NBER WORKING PAPER SERIES

MONETARY INFORMATION AND MACROECONOMIC FLUCTUATIONS

John Boschen

Herschel Grossman

Working Paper No. 498

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge MA 02138

July 1980

Revised version of a paper presented at a colloquium on Recent Developments in Macroeconomics at the European University Institute, Florence, May 13-14, 1980. The National Science Foundation and the John Simon Guggenheim Memorial Foundation have supported this research. We have received useful comments from Mark Edwards, Oliver Hart, Robert King, Axel Leijonhufvud, and Edmond Malinvaud. The research reported here is part of the NBER's research program in Economic Fluctuations. Any opinions expressed are those of the authors and not those of the National Bureau of Economic Research.

NBER Working Paper #498
July, 1980

Monetary Information and Macroeconomic Fluctuations

ABSTRACT

This paper introduces contemporaneously available monetary data into an "equilibrium" model that combines rational expectations, market clearing, and incomplete information about monetary disturbances. Data on the current money stock involve a preliminary estimate that is subject to a subsequent process of gradual revision. The model implies the testable hypothesis that aggregate output and employment are uncorrelated with the contemporaneous measure of money growth implied by the difference between the currently available estimates of current and past money shocks. Rejection of this hypothesis provides strong evidence against the equilibriums approach to modelling the relation between monetary disturbances and macro-eocnomic fluctuations.

John Boschen
Herschel I. Grossman

Department of Economics
Brown University
Providence, R.I. 02912

(401) 863-2606

Current research in macroeconomics focuses considerable attention on models that appeal to incomplete information about monetary disturbances in an attempt to reconcile assumptions of rational expectations and market clearing with a relation between money and macroeconomic fluctuations. Evaluation of these so-called "equilibrium models" requires understanding of the precise content in this context of the three key ideas. (1) Rational expectations mean that private agents gather and use information efficiently and, more specifically, that they behave as if they understand the economy's essential stochastic structural relations, including the pattern governing the determination of the stock of money. (2) Market clearing means that transactions in individual markets realize all perceived gains from trade. This assumption has taken two alternative forms. Specifically, Lucas [1972; 1973] and Barro [1976] assume that prices and quantities equate spot demands and supplies, whereas Azariadis [1978] assumes that quantities are set contractually to satisfy perceived productive-efficiency conditions, which are similar to spot market-clearing conditions, but that certain prices are set contractually to satisfy risk-sharing-efficiency conditions, which mean that wages are not equated to perceived marginal products. For present purposes, these two forms of market clearing have the same implications. (3) Incomplete information means that only local information about prices is contemporaneously available and that a part of the behavior of monetary aggregates is neither anticipated nor contemporaneously perceived. Specifically, equilibrium models assume that monetary policy is partly stochastic and, with the exception of the recent work of King [1980], existing equilibrium models also assume that no data on the current money stock is available. These models, however, assume that accurate data about past values of the money stock is currently available.

The most striking implication of equilibrium models, derived explicitly by Barro [1976], is a neutrality proposition that says that macroeconomic fluctuations--specifically, the time pattern of differences between actual and natural levels of real variables such as aggregate output and employment--evolve independently of those monetary actions that reflect systematic responses to macroeconomic fluctuations. Because private agents correctly anticipate systematic monetary policy and understand how monetary policy affects the market-clearing conditions, which govern the determination of real variables, their behavioral responses to systematic monetary policy impact on market-clearing prices but do not affect the difference between actual and natural levels of real variables. As a complement to this neutrality proposition, existing equilibrium models also imply that the pattern of macroeconomic fluctuations depends in a significant way on the subset of monetary actions that is nonsystematic. Because of incomplete information, private agents are unable to distinguish random monetary disturbances from relative disturbances. Consequently, their behavioral responses to random monetary disturbances, in contrast to their behavioral responses to systematic monetary policy, produce changes in real variables.

One troublesome feature of existing equilibrium models is their cavalier and unrealistic assumptions about the availability of monetary data. The Federal Reserve Board currently issues preliminary monetary data with only an eight-day lag and then revises this data over a period of months or years. These revisions result from such factors as computational corrections, semi-annual benchmark changes reflecting fuller reporting, and conceptual changes reflecting financial innovations. Existing equilibrium models, however, abstract from both the existence of contemporaneous preliminary monetary data and the process of gradual accumulation of revised monetary data. The neglect of contemporaneous data implies that private agents act as if they ignore readily available and apparently relevant information, an implication that seems inconsistent with the idea of rational expectations. The neglect of the process of data correction implies, in contrast, that private agents act as if they have an unrealistically large amount of information.

In his recent paper, King [1980] makes a start at rectifying this problem by introducing contemporaneously available monetary data into an equilibrium model.
In King's model, this data takes the form of an estimate of the current money stock, subject to a random error that is fully corrected in the next period. The important new implication derived from King's analysis is that real variables such as aggregate output and employment are uncorrelated with this contemporaneously available monetary data.

The model developed in the present paper expands on King's analysis by taking explicit account of the gradual process of accumulation of revised monetary data. Our model, like King's model, includes a contemporaneous estimate of the money stock, but instead of King's assumption that this estimate is corrected in the next period, we assume that developing the finally reported value of the current money stock involves more than one revision and takes more than one period. Our model also allows explicitly for systematic monetary policy in the form of a target monetary growth rate that responds to the past behavior of aggregate output.

The main result from the analysis that follows is that, despite the more complete specification of the accumulation of monetary data, systematic monetary policy, and their interaction, the present model turns out to have implications similar to those derived by Barro and King. Specifically, our analysis implies that aggregate output and employment are independent of systematic monetary policy and are uncorrelated with the contemporaneous measure of money growth implied by the difference between the currently available estimates of current and past money stocks.

This latter implication would seem to be a readily testable hypothesis, and an obvious conjecture would be that it is not consistent with the relevant data. In fact, econometric results reported by Barro and Hercowitz [1980] as well as more extensive econometric analyses reported in Boschen and Grossman [1980] confirm this conjecture. These results provide apparently strong evidence against the equilibrium approach to modelling the relation between monetary disturbances and macroeconomic fluctuations.

1. Setup of the Model

In the existing literature, the development of the incomplete-information paradigm has focused on various, but mutually consistent, stories about information. The following setup is based on the story told by Friedman [1968] in which the representative worker infrequently purchases many of the items that he consumes and, hence, infrequently observes their prices. The representative worker, consequently, does not know precisely the extent to which a change in the nominal value of his product involves a change in his terms of trade between leisure and consumption. His subjective belief about consumption prices and, hence, about the relevant real value of his productive services is the critical expectational variable in the model. The incorporation of rational expectations in the model means that this subjective belief is equal to a true mathematical expectation conditional on available information. The structural equations of the model describe the supply and demand for a representative good, the market-clearing condition that determines the output and price of this good, the behavioral pattern of the monetary authority, the nature of available monetary data, and the formation of rational expectations about average prices.

The current supply of representative good z depends on the subjective belief of the representative producer of this good about the relation between the current price of this good and average prices. Specifically, we assume the log-linear form

(1) $$y_t^s(z) = \alpha\ [p_t(z) - E_t(z)p_t] + n(z),$$

where $y_t^s(z)$ is the log of the current supply of good z,

$p_t(z)$ is the log of the current money price of good z,

$E_t(z)p_t$ is the current subjective belief of the representative producer of good z about the average of the logs of money prices,

α is the positive and constant elasticity of supply with respect to the difference, $p_t(z) - E_t(z)p_t$, and

$n(z)$ is the log of the "natural" level of output of good z.

The current demand for good z depends on the value of aggregate money balances deflated by $p_t(z)$ and on a random disturbance to the relative demands for the various goods. Specifically, we assume the log-linear form

(2) $$y_t^d(z) = \beta\ [M_t - p_t(z)] + \varepsilon_t(z),$$

where $y_t^d(z)$ is the log of the current demand for good z,

M_t is the log of the finally reported value of the current money stock,

β is a positive and constant elasticity of demand with respect to the difference, $M_t - p_t(z)$, and

$\varepsilon_t(z)$ is a random variable distributed according to $\varepsilon_t(z) \sim N(0,\sigma_\varepsilon^2)$, uncorrelated serially, uncorrelated with the other random variables in the model, and summing to zero across all goods, i.e., $\sum_t \varepsilon_t(z) = 0$.

A more general formulation of the supply and demand functions would include the terms, $p_t(z) - E_t(z)p_t$ and $M_t - p_t(z)$, in both of the functions and also would allow for random disturbances to supply and to aggregate demand. These and other possible generalizations would complicate the algebraic analysis of the model without changing the main conclusions regarding the role of monetary information.

Note that we are careful <u>not</u> to define M_t to be the log of the true value of the current money stock. This implied distinction between true values and finally reported values is necessary to make the setup of the model strictly consistent with the rational-expectations assumption that private agents behave as if they know the structure of the economy. Presumably, individuals can acquire this knowledge only from observational experience, a process that implies, as regards the relations between aggregate variables, that, because producers of good z would not directly experience aggregate variables, these variables as contained in the specified structural equations can represent only the most accurate available measurements as reported in revised and corrected published data. The construction of this data implies that individuals, like statisticians and econometricians, cannot know the remaining inaccuracies in this data and, hence, cannot learn from observational experience the structural relations between the true values of these quantities.

The market-clearing condition for good z is that $p_t(z)$ adjusts to satisfy the equality,

$$(3) \qquad y_t(z) = y_t^s(z) = y_t^d(z),$$

where $y_t(z)$ is the log of the actual current output of good z. This part of our model is the same as King's model except that King sets β equal to unity and includes an additional random disturbance to aggregate demand. For present purposes, these differences are inconsequential. The rest of the model involves specification of available information, of the determination of M_t, and of the formation of $E_t(z)p_t$.

Currently available monetary data include a preliminary estimate of the finally reported value of the current money stock and reported values of the money stocks of previous periods. These reported values include some estimates that have already been revised but, like the estimate of last period's money stock, not yet finalized. For the current money stock, we assume a log-linear estimating relation, which is identical to King's formulation,

(4) $\hat{M}_t = M_t + \delta_t$,

where $\hat{M}_t$ is the log of the latest published estimate of the money stock and

δ_t is a random variable distributed according to $\delta_t \sim N(0,\sigma_\delta^2)$, uncorrelated serially, and uncorrelated with the other random variables in the model.

Monetary policy involves a target monetary growth rate, which incorporates both a constant term and a systematic response to past differences between actual and natural levels of aggregate output, and a random factor. Specifically, we assume a log-linear relation of the form,

(5) $M_t = \hat{M}_{t-1} + \phi_t + g_t$,

where $\phi_t = \phi_0 + \phi_1(y_{t-1} - n)$ and

where $\hat{M}_{t-1}$ is the log of the current estimate of last period's money stock,

y_{t-1} is the aggregate across all goods of the logs of output last period, i.e., $y_{t-1} = \sum_z y_{t-1}(z)$,

n is the aggregate across all goods of the logs of the natural levels of output, i.e., $n = \sum_z n(z)$,

ϕ_0 is the constant element in systematic monetary policy,

ϕ_1 is the elasticity of the variable element in systematic monetary policy, and

g_t is a random variable distributed according to $g_t \sim N(0,\sigma_g^2)$, uncorrelated serially, and uncorrelated with the other random variables in the model.

Within the context of equation (5), the random variable, g_t, has at least two possible interpretations, corresponding to different monetary policy processes. One possible process is that M_t results from adding ϕ_t and a random variable, x_t, directly to $\hat{M}_{t-1}$--that is,

$$M_t = \hat{M}_{t-1} + \phi_t + x_t.$$

In this case, g_t is equivalent to x_t. A second possible process is that M_t results from adding ϕ_t and x_t to M_{t-1}--that is,

$$M_t = M_{t-1} + \phi_t + x_t.$$

This equation is identical to King's formulation of monetary policy except for the inclusion of ϕ_t. Given a log-linear estimating relation for $\hat{M}_{t-1}$ in the form

$$\hat{M}_{t-1} = M_{t-1} + \eta_t,$$

where η_t is a random variable, we can express the second monetary policy process as

$$M_t = \hat{M}_{t-1} + \phi_t + x_t - \eta_t.$$

In this case, g_t is equivalent to the difference, $x_t - \eta_t$. In general, these two processes imply different values for σ_g^2 and for g_t and hence have different quantitative implications for the behavior of y_t. These two processes, however, have the same implication for the relation between y_t and $\hat{M}_t - \hat{M}_{t-1}$.

The assumed rationality of expectations prescribes that the subjective belief, $E_t(z)p_t$, is equal to the true mathematical expectation of p_t conditional on the information currently known to producers of good z. Specifically,

(6) $$E_t(z)p_t = E\,[p_t \mid I_t(z)],$$

where $I_t(z)$ is the assumed information set. This set contains useful knowledge about the structure of the economy that includes the form of the structural equations (1) - (6), the values of the parameters, α, β, ϕ_0, and ϕ_1, the natural levels of output of good z and of aggregate output, n(z) and n, and the form of the stochastic disturbances, $\varepsilon_t(z)$, g_t, and δ_t. The information set also contains useful data that includes the current price of good z, $p_t(z)$, the past level of aggregate output, y_{t-1}, and the monetary data, $\hat{M}_t$ and $\hat{M}_{t-1}$. Note that, by implication, the information set includes the current value of systematic monetary policy, ϕ_t. The potentially useful information that is not in $I_t(z)$ includes current and past average prices, p_t and p_{t-1}, the current level of aggregate output, y_t, the finally reported values of the current and last period's money stock, M_t and M_{t-1}, and the realizations of the stochastic disturbances, $\varepsilon_t(z)$, g_t, and δ_t. Note that if p_{t-1} were in the information set, introduction of a random disturbance to aggregate demand would be necessary to prevent individuals from inferring M_{t-1} exactly.

2. Solution of the Model

Theoretical analysis of the model specified by equations (1) - (6) involves finding a solution for the current output of representative good z and, hence, for aggregate output that satisfies the market-clearing condition, given by equation (3), subject to expectations being formed rationally, as specified by equation (6). The method of undetermined coefficients, applied in similar contexts by Lucas [1972] and Barro [1976], provides a solution procedure. The first step is to substitute equations (1) and (2) into the market-clearing condition, given by equation (3), to obtain an equation that relates $p_t(z)$ to M_t, $E_t(z)p_t$, and other variables,

(7) $$p_t(z) = (\alpha + \beta)^{-1} [\alpha E_t(z)p_t + \beta M_t + \varepsilon_t(z) - n(z)].$$

The second step is to use either equation (4) or equation (5) to eliminate M_t from equation (7). As a check of the solution, we work out both strategies. Combining equations (4) and (7) gives

(8a) $$p_t(z) = (\alpha + \beta)^{-1} [\alpha E_t(z)p_t + \beta(\hat{M}_t - \delta_t) + \varepsilon_t(z) - n(z)].$$

Combining equations (5) and (7) gives

(8b) $$p_t(z) = (\alpha + \beta)^{-1}[\alpha E_t(z)p_t + \beta(\hat{M}_{t-1} + \phi_t + g_t) + \varepsilon_t(z) - n(z)].$$

The third step is to conjecture a solution for $p_t(z)$ that is a linear combination of a constant term, which allows for known variables, and each of the stochastic disturbances,

(9) $$p_t(z) = \Pi_0(z) + \Pi_1 g_t + \Pi_2 \delta_t + \Pi_3 \varepsilon_t(z).$$

Aggregating equation (9) across all goods yields a solution for average prices in the form,

(10) $$p_t = \Pi_0 + \Pi_1 g_t + \Pi_2 \delta_t.$$

The assumed rationality of expectations means that the subjective belief, $E_t(z)p_t$, is equal to the true mathematical expectation of equation (10) conditional on $I_t(z)$. This expectation is given by

(11) $$E_t(z)p_t = \Pi_0 + \Pi_1 E_t(z)g_t + \Pi_2 E_t(z)\delta_t,$$

where $E_t(z)g_t$ and $E_t(z)\delta_t$ are true mathematical expectations conditional on $I_t(z)$.

The fourth step is to calculate $E_t(z)g_t$ and $E_t(z)\delta_t$. In forming these expectations, producers of good z can combine the known structural equations describing market clearing, monetary policy, and monetary information, as in equations (8a) and (8b), to obtain the following two equations between linear combinations of stochastic variables and linear combinations of known variables. Rearranging equation (8a) gives

(12) $$-\beta\delta_t + \varepsilon_t(z) = (\alpha + \beta)p_t(z) - \alpha E_t(z)p_t - \beta\hat{M}_t + n(z).$$

Rearranging equation (8b) gives

(13) $$\beta g_t + \varepsilon_t(z) = (\alpha + \beta)p_t(z) - \alpha E_t(z)p_t - \beta(\hat{M}_{t-1} + \phi_t) + n(z).$$

Equations (12) and (13) enable the producers of good z to infer the values of the sums, $-\beta\delta_t + \varepsilon_t(z)$ and $\beta g_t + \varepsilon_t(z)$.

Given the linear normal structure of the model, the relations between the conditional expectations and the known linear combinations of stochastic variables have the form of regression equations,

(14) $$\begin{bmatrix} E_t(z)g_t \\ E_t(z)\delta_t \end{bmatrix} = [R] \begin{bmatrix} -\beta\delta_t + \varepsilon_t(z) \\ \beta g_t + \varepsilon_t(z) \end{bmatrix},$$

where [R] is a matrix of regression coefficients given by

$$[R] = \begin{bmatrix} 0 & \beta\sigma_g^2 \\ -\beta\sigma_\delta^2 & 0 \end{bmatrix} \begin{bmatrix} \beta^2\sigma_\delta^2 + \sigma_\varepsilon^2 & \sigma_\varepsilon^2 \\ \sigma_\varepsilon^2 & \beta^2\sigma_g^2 + \sigma_\varepsilon^2 \end{bmatrix}^{-1}$$

$$= \frac{1}{\beta\Delta} \begin{bmatrix} -\sigma_g^2\sigma_\varepsilon^2 & \sigma_g^2(\beta^2\sigma_\delta^2 + \sigma_\varepsilon^2) \\ -\sigma_\delta^2(\beta^2\sigma_g^2 + \sigma_\varepsilon^2) & \sigma_\delta^2\sigma_\varepsilon^2 \end{bmatrix}$$

and $\Delta = \beta^2\sigma_\delta^2\sigma_g^2 + \sigma_\delta^2\sigma_\varepsilon^2 + \sigma_g^2\sigma_\varepsilon^2$.

The fifth step is to determine the coefficients, $\Pi_0, \ldots, \Pi_3$. The procedure is to substitute into equation (11) the values of $E_t(z)g_t$ and $E_t(z)\delta_t$ given by equation (14), and then to substitute into either equations (8a) or (8b) the resulting value of $E_t(z)p_t$ given by equation (11). Equation (8a) or (8b) then gives an expression for $p_t(z)$ that is a linear combination of the predetermined and exogenous variables, where the weights involve the undetermined coefficients, $\Pi_0, \ldots, \Pi_3$, the parameters, α and β, and the variances of the stochastic variables. Equating each of these weights to the corresponding coefficient in the trial solution given by equation (9) yields a system of four simultaneous equations that we can solve for $\Pi_0, \ldots, \Pi_3$. Using equation (8a), these solutions are

$$\Pi_0' = \hat{M}_t - n(z)\beta^{-1},$$

$$\Pi_1' = -\alpha\ \sigma_\delta^2\sigma_\varepsilon^2\ \Delta^{-1}(\alpha+\beta - \alpha\beta^2\sigma_\delta^2\sigma_g^2\ \Delta^{-1})^{-1},$$

$$\Pi_2' = -[\alpha + \beta - \alpha\sigma_g^2(\beta^2\sigma_\delta^2 + \sigma_\varepsilon^2)\Delta^{-1}](\alpha + \beta - \alpha\beta^2\sigma_\delta^2\sigma_g^2\ \Delta^{-1})^{-1}, \text{ and}$$

$$\Pi_3' = (\alpha + \beta - \alpha\beta^2\sigma_g^2\sigma_\delta^2\ \Delta^{-1})^{-1}.$$

Using equation (8b), the solutions are

$$\Pi_0 = \hat{M}_{t-1} + \phi_t - n(z)\beta^{-1},$$

$$\Pi_1 = \Pi'_1 + 1,$$

$$\Pi_2 = \Pi'_2 + 1, \quad \text{and}$$

$$\Pi_3 = \Pi'_3.$$

The final step is to use these expressions for $\Pi_0, \ldots, \Pi_3$ together with the market-clearing conditions and either the supply function or the demand function to obtain a solution for current aggregate output in terms of the predetermined and exogenous variables. Substituting equation (2) into equation (3) implies

(15) $$y_t(z) = \beta\,[M_t - p_t(z)] + \varepsilon_t(z).$$

Aggregating equation (15) across all goods gives

(16) $$y_t = \beta(M_t - p_t).$$

Using either equation (15) to replace M_t with $\hat{M}_{t-1} + \phi_t + g_t$ or equation (4) to replace M_t with $\hat{M}_t - \phi_t$ and using equation (10) and the solutions for Π_0, Π_1, and Π_2 to eliminate p_t yields the expression for current aggregate output,

(17) $$y_t = n + (1 - \Pi_1)g_t - \Pi_2\delta_t.$$

Straightforward algebraic manipulation reveals that the values of $1 - \Pi_1$ and of Π_2 are both positive but less than unity.

3. Implications of the Solution

Equation (17) indicates that current aggregate output, y_t, equals the natural level of aggregate output, n, plus a linear combination of the realizations of the exogenous random variables that represent the unanticipated part of current monetary policy, g_t, and the currently unperceived part of current monetary policy, δ_t. The coefficients of this linear combination are, as indicated by the expressions for Π_1 and Π_2, themselves functions of the variances of these random variables, σ_g^2 and σ_δ^2, and the variance of the random disturbance to relative demands, σ_ε^2. The calculated value for Π_1 implies that y_t is positively related to g_t. This result obtains because producers of good z mistake some of the increase in the money price of good z that results from a positive value of g_t to be an increase in the relative price of good z. The calculated value of Π_2 implies that y_t is negatively related to δ_t. This result obtains because, as King points out, a high preliminary estimate of the money stock causes the expectations of producers of good z about average prices to be too high and their expectations about the relative price of good z to be correspondingly too low.

The correspondence between the solution for y_t given by equation (17) and the solution that King obtains for his model depends on which of the interpretations of g_t discussed above is relevant. For the case of g_t equivalent to x_t, equation (17) is identical to King's solution, except for the fact that King sets β equal to unity and includes an additional random disturbance to aggregate demand. For the case of g_t equivalent to $x_t - \eta_t$, equation (17) also differs from King's solution to the extend that η_t and σ_η^2 differ from zero.

The models of Lucas, Barro, and King imply that fluctuations of aggregate output relative to its natural level require the existence of random disturbances from all of the three sources--relative demands, monetary policy, and contemporaneously available estimates of the money stock. To confirm that this conclusion also applies to the present model, consider the effect of setting either $\varepsilon_t(z)$ or g_t or δ_t equal to a known constant. Any one of these changes in the model would mean that producers of good z either know or are able to infer g_t and δ_t exactly from equations (12) and (13). In this case, equation (14) would not be the relevant for calculating $E_t(z)g_t$ and $E_t(z)\delta_t$. Instead, the solution of the model would involve setting $E_t(z)g_t$ equal to g_t and $E_t(z)\delta_t$ equal to δ_t in equation (11). Solving for the undetermined coefficients would then imply that Π_1 equals unity and that Π_2 equals zero, so that y_t equals n.

King shows that in his model the covariance between y_t and his contemporaneous measure of money growth, $\hat{M}_t - M_{t-1}$, is equal to zero. Now, let us calculate the covariance between y_t and the contemporaneous measure of money growth, $\hat{M}_t - \hat{M}_{t-1}$, that applies in the present model. Observe that combining equations (4) and (5) implies

$$(18) \qquad \hat{M}_t - \hat{M}_{t-1} = g_t + \delta_t + \phi_t.$$

Thus, we have from equations (17) and (18),

$$(19) \qquad \text{cov}\,(y_t, \hat{M}_t - \hat{M}_{t-1}) = \text{cov}\,[n + (1-\Pi_1)g_t - \Pi_2\delta_t,\ g_t + \delta_t + \phi_t]$$
$$= (1-\Pi_1)\sigma_g^2 - \Pi_2\sigma_\delta^2.$$

Substituting the calculated values of Π_1 and Π_2 into equation (19), we obtain

$$\text{(20)} \quad \operatorname{cov}(y_t, \hat{M}_t - \hat{M}_{t-1}) = 0.$$

Equation (20) provides the basis for the econometric tests reported in Boschen and Grossman [1980]. These tests imply rejection of the hypothesis, represented by equation (20), that current aggregate output is independent of the contemporaneous measure of money growth. Because this hypothesis seems to be an inescapable implication of the equilibrium approach to macroeconomic modelling, these empirical results also imply rejection of this approach.

REFERENCES

C. Azariadis, "Escalator Clauses and the Allocation of Cyclical Risks," Journal of Economic Theory, 18, June, 1978, 119-155.

R.J. Barro, "Rational Expectations and the Role of Monetary Policy," Journal of Monetary Economics, 2, January, 1976.

R.J. Barro and Z. Hercowitz, "Money Stock Revisions and Unanticipated Money Growth," Journal of Monetary Economics, 6, April, 1980.

J. Boschen and H.I. Grossman, "Tests of Equilibrium Macroeconomics Using Contemporaneous Monetary Data," Working Paper in progress, 1980.

M. Friedman, "The Role of Monetary Policy," American Economic Review, 58, March, 1968, 1-17.

R. King, "Monetary Information and Monetary Neutrality," Journal of Monetary Economics, 6, 1980.

R.E. Lucas, Jr., "Expectations and the Neutrality of Money," Journal of Economic Theory, 4, April, 1972, 103-124.

R.E. Lucas, Jr., "Some International Evidence on Output-Inflation Trade-Offs," American Economic Review, 63, June, 1973, 326-334.