THE MACROECONOMICS OF DR. PANGLOSS

A Critical Survey of the New Classical Macroeconomics

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Abstract of "The Macroeconomics of Dr. Pangloss"

A critical evaluation is made of the new classical macroeconomics--the combination of rational expectations in the sense of Muth with the assumption that only unanticipated policy changes affect the behavior of real variables. Among the topics that are discussed are the following. The dependence of private sector structural parameters on public sector policy rules. The inconsistency of optimal plans derived from traditional dynamic programming methods when the controller is not playing a game against nature but against optimizing agents endowed with rational expectations. The relevance of rational expectations. The foundations of the "only surprises matter" supply function. The paper concludes that there is considerable scope for economic policy to influence the cyclical behavior of the economy and the nature of its long-run growth path.

Pangloss: "'Tis demonstrated, ..., that things cannot be otherwise; for, since everything is made for an end, everything is necessarily for the best end" (Voltaire [1949], p. 230).

Candide: "If this is the best of all possible worlds, what are the others?" (Voltaire [1949], p. 241).

1. Introduction

The short-run and long-run effects of monetary and fiscal policy continue to be the subject of considerable research activity and lively debate. For a while in the early and mid-70's Panglossian theorizing dominated the stage. Activist monetary and fiscal policies were argued to have, at best, no effects on real economic variables; at worst they could be responsible for a net increase in economic instability. During the last two or three years, however, the professional consensus seems to have shifted again towards a more balanced view of the scope for fiscal and monetary policy in influencing cyclical fluctuations--stabilization policy--and in co-determining the nature of the long-run trend growth path of the economic system.

A more precise statement of the "policy neutrality" [Tobin and Buiter, (1979)] view is that deterministic policy rules can have no effect on the joint probability distribution functions of real economic variables, but that stochastic policy behavior can increase the variability of real variables relative to their full information values. The formal analysis supporting this view is invariably conducted in terms of monetary policy alone. Conclusions often tend to be phrased in terms of stabilization policy in general (McCallum 1977). The important practical policy implication is that attempts to stabilize the real economy through (monetary) feedback rules will at best have no real effects, but may very well lead to outcomes inferior to those resulting from the application of a simple, easily understood fixed rule such as a constant growth rate of the nominal money stock. Various aspects of the policy neutrality view can be found in Lucas [1972a, 1972b, 1975, 1976], Sargent and Wallace [1975, 1976], Barro [1976a] and McCallum [1977, 1978]. The theoretical foundations of this view are the

two pillars of Muth-rational expectations and the 'Phelps-Friedman-Lucas-instantaneous-natural rate or only wage-and-price-surprises-matter' supply function. (Phelps [1970], Friedman [1968], Lucas [1972b], Lucas and Rapping [1969].) For brevity this supply function will be referred to as the 'surprise' supply function. In the second Section of this paper I evaluate the implications of Muth-rational expectations for macroeconomic and macroeconometric modeling. The foundations and implications of the 'surprise' supply function are scrutinized in Section 3. While most of the points emphasized in this paper have been made before, there has not been any attempt to focus them into a broad and consistent critique of the new classical macroeconomics. The purpose of this paper is to provide such a survey and synthesis.

2. Rational Expectations

In accordance with normal usage in economics, the term rational (or optimal) expectations ought to be reserved for forecasts generated by a rational, expected utility maximizing decision process in which the costs of acquiring, processing and evaluating additional information are balanced against the anticipated benefits from further refinement of the forecast. The rational expectations concept introduced by Muth [1961] and first applied to macroeconomics by Lucas [1972a, 1972b] and by Sargent and Wallace [1975, 1976] goes well beyond that of a "Bayesian" predictor derived from explicit optimizing behavior (Turnovsky [1969], Cyert and DeGroot [1974]). Muth hypothesized that the mean expectation of firms with respect to some phenomenon, say price, was equal to the prediction that would be made by the relevant (and correct!) economic theory. Future variables anticipated at time t are "true mathematical expectations of the future variables conditional on all variables in the model which are known to the public at time t" (Shiller [1978, p. 3]).[1/] To emphasize the fact that such expectations have not been generated by an explicit, rational cost-benefit calculus I shall henceforth refer to them as Muth-rational expectations.

Dependence of structural parameters on policy rules

The Muth-rational expectations literature and Lucas in particular have made a significant and lasting contribution to the theory of economic policy and the construction of policy-oriented econometric models. The basic insight is the possibility of non-invariance of private sector structural behavioral relationships when public sector behavioral relationships are altered. Private sector behavior is influenced in many ways by expectations of future variables. If changes in government behavior change these expectations, models that ignore such links from government behavior via private expectations to private behavior are likely to forecast poorly and to lead to misleading conclusions being drawn from policy simulations. This conclusion does not require Muth-rational expectations per se, only some direct effects of government behavior on private expectations. The assumption of Muth-rational expectations provides the additional hypothesis that the link between private sector expectations and government behavior comes through the private sector's knowledge of the true structure of the model, including the parameters that describe government behavior. Thus the main implication of the Muth-rational expectations hypothesis for macro-modeling is the necessity of solving simultaneously for the currently anticipated value of a variable and its future value calculated from the model. When this has been done, the model--which now incorporates the Muth-rational expectations assumption (i.e., the response of the private sector to current and anticipated future policy actions) and thus respects the "principle of policy-dependent structural parameters"--can be used for policy simulation in the standard manner. See e.g., Chow [1978] and Buiter [1977b].) The computational requirements of a full Muth-rational expectations equilibrium calculation may be formidable, especially for non-linear models, but there are no special conceptual problems involved.

Inconsistency of optimal plans

Interesting and important issues arise in Muth-rational models when policy optimization rather than policy simulation is considered. Standard

stochastic dynamic programming approaches to the derivation of optimal policies may be inappropriate when the model takes on the features of a dynamic game[2/] (Kydland [1975, 1977]). Private agents optimize with reference to private objective functions and the government attempts to optimize a social welfare function. The assumption of Muth-rational expectations (or its deterministic counterpart: perfect foresight) implies that all agents know each other's aims and anticipate each other's actions. This may lead to what Kydland and Prescott [1977] have called the inconsistency of optimal plans.

The Principle of Optimality of Dynamic Programming states that "An optimal policy has the property that, whatever the initial state and decision (i.e., control) are, the remaining decisions must constitute an optimal policy with regard to the state resulting from the first decision" (Bellman [1957]). This permits the derivation of the fundamental recurrency relation of dynamic programming and the closed-loop optimal feedback controls familiar from e.g., linear-quadratic regulator problems (Chow [1975]). Such policies will be optimal in a "game against nature" but not in a game between (two) rational, optimizing agents such as the private and public sectors, each one of which is endowed with Muth-rational expectations as regards the behavioral strategies of the other. Traditional optimal control techniques fail to take account of the impact of future policy measures on current events through the changes in current behavior induced by anticipation of these future policy measures.

Paraphrasing Prescott [1977], we can define a consistent policy or plan as a sequence of rules, one for each period, which specifies policy actions contingent on the state of the world in that period. Each such rule has the property of being optimal given the subsequent elements in the sequence. In dynamic games between optimizing agents endowed with rational expectations, it can happen that the optimal plan in subsequent periods is not the continuation of the first-period optimal plan over the remainder of the planning

period: the optimal plan is not consistent. A two-period flood disaster control example can illustrate this.

There are two states of the world, good and bad, in period 2. In the bad state a major flood occurs; in the good state there is no flood. The true state will not be known until the beginning of period 2. In period 1 the government can try to discourage people from living in the potential flood disaster zones by promising not to send any relief in period 2, should a disaster occur. If, at the beginning of period 2, people have ignored the warning given in period 1 and have settled in the potential disaster area, it may be optimal--since bygones are bygones--for the government to break its promise of period 1 and to send relief if the bad state occurs. Rational private economic agents will anticipate such behavior and will be more inclined to settle in the potential disaster area.

The implication of examples such as this, however, is not that policy optimization is impossible in rational expectations models. Instead, as Taylor [1977, p. 94] points out, "any optimization technique used for macroeconomic stabilization should be able to incorporate the endogeneity of expectations." It has been demonstrated in a number of papers (Taylor [1976], Buiter [1977b]) that by restricting the search for optimal policies to a particular class of functions (e.g., linear feedback) characterized by some set of parameters, restricted consistent optimal policy rules can be derived. In the flood disaster example, we could e.g., constrain the set of solutions by insisting that the government cannot renege on its period 1 promises. A constrained optimal policy rule can then be derived quite easily. By suitably restricting the class of policy rules over which the government can optimize, it will in general be possible to write current decisions as functions only of current and past variables, even when both public and

private agents "forecast efficiently conditional on their information sets" (Brunner and Meltzer [1977, p. 5]). As another example, a constant growth rate for a monetary aggregate, M, is a very special case of a linear feedback rule [$\Delta \ln M_t = \Delta \ln M_{t-1}$]. It would be of considerable interest to investigate, for a given macromodel, whether, and under what circumstances, the constant growth rate rule is the optimal linear feedback rule. It is quite possible that the optimal linear feedback rule will be dominated by some non-linear policy rule, but current methods do not permit us to derive the optimal unrestricted, non-linear policy rule. Many important unresolved problems remain, including the formulation of an appropriate dynamic game-theoretic equilibrium concept in a Prescott-Kydland-type model (see Leitman and Wan [1978]). The influence of anticipated or unanticipated policy on real economic outcomes and consequently the potential for beneficial or detrimental policy actions is not an issue here.[3/]

How good an assumption are Muth-rational expectations? Unfortunately the hypothesis is seldom tested in isolation. Instead composite hypotheses tend to be tested: natural rate cum Muth-rational expectations, term structure cum Muth-rational expectations, international interest parity cum Muth-rational expectations, etc. The hypothesis appears to be in danger of being consistent with any conceivable body of empirical evidence, because the assumption of optimal use of the available information cannot be tested independently of an assumption about the available information set.[4/] In empirical applications, Muth-rational expectations are best linear unbiased predictors, conditional on some information set. By suitable redefinition of the information set conditioning the forecast, any pattern of serial correlation in the endogenous variables of a model can be rationalized as consistent with Muth-rational expectations. By becoming irrefutable, the hypothesis would cease to belong to the realm of scientific (i.e., positive or empirical) theory, as defined by Popper (1959), although it would not lose its heuristic value.

Muth-rational expectations are best not viewed as a positive theory of how expectations are actually formed. The issue of how economic agents acquire their knowledge of the true structure of the economy, which they use in making their rational forecasts is not addressed by the theory. The appeal of Muth-rational expectations is that any expectation scheme that is not Muth-rational will be consistently wrong, in the sense of yielding systematic expectational errors. Sensible economic agents will ultimately abandon such a scheme (see e.g., Minford [1978]). Very little is known, unfortunately, about the learning process by which unsatisfactory forecasting schemes are revised. Convergence to a Muth-rational expectations mechanism cannot be postulated as self-evident or inevitable (Taylor [1975], Decanio [1979]). It seems reasonable to view strict Muth-rational expectations as an acceptable representation of private (and public!) agents' forecasting behavior only in the tranquillity of a long-run steady-state equilibrium. It is in the evaluation of the scope for short-run stabilization policy, however, that Muth-rational expectations--combined with the hypothesis that government policy can only affect the real variables of the economic system by influencing the price or wage forecast errors of private economic agents--have had their most powerful and challenging implications.

3. The 'surprise' supply function

When the hypothesis (1) that only price or wage surprises cause the economy to diverge from the exogenous 'natural rate of unemployment' or the 'natural level of output' is combined with the Muth-rational expectations assumption (2) that the government cannot introduce systematic surprises into the economy when the deterministic part of government behavior is included in the information set conditioning private forecasts, the conclusion (3) that deterministic policy rules cannot affect the probability density functions of the real side of the economy emerges inexorably. How plausible

a construct is the 'surprise' supply function? Both theoretical considerations and empirical evidence suggest overwhelmingly that anticipated and unanticipated changes in monetary and fiscal policy will have real effects, short run and long run. I shall emphasize the theoretical objections to the 'surprise' supply function in what follows.

Real effects of anticipated fiscal and monetary policy in frictionless, market-clearing models.

It is trivial to show that fully anticipated fiscal policy changes will have real effects. From the standard microeconomics of the utility maximizing household, changes in tax rates will alter labor supply and saving behavior (Fair [1978a, 1978b]). The theory of the firm tells us of the effects of the payroll tax on labor demand and of the influence of investment tax credits, depreciation allowances, etc. on capital formation. In the classical full employment model, the short-run effects of an increase in exhaustive public spending on private consumption and capital formation and the long-run effects on productive capacity and real output are well-known. The importance of direct complementarity or substitutability between various components of private and public spending has been analyzed in Buiter [1975, 1977a] and Tobin and Buiter [1979]. Such real effects occur even in perfect foresight models, whether or not the state of the economy is characterized at each instant by a frictionless, market-clearning competitive Walrasian temporary equilibrium. Clearly fiscal policy is "non-neutral" even in the most classical of economic systems.

Retaining for the moment the temporary Walrasian equilibrium assumption, we can also establish the non-neutrality of monetary policy. First consider 'superneutrality'--invariance of real variables under different proportional rates of growth of the nominal stock of money. Different fully anticipated

proportional rates of growth of the nominal money supply are associated with different proportional rates of inflation. This will alter the composition of output in the short run and the level of output in the long run. The mechanism is that changes in the rate of inflation alter the real rate of return on money balances whose nominal rate of return is fixed at zero.[5/] This changes equilibrium portfolio composition and alters the rate of capital formation in the short run and the capital-labor ratio in the long run. In simple 2 asset (money-capital) models, higher rates of monetary expansion tend to be associated with higher steady-state capital-labor ratios, but this result does not automatically generalize to models with richer asset menus.

Carrying the argument one step further, we ignore real capital formation so that no real effects of fully anticipated monetary policy can operate through that channel. Fully anticipated once-and-for-all changes in the quantity of money will still have real effects if non-monetary nominally denominated claims on the public sector (bonds) are held by the private sector and if these bonds enter as arguments into private sector behavioral relationships. Traditionally, this issue has been characterized by the question "Are government bonds net wealth" (Barro [1974]), but it is not at all necessary for the effect of public sector debt on private behavior to take the form of a wealth effect. Liquidity effects or portfolio composition effects could also be the source of non-neutrality of public interest-bearing debt. Debt neutrality in its simplest form is due to the cancellation of private sector holdings of public debt as a component of private net worth by the present discounted value of future taxes 'required' to service this debt. It is a precondition both for the neutrality of level changes in the quantity of money and for the absence of effects on aggregate demand from a shift between tax financing and borrowing.

The theoretical underpinnings of the debt neutrality theorem (Barro, [1974, 1976b, 1977]) have been scrutinized by Buiter [1978] and Tobin and Buiter [1979]. They conclude that the debt neutrality theorem is a theoretical curiosum. Beyond the near-certainty of non-neutrality, there is a strong presumption about the direction of the effect of substitution of borrowing for tax financing. In the short run it is likely to absorb saving; in a world with Keynesian unemployment of resources, this can stimulate effective demand and increase output and employment. In the long run, it is likely to crowd out real capital. An open market purchase of bonds is likely to be expansionary (or inflationary) in the short run. Its long-run effect is very sensitive to assumptions about relative asset substitutabilities and about the policy rules that govern the behavior of the various components of the government budget constraint (Currie [1978], Tobin and Buiter [1979]).

Real effects of fiscal and monetary policy in non-Walrasian equilibrium models.

Even if one were to ignore all the previously mentioned channels of real effects of fully anticipated monetary and fiscal policy, abandoning the continuous Walrasian equilibrium assumption can generate real effects of fully anticipated monetary and fiscal policy. Two examples will be presented.

For a very simple and familiar case, consider an economy in which money wage and money price level are fixed, either indefinitely because of wage and price controls or temporarily because of multi-period contracts. Such an economy could be in the Keynesian general excess supply configuration of the Barro-Grossman disequilibrium model (Barro and Grossman [1971]). Fully anticipated changes in the quantity of money (or in the level of public spending) will have the familiar fixed price level IS-LM effects. The fixed price assumption is perhaps somewhat unsatisfactory, but no more so

than the ad-hoc assumption of instantaneous and continuous competitive equilibrium applied so routinely to labor and commodity markets by economists of the 'New Classical School'; the Walrasian auctioneer is no substitute for a theory of price determination and exchange. Relatively little empirical work has been aimed at testing the Walrasian equilibrium hypothesis for labor and commodity markets. Rosen and Quandt [1978] test for the existence of equilibrium or disequilibrium in the aggregate U.S. labor market and find that the data reject the hypothesis that the labor market is in continuous equilibrium. Fair indirectly tested the disequilibrium hypothesis by including a "disequilibrium variable" representing a binding constraint in the loan market and in the labor market in his econometric model of the U.S. economy. This variable was found to be significant (Fair [1978b]). As the authors of those studies are the first to point out, these conclusions are highly tentative and provisional. When combined with the (at any rate to this author) overwhelming casual empirical evidence as to the existence and persistence of disequilibrium in factor and product markets, there would seem to be a strong prima facie case for the practical relevance of the disequilibrium macroeconomics literature.

A rather more interesting but still very simple disequilibrium price adjustment mechanism is the following. Let p* denote the log of the equilibrium price level, p the log of the actual price level and $\hat{p}_{t,t+1}$ the log of the price level expected, at time t, to prevail at time t+1. Y_t is actual output and $\bar{Y}_t$ full employment or capacity output. We postulate the equilibrium price equation:

$$(1) \qquad p_t^* = \alpha(Y_t - \bar{Y}_t) + \hat{p}_{t-1,t} \; ; \qquad \alpha > 0.$$

The actual price level adjusts sluggishly to the equilibrium price level according to

$$(2) \qquad \Delta p_t \equiv p_t - p_{t-1} = \beta (p_t^* - p_{t-1}) \qquad 0 \leq \beta \leq 1.$$

This specification is not implausible in an economic system without a clear underlying inflationary or deflationary trend. With such a trend, the partial adjustment price mechanism should incorporate first or higher order differences of p^*.[6/] Combining the equilibrium price equation and the partial adjustment, disequilibrium price mechanism we obtain:

$$(3) \qquad \Delta p_t = \alpha\beta (Y_t - \bar{Y}_t) + \beta (\hat{p}_{t-1,t} - p_{t-1}).$$

If there are no stochastic elements, Muth-rational expectations are equivalent to perfect foresight: $\hat{p}_{t-1,t} = p_t$. Equation (3) suggests that even perfect foresight implies $Y_t \equiv \bar{Y}_t$ only if $\beta = 1$, i.e., only if the adjustment of actual price to equilibrium price is immediate. Only for the limiting case of the disequilibrium model in which it is equivalent to an equilibrium model, does the Muth-rational expectations assumption constrain the economy to be at the natural level of output. Disequilibrium specifications (or non-Walrasian equilibrium specifications) thus permit one to avoid the conclusion so often derived from models incorporating the 'surprise' supply function construct, that actual output differs from its natural level (or that the rate of unemployment differs from the natural rate) if and only if there are price or wage forecast errors. Fischer [1977], Phelps and Taylor [1977], and Taylor [1978] have constructed quite plausible simple models with multi-period wage contracts or price setting in advance of the period in which the price will apply. This causes the information set available at the time of the current money supply decision to be richer than the information set available at the time that the current wage or price was decided on. Public and private agents have the same <u>information set</u> at any point in time, but only the public agent is free to

change his controls in response to new information; the private agent is contractually committed by the past. Public and private agents do not have the same opportunity sets. It may not be feasible for private economic agents to react to a fully anticipated change in public sector policy in such a way as to undo all real effects of this change. Even if it is feasible, full neutralization may not be optimal. Deterministic monetary (and fiscal) feedback rules can then affect the probability distributions of real output and employment, even with rational expectations. (See also Baily [1978].) A lot of work remains to be done to show rigorously how such multi-period contracts can be generated as the (game-theoretic ?) equilibrium outcomes of realistic labor market and produce market strategies pursued by workers, unions and firms. It is tempting, and very simple, to turn the multi-period private contracts into contingent forward contracts that are isomorphic to the sequence of contracts that would be concluded were markets to re-open continuously. If our aim is to model the economic system as it is rather than as we would like it to be, this temptation is to be resisted.

In equations (1) and (2) both Y_t and p_t are endogenous variables. To identify the exact scope for monetary and fiscal policy, it is necessary to obtain the reduced form equation for Y_t. To complete the model we add a demand side and a very simple stochastic structure. Output is equal to real effective demand, A.

$$(4) \qquad Y_t = A_t.$$

Effective demand is an increasing function of the real stock of money balances and of real exhaustive public spending, G. m is the log of the nominal stock of money. ε_t^d is a random demand disturbance.

$$(5) \qquad A_t = \gamma(m_t - p_t) + \delta G_t + \varepsilon_t^d \qquad \gamma > 0, \delta > 0.$$

Full employment output is a constant plus a random supply disturbance:

$$(6) \qquad \bar{Y}_t = \bar{Y} + \varepsilon_t^s.$$

$\bar{Y}$ can be interpreted as the full information level of capacity output. The Muth-rational expectation of the price level, $\hat{p}_{t-1,t}$, is $E(p_t|\phi_{t-1})$ where ϕ_{t-1} denotes the information set available as of t-1 and E is the mathematical expectation operator. If the disturbances are mutually serially independently and identically distributed random variables with zero means, if economic agents know the structure of the model and if they observe p_{t-1} at time t-1, the Muth-rational expectation of the price level is easily found to be:

$$(7) \qquad E(p_t|\phi_{t-1}) = \frac{\beta\alpha\gamma}{1-\beta+\alpha\beta\gamma} E(m_t|\phi_{t-1}) + \frac{\beta\alpha\delta}{1-\beta+\alpha\beta\gamma} E(G_t|\phi_{t-1}) - \frac{\beta\alpha}{1-\beta+\alpha\beta\gamma} \bar{Y}$$

$$+ \frac{(1-\beta)}{1-\beta+\alpha\beta\gamma} p_{t-1}.$$

With $\beta = 1$ this reduces to:

$$(7') \qquad E(p_t|\phi_{t-1}) = E(m_t|\phi_{t-1}) + \frac{\delta}{\gamma} E(G_t|\phi_{t-1}) - \frac{\alpha}{\gamma} \bar{Y}.$$

The reduced form of real output is given by

$$(8) \quad Y_t = \frac{\gamma}{1+\alpha\beta\gamma} m_t - \frac{\alpha\beta^2\gamma^2}{(1+\alpha\beta\gamma)(1-\beta+\alpha\beta\gamma)} E(m_t|\phi_{t-1}) + \frac{\delta}{1+\alpha\beta\gamma} G_t - \frac{\alpha\beta^2\gamma\delta}{(1+\alpha\beta\gamma)(1-\beta+\alpha\beta\gamma)} E(G_t|\phi_{t-1})$$

$$+ \frac{\alpha\beta\gamma\bar{Y}}{1-\beta+\alpha\beta\gamma} - \frac{(1-\beta)\gamma}{1-\beta+\alpha\beta\gamma} p_{t-1} + \frac{1}{1+\alpha\beta\gamma} \varepsilon_t^d + \frac{\alpha\beta\gamma}{1+\alpha\beta\gamma} \varepsilon_t^s.$$

If the policies pursued by the authorities are known exactly by the private sector, $E(m_t|\phi_{t-1}) = m_t$ and $E(G_t|\phi_{t-1}) = G_t$. In that case (8) simplifies to:

$$(8') \quad Y_t = \frac{\gamma(1-\beta)}{1-\beta+\alpha\beta\gamma} m_t + \frac{\delta(1-\beta)}{1-\beta+\alpha\beta\gamma} G_t + \frac{\alpha\beta\gamma}{1-\beta+\alpha\beta\gamma} \bar{Y} - \frac{\gamma(1-\beta)}{1-\beta+\alpha\beta\gamma} p_{t-1}$$

$$+ \frac{1}{1+\alpha\beta\gamma} \varepsilon_t^d + \frac{\alpha\beta\gamma}{1+\alpha\beta\gamma} \varepsilon_t^s.$$

If $\beta = 1$ this reduces to:

$$(8'') \qquad Y_t = \bar{Y} + \frac{1}{1+\alpha\gamma}\,\varepsilon_t^d + \frac{\alpha\gamma}{1+\alpha\gamma}\,\varepsilon_t^s.$$

If the policies pursued by the authorities have a stochastic component, $E(m_t|\phi_{t-1}) = e^m_{t-1,t} + m_t$ and $E(G_t|\phi_{t-1}) = e^G_{t-1,t} + G_t$. Here $e^m_{t-1,t}$ and $e^G_{t-1,t}$ are forecast errors orthogonal to (independent of) the private information set ϕ_{t-1}. If we assume that the private sector information set ϕ_t is identical to the public sector information set ψ_t, the private forecast errors $e^m_{t-1,t}$ and $e^G_{t-1,t}$ do not constitute channels through which the authorities can exercise <u>systematic</u> influence on private sector behavior. If the authorities are aware of their own systematic policy behavior, i.e., if the deterministic part of the policy rule belongs to ψ_t, it will also belong to ϕ_t.[7] The authorities are able to influence the probability distribution of real output by randomizing their behavior and thereby introducing additional noise into the system. They are ill-advised to do so, however. Random policy behavior will never be consistent with minimizing the variance of real output around its full information value. Thus, if the public sector has no informational advantage over the private sector, equations (8') and (8'') are sufficiently general for the analysis of the scope for systematic stabilization policy.

When the Walrasian equilibrium condition ($\beta = 1$) is imposed, we see from (8'') that real output is not affected by deterministic monetary and fiscal policies. This, however, is on the assumption that $\bar{Y}$ is independent of such policies. The earlier discussion of the effects of fully anticipated fiscal and monetary policy on capacity output in market-clearing models led to the conclusion that $\bar{Y}$ <u>will</u> be affected by anticipated (and unanticipated) fiscal and monetary policies because of the effects of such policies on labor supply, portfolio allocation and capital formation.[8]

Equation (8') shows that even without making $\bar{Y}$ dependent on the parameters of fiscal and monetary policy, real output can be influenced by known, activist policy rules if $\beta < 1$. Inertia in the adjustment of actual price to equilibrium price provides scope for fully anticipated changes in m_t and G_t to render Y_t systematically different from $\bar{Y}$.

McCallum [1978] has argued recently that price level stickiness by itself is not always sufficient to invalidate the proposition that deterministic stabilization policy cannot affect the probability distributions of real variables. It is indeed possible to disguise a classical market-clearing sheep in non-Walrasian wolf's clothing.[9/] In McCallum's model the behavior of real output is governed ultimately by a second other stochastic difference equation in real output. Policy can only affect the behavior of output via a one-period price forecast error: $p_t - p_{t|t-1}$. With rational expectations policy is automatically emasculated. I would therefore argue that more weight should be attached to the conclusion reached in this section: it is very simple to construct quite plausible models with sluggish wage or price adjustment that do leave scope for real effects of deterministic monetary and fiscal policy.[10/] The example developed in equations (1) to (6) suffices to establish this.

4. Conclusion

Muth-rational expectations are a useful addition to the small collection of simple and tractable hypotheses about expectation formation in the macroeconomist's toolkit. The assumption that economic agents use the true model to make their (unbiased) forecasts suggests that Muth-rational expectations are likely to be most appropriate when the analysis is restricted to the tranquillity of a long-run steady state. The positive economic question as to how economic agents form forecasts when they do not know the true

underlying economic model still remains to be answered (see DeCanio [1979] and Friedman [1979]).

The dependence of the structural parameters of economic and econometric models on the policy rules followed by the authorities in Muth-rational expectations models is an important theoretical insight. Its practical importance for policy evaluation exercises using econometric models still remains to be established on a case-by-case basis.

Optimal control theory can be used--with care--in Muth-rational expectations models once the endogeneity of expectations has been allowed for in the specification of these models. The distinction between a game against nature and a game between optimizing players endowed with foresight is extremely important and has implications well beyond the current debate. Once we cease to model private agents as playing a game against nature--the competitive market--standard optimization techniques are no longer applicable within the private sector.

The weakness of the theoretical foundations of the 'surprise' supply function, according to which alternative anticipated fiscal and monetary policy rules will not generate different outcomes for real economic variables, can be exposed in four propositions.

Proposition 1:

The behavior of real economic variables is not in general[11/] invariant under alternative fully anticipated trajectories of fiscal policy instruments such as government spending and tax rates, even in classical, frictionless models.

Proposition 2:

The behavior of real economic variables is not in general invariant under alternative fully anticipated proportional rates of growth of the nominal money stock, even in classical, frictionless models.

Proposition 3:

The behavior of real economic variables is not in general invariant under alternative, fully anticipated levels of the nominal money stock--i.e., money is not neutral--even in classical, frictionless models.

Propositions 1 to 3 rely on the effects of fiscal and monetary policy on labor supply, saving and investment behavior and portfolio composition. Even if, for the sake of argument, the standard microeconomic and portfolio-theoretic considerations underlying Propositions 1 to 3 are dismissed, policy-neutrality can be invalidated because of Proposition 4.

Proposition 4:

Non-Walrasian equilibria with quantity rationing and inertia in the adjustment processes of wages and prices can cause real economic variables to track different time paths when alternative, fully anticipated fiscal or monetary policies are followed. Fiscal and monetary policy changes, anticipated or unanticipated, can alter real effective demand, output and employment even if the notional supply of and demand for labor, the real interest rate and the composition of private sector portfolios are not affected.

Now that Sargent [1976] has convincingly argued the "observational equivalence of natural and unnatural (sic) rate theories of macroeconomics," the evidence concerning the relevance of the Walrasian and the non-Walrasian equilibrium models will have to come either from the comparison of sample periods during which different policy rules were in effect or from the detailed study of price, wage and quantity adjustments in individual markets.

There is no reasonable case that deterministic monetary and fiscal policy rules cannot alter the cyclical fluctuations of the economic system

or the nature of its trend growth path. Whether "stabilization policy" has in fact been stabilizing or destabilizing is a separate empirical issue--one that will be extremely difficult to settle with any degree of confidence. The recognition that monetary and fiscal policy give the government a handle on the real economy implies the existence of scope for both beneficial and detrimental policy behavior. There is no presumption at all that a government that sits on its hands and determines the behavior of its instruments by the simplest possible fixed rules is guaranteed to bring about the best of all possible worlds.

FOOTNOTES

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1/ This definition of Muth-rational expectations has been extended in a natural manner by Lucas and Prescott [1974]. They define rational expectations by the condition that the subjective probability distribution of future economic variables held at time t coincides with the actual, objective conditional distribution based on the information assumed to be available at time t.

2/ The game will probably not be a symmetric game. There are many "small" private sector agents facing a "large" public sector. It is probably better to model the public sector as the dominant player and the private sector as the non-dominant player. An asymmetric equilibrium concept such as a Stackelberg equilibrium suggests itself.

3/ It should be noted that Prescott's proposition about the time-inconsistency of (unrestricted) optimal plans is also applicable to games involving only private economic agents. The same fundamental problems arise within the private sector, e.g. when oligopolistic interdependence of firms is combined with rational expectations. Another example can be drawn from the optimal labor market contracts literature (see e.g., H.I. Grossman [1978]). Multi-period employer-worker contingent contracts involving elements of risk-sharing have the property that "although both parties can improve their expected outcomes by making the arrangement, one of the parties usually will

find that his actual outcome would be better if he were not bound by the arrangement." (Grossman [1978, p. 666].) In such states of nature reneging on the contract would be optimal. Thus optimal labor-market contracts can be "inconsistent." In response to this, institutions tend to be created that restrict the opportunities for private agents to re-optimize as time passes and new states of nature are realized. Legal enforcement of long-term contracts after the present value of continuing to honor the contract becomes negative for one of the parties, is an example. I would not wish to argue that because optimization is thus restricted, the whole notion of utility maximization and market value maximization is a useless one and should be replaced by the study of the operating characteristics of various fixed rules of thumb. Yet this is exactly what Prescott appears to insist should be done in dynamic games with rational expectations.

4/ It should be noted that "available" is not an economic category. The information set can presumably be expanded by the expenditure of additional resources.

5/ The only kind of model that exhibits super-neutrality obtains this result by incorporating real money balances as an argument in the direct utility function of (infinitely lived) households. A constant total real rate of return on money balances can be made up of any combination of the explicit return (due to changes in the general price level) and the implicit marginal utility yield from holding money balances (Sidrauski [1967]). No proper transactions role for money balances is included.

6/ Such a 'multi-geared price adjustment equation' can be constructed in a manner analogous to John Flemming's 'multi-geared adaptive expectations hypothesis' (Flemming [1976]). The price adjustment mechanism of equation 2 would be optimal if the cost of departing from the equilibrium

price and the cost of adjusting towards the equilibrium price were both quadratic.

[7] It should be clear that, if the government has an informational advantage over the private sector ($\psi_t \supset \phi_t$), e.g., because of differential access to or capacity to utilize certain kinds of information, monetary (and fiscal) policy can have real effects even when the continuous Walrasian equilibrium assumption is maintained (Barro [1976a]).

[8] These effects could be incorporated in the model of equations 1, 2, 4, 5 and 6 in the following way. Add a labor market. The supply of labor depends (inter alia) on the after-tax real wage. The notional demand for labor depends on marginal wage and non-wage labor costs and on the capital stock. $\bar{Y}$ is now the full information level of output that would be produced if the labor market were to clear with the given stock of capital. Equation (5) is decomposed into an effective demand (IS) equation and a monetary equilibrium (LM) equation. Real capital formation depends on the real interest rate. The demand for real money balances depends on the nominal interest rate. Private sector net worth, which is an argument in all household sector behavioral relationships (including labor supply) depends on private sector holdings of interest-bearing public debt.

[9] This has been familiar since the early days of the expectations-augmented wage-Phillips curve. What prima-facie looks like a disequilibrium labor market adjustment mechanism is transformed into an instantaneous natural rate model once Muth-rational expectations are added. w denotes the log of the money wage rate, u the actual unemployment rate, u* the natural unemployment rate and Π the rate of growth of labor productivity. Combining a disequilibrium wage adjustment equation with a mark-up price

equation (or with the real wage equals marginal product of labor condition) we obtain a 'surprise' supply function model of deviations of the actual from the natural rate of unemployment.

$$w_t - w_{t-1} = \Pi_t + \eta(u-u^*) + \hat{p}_{t-1,t} - p_{t-1} \qquad \eta < 0$$

and

$$p_t - p_{t-1} = w_t - w_{t-1} - \Pi_t$$

imply

$$p_t = \eta(u-u^*) + \hat{p}_{t-1,t}$$

10/ In the wage-price model of the previous footnote, inertia can be built into the labor market adjustment equation or into the price adjustment equation as in equations (1) and (2). This would restore the scope for activist policy.

11/ Here and in what follows 'in general' is shorthand for 'except in very special conditions that are not likely to be of practical interest.'

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