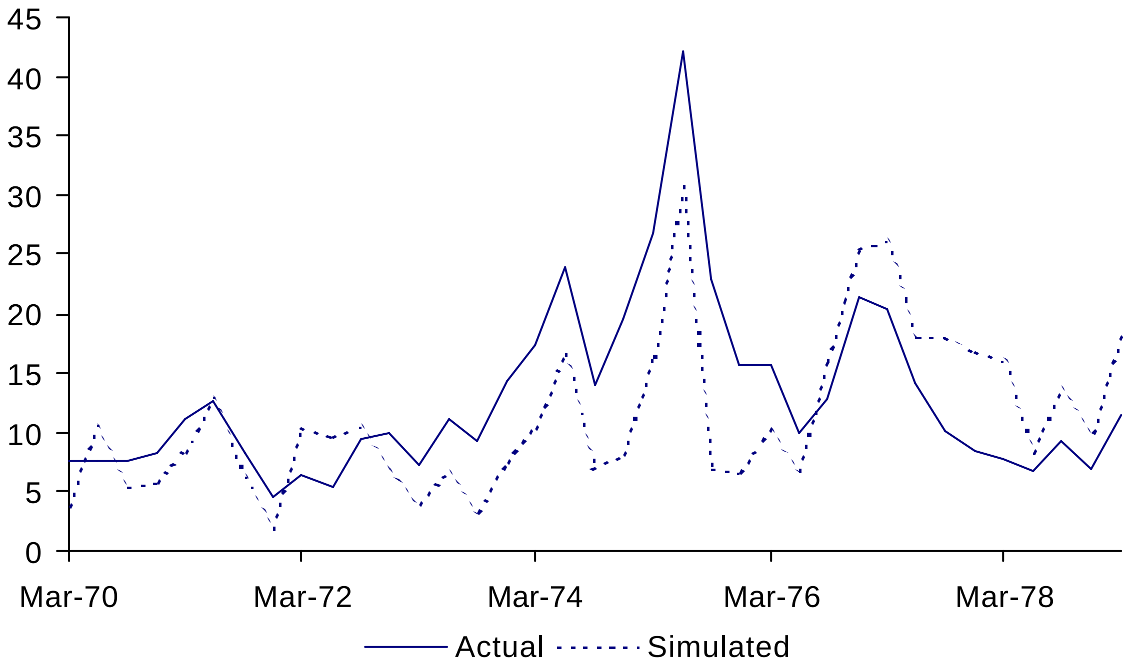
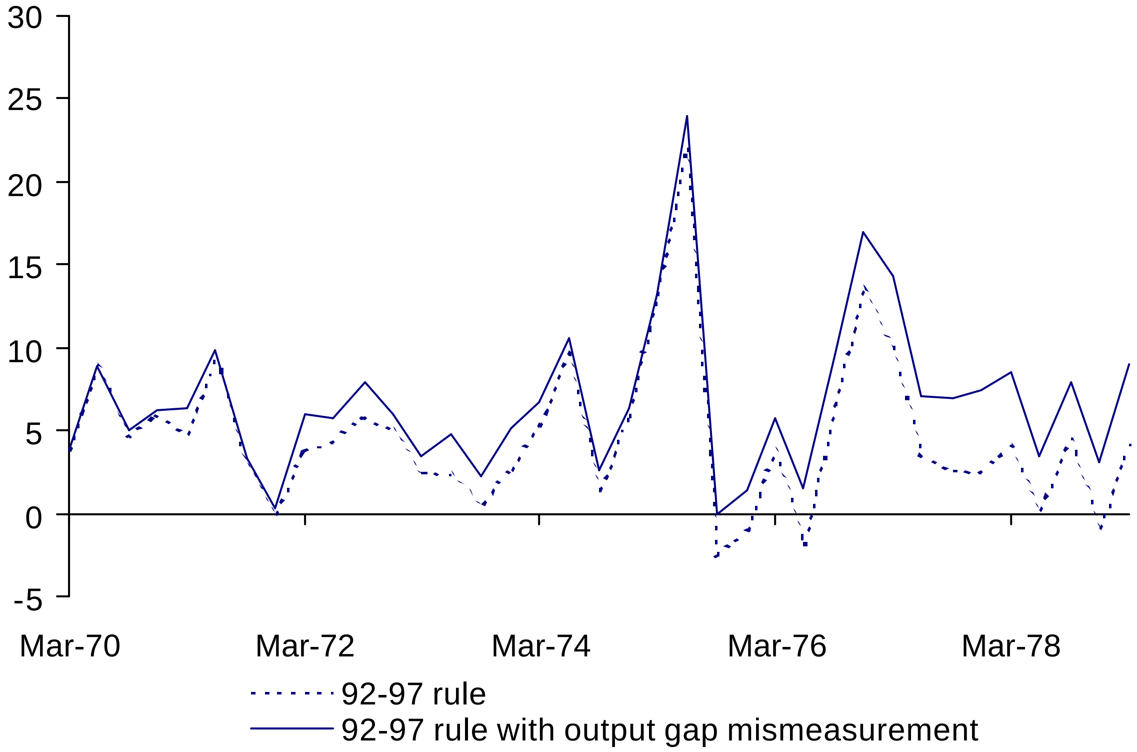


Chart 6: Quarterly UK inflation (annualized) 1970 Q1–1979 Q1, Counterfactual simulation using 1992–97 reaction function

Per cent



Monetary policy neglect produces most of the rise in inflation in the 1970s. The rise in inflation attributed to output gap mismeasurement is slightly below our estimate in Nelson and Nikolov (2001) on the basis of stochastic simulations, but very substantial nevertheless.

The model would account for much of the inflation attributed above to "factors not in model" if it could generate the very negative real interest rates of the mid-1970s. These negative real rates are surely largely attributable to inappropriate monetary policy, namely a prolonged attempt to peg nominal rates too low. So the portion of 1970s inflation that could have been avoided by a better policy rule, even in the face of output gap mismeasurement, may be larger than 5 percentage points. And this in turn is likely to be a lower bound on the amount of inflation that could have been avoided by a rule that was, implicitly or explicitly, formulated to take into account the presence of output gap mismeasurement. On the latter, see (eg) Aoki (2002), Lansing (2001), McCallum and Nelson (1999a), and Orphanides (2000).

Finally, our simulations for 1970–79 generate an output gap/inflation correlation of 0.7. The simulations in Neiss and Nelson (2001) suggest that this kind of New Keynesian model typically produces a strong negative correlation between the output gap and detrended output. With the output gap and output negatively correlated, and the output gap and inflation positively correlated, it appears that our model is capable of generating a negative detrended output / inflation correlation. Thus the model is capable of generating a symptom of "stagflation."

6 Conclusion

This paper estimated a New Keynesian macroeconomic model on 40 years of UK data. Parameter estimates are significant and interpretable, in contrast to traditional backward-looking approaches. The individual estimated equations are able to track most of the movements in UK output and inflation since the late 1950s.

In addition, the model, simulated with an estimated monetary policy rule, accounts for most of the secular rise in UK inflation in the 1970s. The analysis in this paper of that rise in inflation drew both on general equilibrium modelling and on analysis of policymakers' views in "real time," both of the output gap and of the model of the economy. Like previous studies, we found much of the 1970s inflation was attributable to an inappropriate monetary policy rule. But unlike previous studies, we stressed inappropriate choice of the intercept in the policy rule, not just inappropriate response parameters. And we argued that belief in a long-run Phillips curve trade-off was not crucial. Rather, we argued that this policy rule was followed because of "monetary policy neglect"—underestimation of the importance, both in the short and long run, of monetary policy for controlling inflation.

Data Appendix

π_t: Quarterly seasonally adjusted inflation. As there is no official seasonally adjusted version of the Retail Price Index excluding mortgage interest (RPIX) series that is targeted in the United Kingdom, a quarterly seasonally adjusted inflation series was needed. The first step was to construct a nonseasonally adjusted RPIX series by splicing an RPIX series which begins in 1974 Q1 into a Retail Price Index series for 1955 Q1–1974 Q1. A nonseasonally adjusted inflation series, π_t^{nsa}, was obtained using the percentage change formula, $(P_t^{nsa} - P_{t-1}^{nsa})/P_{t-1}^{nsa}$. The issue then became how to seasonally adjust the series. Automated procedures such as X–11, which apply moving-average type filters, seemed inappropriate. The problem was that large price level shocks distorted the inflation series in particular quarters, and from an econometric point of view it is desirable to isolate these events rather than spread them over adjacent quarters. This was especially so for the period 1972 Q4–1975 Q2, which features a large number of important one-off events: the Heath price controls and their subsequent removal (1972 Q4–1974 Q2), the UK's entry into the EEC in 1973 Q1, the introduction of value added tax (VAT) in 1973 Q2, the sharp cut in VAT and increases in food subsidies in 1974 Q3, and the oil and commodity price explosions of 1972–74.

In light of the above considerations, seasonal adjustment was undertaken using seasonal dummy variables. Even then, two problems were the need to allow for some change in seasonal patterns across the sample period; and to avoid the above events affecting the estimated seasonal patterns. The solution was to estimate seasonal dummy coefficients over 1955 Q2–1972 Q3 and impose those coefficients in seasonally adjusting inflation over 1955 Q2–1975 Q2. Data for 1975 Q3–1986 Q4 were then seasonally adjusted using seasonal patterns estimated from a regression for that period of π_t^{nsa} on seasonal dummies and a dummy for 1979 Q3, the latter present to insulate the estimated seasonality from the impact effect of the 1979 increase in VAT. Finally, the 1987 Q1–2000 Q4 data were seasonally adjusted using a regression of π_t^{nsa} on seasonal dummies and a dummy variable for the 1990 Q2 community charge introduction. The seasonally adjusted inflation series was constrained to have the same mean as the nonseasonally adjusted series for each of the periods 1955 Q2–1972 Q3, 1972 Q4–1975 Q2, 1975 Q3–1986 Q4, and 1987 Q1–2000 Q4. Annualized inflation was then defined as $\pi_t^a = (1 + \pi_t)^4 - 1$.

R_t: Quarterly average Treasury bill rate. Sources: *IFS* for 1957–2000; Capie and Webber (1985) for 1955–1956.

y_t: Log quarterly real GDP in United Kingdom (log of ONS series ABMI.Q).

y_t^d: Residuals from a regression for 1955 Q1–2000 Q4 of y_t on a constant, a linear trend, and dummy variables for breaks in intercept and trend slope in 1973 Q4 and 1981 Q4.

g_t: Log quarterly real government consumption in the United Kingdom (log of ONS series NMRY.Q).

a_t: Estimate of the Solow residual for the United Kingdom, constructed as in Neiss and Nelson (2001).

${}_t y_t^d$: Real-time output gap series: estimates from Nelson and Nikolov (2001).

References

Amato, J.D., and S. Gerlach (2000). "Comparative Estimates of New Keynesian Phillips Curves." Manuscript, BIS.

Amato, J.D., and T. Laubach (2002). "Estimation and Control of an Optimization-Based Model with Sticky Prices and Wages," *Journal of Economic Dynamics and Control*, forthcoming.

Aoki, K. (2002). "On the Optimal Monetary Policy Response to Noisy Indicators," *Journal of Monetary Economics*, forthcoming.

Balakrishnan, R., and J.D. López-Salido (2001). "Understanding UK Inflation: The Role of Openness and Structural Change." Manuscript, Bank of Spain.

Balogh, T. (1970). *Labour and Inflation*. Fabian Society.

Balogh, T., and P. Balachs (1973). *Fact and Fancy in International Economic Relations*. Pergamon Press.

Barsky, R.B., and L. Kilian (2001). "Do We Really Know That Oil Caused the Great Stagflation? A Monetary Alternative," *NBER Macroeconomics Annual*, Vol. 16(1), forthcoming.

Batini, N., B. Jackson, and S. Nickell (2000), "Inflation Dynamics and the Labor Share in the UK." External MPC Unit Discussion Paper No. 2, Bank of England.

Beyer, A and Farmer, R.E.A (2002). "Natural Rate Doubts." ECB Working Paper No. 121.

Boivin, J., and M. Giannoni (2002). "Has Monetary Policy Become Less Powerful?" Manuscript, Federal Reserve Bank of New York.

Brown, A.J. (1985), *World Inflation Since 1950*. Cambridge University Press.

Cairncross, A. (1996). *Managing the British Economy in the 1960s*. Palgrave.

Cairncross, A. (1997). *The Wilson Years: A Treasury Diary 1964–1969*. Historian's Press.

Calvo, G.A. (1983). "Staggered Prices in a Utility-Maximizing Framework," *Journal of Monetary Economics*, Vol. 12(3), 383–398.

Capie, F., and A. Webber (1985). *A Monetary History of the United Kingdom, 1870–1982, Volume I: Data, Sources, Methods*. George Allen and Unwin.

Chadha, B., P.R. Masson, and G. Meredith (1992). "Models of Inflation and the Costs of Disinflation," *IMF Staff Papers*, Vol. 39(2), 395–431.

Chari, V.V., L.J. Christiano, and M. Eichenbaum (1998). "Expectation Traps and Discretion," *Journal of Economic Theory*, Vol. 81(2), 462–492.

Christiano, L.J., and C.J. Gust (2000). "The Expectations Trap Hypothesis," *Federal Reserve Bank of Chicago Economic Perspectives*, Vol. 24(2), 21–39.

Clarida, R., J. Galí, and M. Gertler (2000). "Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory," *Quarterly Journal of Economics*, Vol. 115(1), 147–180.

Darby, M.R., and J.R. Lothian (1983). "Conclusions on the International Transmission of Inflation," in Darby *et al*, *The International Transmission of Inflation*. University of Chicago Press. 493–523.

Day, R. (1993). *...But with Respect*. Weidenfeld and Nicolson.

DeLong, J.B. (1997). "America's Peacetime Inflation: The 1970s." In C.D. Romer and D.H. Romer (eds.), *Reducing Inflation: Motivation and Strategy*. University of Chicago Press. 247–276.

Dotsey, M., R.G. King, and A.L. Wolman (1999). "State-Dependent Pricing and the General Equilibrium Dynamics of Money and output," *Quarterly Journal of Economics*, Vol. 114(2), 655–690.

Erceg, C.J., D.W. Henderson, and A.T. Levin (2000). "Optimal Monetary Policy with Staggered Wage and Price Contracts," *Journal of Monetary Economics*, Vol. 46(2), 281–313.

Estrella, A., and J.C. Fuhrer (2000). "Are 'Deep' Parameters Stable? The Lucas Critique as an Empirical Hypothesis." Manuscript, FRB Boston.

Friedman, M., and A.J. Schwartz (1963), *A Monetary History of the United States, 1867–1960*. Princeton University Press.

Fuhrer, J.C. (2000). "Habit Formation in Consumption and Its Implications for Monetary-Policy Models," *American Economic Review*, Vol. 90(3), 367–390.

Galí, J., and M. Gertler (1999). "Inflation Dynamics: A Structural Econometric Analysis," *Journal of Monetary Economics*, Vol. 44(2), 195–222.

Galí, J., M. Gertler, and J.D. López-Salido (2001). "European Inflation Dynamics," *European Economic Review*, Vol. 45(7), 1237–1270.

Goodhart, C.A.E. (1997). "Whither Now?," *Banca Nazionale del Lavoro Quarterly Review*, Vol. 50(203), 385–430.

Gordon, R.J. (1997). "The Time-Varying NAIRU and Its Implications for Economic Policy," *Journal of Economic Perspectives*, Vol. 11(1), 11–32.

Hafer, R.W., and D.C. Wheelock (2001). "The Rise and Fall of a Policy Rule: Monetarism at the St. Louis Fed, 1968–1986," *Federal Reserve Bank of St. Louis Review*, Vol. 83(1), 1–24.

Haldane, A., and D. Quah (1999). "UK Phillips Curves and Monetary Policy," *Journal of Monetary Economics*, Vol. 44(2), 259–278.

Hall, R.E., and J.B. Taylor (1997), *Macroeconomics*. 5th edition. W.W. Norton.

Hendry, D.F., and G.E. Mizon (1993). "Evaluating Dynamic Econometric Models by Encompassing the VAR." In P.C.B. Phillips (ed.), *Models, Methods, and Applications of Econometrics*. Blackwell. 272–300.

Hetzel, R.L. (1998). "Arthur Burns and Inflation," *Federal Reserve Bank of Richmond Economic Quarterly*, Vol. 84(1), 21–44.

Hetzel, R.L. (2000). "The Taylor Rule: Is It a Useful Guide to Understanding Monetary Policy?," *Federal Reserve Bank of Richmond Economic Quarterly*, Vol. 86(2), 1–33.

House of Commons (1974). *Ninth Report from the Expenditure Committee: Public Expenditure, Inflation and the Balance of Payments.* HMSO.

Ireland, P.N. (1999). "Does the Time-Consistency Problem Explain the Behavior of Inflation in the United States?," *Journal of Monetary Economics*, Vol. 44(2), 279–291.

Ireland, P.N. (2001). "Money's Role in the Monetary Business Cycle." NBER Working Paper No. 8115.

Kaldor, N. (1970). "The New Monetarism," *Lloyds Bank Review*, July, 1–17.

King, M.A. (2000). "Monetary Policy: Theory in Practice." Address to the Joint Luncheon of the American Economic and American Finance Associations, 7 January (www.bankofengland.co.uk/speeches/speech67intro.htm).

King, R.G., and S. Rebelo (1999). "Resuscitating Real Business Cycles." In J.B. Taylor and M. Woodford (eds.), *Handbook of Macroeconomics, Volume 1B*. North Holland. 927–1007.

Laidler, D. (1989). "Dow and Saville's *Critique of Monetary Policy*—A Review Essay," *Journal of Economic Literature*, Vol. 27(3), 1147–1159.

Lansing, K.J. (2001). "Learning about a Shift in Trend Output: Implications for Monetary Policy and Inflation." Manuscript, Federal Reserve Bank of San Francisco.

Lipsey, R.G., and K.A. Chrystal (1995). *An Introduction to Positive Economics*. 8th edition. Oxford University Press.

Matthews, K., and P. Minford (1996). "British Inflation and Unemployment in the 1970s: A Model-Based Decomposition," *Applied Economics*, Vol. 28(1), 103–115.

Mayer, T. (1999). *Monetary Policy and the Great Inflation in the United States: the Federal Reserve and the Failure of Macroeconomic Policy, 1965–79*. Elgar.

McCallum, B.T., and E. Nelson (1999a). "Performance of Operational Policy Rules in an Estimated Semi-Classical Structural Model." In J.B. Taylor (ed.), *Monetary Policy Rules*. University of Chicago Press. 15–45.

McCallum, B.T., and E. Nelson (1999b). "An Optimizing IS-LM Specification for Monetary Policy and Business Cycle Analysis," *Journal of Money, Credit, and Banking*, Vol. 31(3), 296–316.

Meltzer, A.H. (1981). "Tests of Inflation Theories from the British Laboratory," *The Banker*, July, 21–27.

Neiss, K.S., and Nelson, E (2001). "The Real Interest Rate Gap as an Inflation Indicator." CEPR Discussion Paper No. 2848.

Nelson, E. (2001). "What Does the UK's Monetary Policy and Inflation Experience Tell Us about the Transmission Mechanism?" CEPR Discussion Paper No. 3047.

Nelson, E., and K. Nikolov (2001). "UK Inflation in the 1970s and 1980s: The Role of Output Gap Mismeasurement." Bank of England Working Paper No. 148 and CEPR Discussion Paper No. 2999.

Orphanides, A. (2000). "The Quest for Prosperity Without Inflation." ECB Working Paper No. 15.

Orphanides, A. (2001). "Monetary Policy Rules, Macroeconomic Stability and Inflation: A View from the Trenches." FEDS paper No. 2001–62, Federal Reserve Board, and ECB Working Paper No. 115.

Radcliffe Committee (1959). *Report of the Committee on the Working of the Monetary System*. Cmnd. 827, HMSO.

Roberts, J.M. (1995). "New Keynesian Economics and the Phillips Curve," *Journal of Money, Credit, and Banking*, Vol. 27(4), 975–984.

Roberts, J.M. (2001). "How Well Does the New Keynesian Sticky-Price Model Fit the Data?," FEDS paper No. 2001–13, Federal Reserve Board.

Rotemberg, J.J., and M. Woodford (1997). "An Optimization-Based Econometric Framework for the Evaluation of Monetary Policy," *NBER Macroeconomics Annual*, Vol. 12(1), 297–346.

Rowan, D.C. (1980). *Australian Monetary Policy 1950–1975*. Allen and Unwin.

Rudebusch, G.D., and L.E.O. Svensson (1999). "Policy Rules for Inflation Targeting." In J.B. Taylor (ed.), *Monetary Policy Rules*. University of Chicago Press. 203–246.

Samuelson, P.A. (1971). "Reflections on the Merits and Demerits of Monetarism." Lecture reprinted in H. Nagatani and K. Crowley (eds.), *The Collected Scientific Papers of Paul A. Samuelson Vol. 4*. MIT Press, 1977. 765–779.

Samuelson, P.A. (1973). *The Samuelson Sampler*. W.W. Norton.

Samuelson, P.A. (1975). "Worldwide Stagflation," *Intermountain Economic Review*, Vol. 6(2), 8–15. Reprinted in H. Nagatani and K. Crowley (eds.), *The Collected Scientific Papers of Paul A. Samuelson Vol. 4*. MIT Press, 1977. 801–807.

Sargent, T.J. (1999). *The Conquest of American Inflation*. Princeton University Press.

Sbordone, A. (2002). "Prices and Unit Labor Costs: A New Test of Price Stickiness," *Journal of Monetary Economics*, Vol. 49(2), 265–292.

Smets, F. (2000). "What Horizon for Price Stability?" ECB Working Paper No. 24.

Smets, F., and R. Wouters (2002). "Monetary Policy in an Estimated Stochastic Dynamic General Equilibrium Model of the Euro Area." Manuscript, ECB.

Stock, J.H., and M.W. Watson (2001). "Forecasting Output and Inflation: The Role of Asset Prices." NBER Working Paper No. 8180.

Tavlas, G.S. (1981). "Keynesian and Monetarist Theories of the Monetary Transmission Process: Doctrinal Aspects," *Journal of Monetary Economics*, Vol. 7(3), 317–337.

Taylor, J.B. (1993). "Discretion Versus Policy Rules in Practice," *Carnegie-Rochester Conference Series on Public Policy*, Vol. 39(1), 195–214.

Thatcher, M. (1993). *The Downing Street Years*. HarperCollins.

Wilson, T. (1984). "Monetarism in Britain." In T. Wilson, *Inflation, Unemployment, and the Market*. Clarendon. 41–78.

Woodford, M. (1999). "Optimal Monetary Policy Inertia," *Manchester School* (*Supplement*), Vol. 67(1), 1–35.

Woodford, M. (2000). "A Neo-Wicksellian Framework for the Analysis of Monetary Policy." Chapter 4 of *Interest and Prices: Foundations of a Theory of Monetary Policy*. Manuscript, Princeton University.