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Monetary, Financial, and Fiscal Policies Under Rational Expectations

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NEO-KEYNESIAN ACCOUNTS of the roles of monetary, financial, and fiscal policies have recently been challenged by a revival of classical macroeconomic thinking—an approach to theory and policy that many had considered forever buried under the economic ruins of the Great Depression. This new classical macroeconomics is associated originally with Milton Friedman (1968) and more recently with Phelps (1970), Lucas (1972 a and b, .1975, 1976), Sargent and Wallace (1975, 1976), Barro (1974, 1976, 1979), and a host of others. The main implications of this approach for macroeconomic policy can be summarized in two ''neutrality or worse'' propositions.

(1) Deterministic (and known) monetary policy rules can have no effect on the joint probability distribution functions of real economic variables—neutrality; but stochastic monetary policy behavior can increase the variability of real variables relative to their full information values—or worse. This proposition has at times been extended to encompass not only monetary policy but stabilization policy in general (McCallum, 1977).

(2) Debt neutrality: the full real impact of the government sector is measured by the magnitude and composition of its real spending program. The financing mode chosen—current taxes, borrowing, or currency creation—is of no consequence. This proposition, first analyzed by Ricardo, has recently been restated by Barro (1974).

In a recent paper the author presented a nontechnical survey

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of the two theoretical cornerstones of the new classical macroeconomics. These are rational expectations in the sense of Muth and what the author called the "surprise" supply function—the proposition that only unanticipated policy changes (or other unanticipated, exogenous disturbances) can cause the real economic system to depart from an otherwise policy-invariant equilibrium trajectory (Buiter, 1980). In this paper nothing further will be said about the rational expectations assumption. It, or its deterministic counterpart, perfect foresight, will be incorporated in every model considered below. The purpose is to provide a more complete statement of the propositions advanced in the paper referred to above (Buiter, 1980) concerning the scope for monetary policy, debt management policy, and fiscal policy under rational expectations.

The setup of the paper is as follows: Section I presents a fairly standard, small deterministic macromodel with a number of classical features. All markets clear instantaneously, there is no money illusion, and perfect foresight rules. The effects of monetary, financial, and fiscal policies in this model are analyzed. A number of nonneutrality propositions are stated. The drawback of this model is that it is ad hoc in the sense that private behavioral relationships have not been derived from explicit optimizing behavior. Section II, therefore, summarizes the results of some studies on debt neutrality and monetary superneutrality in a "fully rational" overlapping generations model. This leads to the conclusion that the ad hoc model of Section I is not a bad parable for such fully rational models. Section III abandons the assumption of universal instantaneous Walrasian equilibrium and considers the consequences of price and wage stickiness for the scope for stabilization policy; stochastic models are analyzed here, which also permits the consideration of some of the interesting issues associated with incomplete information.

There are two major limitations on the scope of this critique of the new classical macroeconomics: it is mainly theoretical and it is limited to models of a closed economy.

I. Monetary, Financial, and Fiscal Policies in Ad Hoc Equilibrium Model with Rational Expectations

DESCRIPTION OF THE MODEL

The model represented in equations (1) through (19) is the full

employment version of the textbook closed economy IS-LM model. The nominal interest rate, the price level, and the money wage rate always instantaneously assume the values required to equilibrate the asset market, the output market, and the labor market.

C^P = private consumption
I^P = private investment
C^G = government consumption
Y = real income
K = stock of capital
N = employment
L = demand for real money balances
M = nominal stock of money
B = nominal value of the stock of government bonds
A = real private nonhuman wealth
D = real government deficit
T = real taxes net of transfers, excluding debt service
p = price of output
q = price of installed capital in terms of current output
W = money wage
R = nominal interest rate
r_K = required real rate of return on capital
t_R = proportional tax on interest income
t_π = proportional tax on profits
t_c = proportional tax on capital gains
t_w = proportional tax on labor income
t_e = proportional payroll tax on employers
τ = lump-sum tax on households
x^p = expected rate of inflation
x^q = expected proportional rate of change of q
δ = fraction of the public sector deficit financed by borrowing
α = fraction of private holdings of public sector interest-bearing debt perceived as net worth by the private sector
β = fraction of public spending perceived as real private income in kind

$$C^P + C^G + I^P = f(K, N);\ f_K, f_N > 0;\ f_{KK} < 0;\ f_{NN} < 0 \quad (1)$$

$$L = \frac{M}{p} \quad (2)$$

$$C^P = C(C^G, R(1 - t_R) - x^p, Y, A); \; -1 \le C_1 \le 1;$$
$$C_2 \leqslant 0; \; 0 < C_3 < 1; \; C_4 > 0 \tag{3}$$
$$I^P = I(q); \; I' > 0; \; I(1) = 0 \tag{4}$$
$$q = \frac{f_K(K, N)(1 - t_\pi) - t_c x^q}{r_K - x^q} \tag{5}$$
$$r_K = R(1 - t_R) - x^p \tag{6}$$
$$L = L(R(1 - t_R), Y, A), \; L_1 \le 0; \; L_2 > 0; \; 0 < L_3 < 1 \tag{7}$$
$$Y = f(K, N) + \frac{RB}{p} - T - (1 - \alpha)(1 - \delta)D + \beta C^G - x^p\left[\frac{M + \alpha B}{p}\right] + x^q qK \tag{8}$$
$$T = t_w \frac{W}{p} N + t_e \frac{W}{p} N + t_\pi f_K K + t_c x^q qK + t_R \frac{RB}{p} + \tau \tag{9}$$
$$D = C^G + \frac{RB}{p} - T \tag{10}$$
$$A = \frac{M + \alpha B}{p} + qK \tag{11}$$
$$\left(\frac{W}{p}\right)^d = f_N(K, N)\,(1 - t_e) \tag{12}$$
$$\left(\frac{W}{p}\right)^s = h(N, C^G, R(1 - t_R) - x^p, A)\,(1 + t_w); \; h_1 \ge 0;$$
$$h_2 \lesseqgtr 0; \; h_3 \lesseqgtr 0; \; h_4 \ge 0 \tag{13}$$
$$\left(\frac{W}{p}\right)^d = \left(\frac{W}{p}\right)^s \tag{14}$$
$$x^p = \Delta p/p \tag{15}$$
$$x^q = \Delta q/q \tag{16}$$
$$\Delta K = I/q \tag{17}$$
$$\Delta\left(\frac{M}{p}\right) = \delta D - \frac{\Delta p}{p}\frac{M}{p} \tag{18}$$
$$\Delta\left(\frac{B}{p}\right) = (1 - \delta)D - \frac{\Delta p}{p}\frac{B}{p} \tag{19}$$

The steady-state equilibrium of the model is obtained by setting $\Delta K = \Delta\left(\frac{M}{p}\right) = \Delta\left(\frac{B}{p}\right) = 0$. Thus, equations (17), (18), and (19) are replaced by

$$q = 1, \text{ that is, } r_K = f_K(K, N)\,(1 - t_\pi) \tag{20}$$
$$\delta D = \frac{\Delta p}{p}\frac{M}{p} \tag{21}$$
$$(1 - \delta)D = \frac{\Delta p}{p}\frac{B}{p} \tag{22}$$

Equation (1) is the IS equation equating effective demand for output to full employment production. [1] Full employment production is given by a linear homogenous production function, f, in capital and labor, with positive and diminishing marginal products. Equation (2) is the LM or portfolio balance equation. Private consumption depends on the real interest rate, real income, and real private net worth. It also may depend directly on government consumption. [2] This will be the case, for example, if government consumption is a substitute for private consumption (free school milk, etc.). Private capital formation is an increasing function of the price of installed capital goods relative to the cost of producing new investment goods. The current price of capital equals the discounted value of current after-tax cash flow plus next period's expected price of capital (equation (5)). Due allowance has to be made for taxes on profits (at rate t_π) and capital gains taxation (at rate t_c). The required real rate of return on capital, r_K, equals the real rate of return on bonds (equation (6)), a reflection of the Keynesian assumption that bonds and claims on existing capital are perfect substitutes in private portfolios. Interest income is taxed at a rate t_R. Inflationary capital gains or losses on money and bonds are not taxed. The demand for money depends on the real after-tax rate of return differential between bonds-cum-capital and money, on real income, and on real nonhuman wealth. Real income, equation (8), consists of disposable private income, $f + RB/p - T$, adjusted in a number

[1] For simplicity, government capital formation is ignored.
[2] Since labor supply and consumption decisions are jointly determined by the household's intertemporal utility maximization program, the consumption function and labor supply function should have the same arguments. Choosing the more standard (ad hoc) specifications of equations (3) and (13) does not affect the argument.

of ways. First, expected capital gains (or losses) due to expected inflation and expected changes in q are added $(-x^p(M + \alpha B/p) + x^q qK)$. Then allowance is made for the fact that a fraction, $1 - \alpha$, of the stock of government bonds held by the private sector may not be viewed as private net worth because it is offset by the present value of the future taxes required to service this debt. The flow counterpart of this wealth adjustment is the subtraction of a fraction, $1 - \alpha$, of the bond-financed part of the government deficit in equation (8). That part of the deficit is viewed as equivalent to current taxes. Finally, if government spending on real goods and services is perceived as income in kind, this has to be added in. Equation (9) defines total tax in terms of its constituent components. Equation (10) is the public sector real deficit. Real nonhuman wealth, in equation (11), includes the adjustment for bonds mentioned earlier. Equations (12) and (13) give the real demand price and real supply price of labor, respectively. The demand price equals the marginal product of labor net of payroll taxes. Labor supply depends on the real after-tax wage, the real interest rate, real net worth, and government spending. Labor market equilibrium is assumed in equation (14). Equations (15) and (16) impose rational expectations for the general price level and the price of capital. Equations (17), (18), and (19) are the dynamic equations describing the behavior over time of the capital stock,[3] of the stock of real money balances, and of the real stock of bonds.

EFFECTS OF "STRUCTURAL" FISCAL AND MONETARY POLICIES

Fiscal and monetary policies will have important effects in this equilibrium model. The level and composition of real full employment output can be influenced in the short run (identified with the unit period of analysis), in the long run (the steady-state equilibrium), and in the real-time intermediate run in which policy decisions are actually made. These real output effects are not due to the elimination of involuntary Keynesian excess supply but to policy-induced changes in important relative prices. This alters the labor-leisure trade-off, the intertemporal consumption trade-off, the marginal cost of labor, and so forth. Standard comparative statics yield the following policy conclusions.

[3] Depreciation is ignored.

Taxation

The non-lump-sum tax changes are constant revenue changes with τ adjusting endogenously. Consider the special case of the labor supply function where it is independent of the real interest rate and of net worth. If the labor supply schedule is upward sloping, an increase in the tax rate on labor income, t_w, will shift it to the left, reducing full employment output and employment for a given stock of capital. An increase in the payroll tax, or in employers' national insurance contributions, t_e, reduces employment and output by shifting the labor demand schedule to the left, for a given stock of capital. An increase in t_π, the profits tax, will affect—presumably lower—the rate of private capital formation in the short run and the steady-state capital-labor ratio in the long run. An increase in capital gains taxation, t_c, will have similar effects in the short run. In steady-state equilibrium there are no real capital gains; therefore, changes in capital gains taxation will not affect the long-run real equilibrium. An increase in the tax rate on interest income, t_R, will lower the required rate of return on capital. This will tend to stimulate capital formation in the short run and raise the capital-labor ratio in the long run. An increase in lump-sum taxes, τ, will reduce real income unless, given the government's real spending program, money-financed and bond-financed deficits are exactly equivalent to explicit lump-sum taxation. For this to be the case, it is necessary that government bonds not constitute net private sector wealth to any extent, that is, that $\alpha = 0$. With exclusively bond-financed deficits, $\delta = 0$, the appropriate real income concept then becomes, using equation (8),

$$Y = f(K, N) + (\beta - 1)\, C^G - \frac{\Delta p}{p}\frac{M}{p} + \frac{\Delta q}{q} qK \quad (23)$$

A substitution of lump-sum tax financing for borrowing will have no real effects. With money-financed deficits, $\delta = 1$, equation (8) can be written as

$$Y = f(K, N) + (\beta - 1)C^G + \frac{\Delta M}{p} - \frac{\Delta p}{p}\left(\frac{M}{p}\right) + \frac{\Delta q}{q} qK \quad (24)$$

A once-and-for-all increase in the level of the stock of money will be strictly neutral in the model only if $\alpha = 0$.[4] This means

[4] This neutrality proposition can be interpreted in one of the two following ways. (1) Compare the solution trajectories for two economies, identical in all

that $\frac{\Delta M}{p} - \frac{\Delta p}{p}\frac{M}{p}$ is zero when such a shift occurs and that $\frac{\Delta q}{q}$ is independent of such a shift. Thus, a one-period unexpected shift from money financing to lump-sum tax financing will not have any real effects.

Government spending

In this classical equilibrium model, changes in government spending on real goods and services will have powerful short-run and long-run effects. All tax rates are assumed constant. Any changes in the public sector deficit or surplus are financed according to equations (18) and (19). If there is no direct "crowding out" (Buiter, 1977 and 1979 a), that is, if government consumption is not a substitute or complement for private consumption and leisure ($C_1 = 0, \beta = 0, h_2 = 0$), government spending will crowd out private consumption and investment spending on a one-for-one basis by raising the price level and the interest rate.[5] In the long run, a higher level of public spending is likely to crowd out real capital, although this need not be the case. If higher public spending leads to steady-state deficits, these could be associated with higher rates of inflation. This would make real capital a more attractive asset compared with money and creates the possibility of long-run "crowding in." Getting rid of all real effects of government spending requires some very strong assumptions. (1) No direct effect of public consumption on the supply of labor: $h_2 = 0$. (2) Public consumption is a perfect substitute for private consumption and thus constitutes income in kind on a one-for-one basis: $C_1 = -1$ and $\beta = 1$. (3) Debt neutrality prevails: $\alpha = 0$. (4) If the higher level of public spending is associated with increased deficits, these are financed either by borrowing or by money creation; to the extent that they are financed by money creation, they involve only a once-and-for-all step increase in the money supply. Since most of these assumptions are rather silly, the real trajectory of the economy will certainly not be invariant under alternative paths for real government spending.

respects except that the nominal stock of money in country 2, $M^2(t)$, exceeds that in country 1, $M^1(t)$, by a fixed fraction: $M^2(t) = M^1(t)(1 + \alpha)$, $\alpha > 0$, for all t. In economy 2, the equilibrium solutions for the price level, $p^2(t)$, and the money wage, $W^2(t)$, will exceed those in country 1, $p^1(t)$ and $W^1(t)$, by the same fraction, α. $p^2(t) = (1 + \alpha)\,p^1(t)$; $W^2(t) = (1 + \alpha)\,W^1(t)$. All real variables are the same. (2) Consider the solution trajectory of a given economy before and after an unanticipated change in the money supply at $t = \tau$. Let the money supply up to τ be $M^1(t)$. Until $t = \tau$, economic agents expect the money supply to follow $M^1(t)$ indefinitely into the future. At τ, the actual and anticipated money supply path becomes $M^2(t) = M^1(t)(1 + \alpha)$, $\alpha > 0$ for $t \geq \tau$. If there is this unanticipated change at $t = \tau$ in the money stock process, the price level path after τ is $p^2(t) = (1 + \alpha)p^1(t)$, $t \geq \tau$. Here, $p^1(t)$ is the price level path that would have prevailed at and beyond $t = \tau$ had no unanticipated change in the money supply occurred at $t = \tau$.

[5] For simplicity, the author has abstracted from the wealth effect and the real interest rate effect on the labor supply.

Money neutrality

A once-and-for-all unanticipated step increase in the nominal stock of money will be neutral, that is, have no real effects, only if $\alpha = 0$: debt neutrality prevails. A given percentage change in M, if it were associated with an equal percentage change in p and W, would reduce the real value of a given nominal stock of bonds. This will fail to have real consequences only if bonds do not matter, that is, if $\alpha = 0$. Debt neutrality is discussed at length in Section II.

Monetary superneutrality

Monetary superneutrality is the property that the real trajectory of the economic system is invariant under alternative proportional rates of growth of the nominal money supply. It is easily seen that if $B \neq 0$, debt neutrality is a necessary condition for monetary superneutrality. As can be seen from equations (21) and (22), only a common proportional rate of growth of the nominal stocks of money and bonds is consistent with steady-state equilibrium if $\alpha \neq 0$. Even if debt neutrality prevails, superneutrality will be negated by the fact that no market-determined interest rate is paid on money balances. The real rate of return on money is minus the expected rate of inflation. Higher proportional rates of money growth are, across steady states, associated with higher proportional rates of inflation. These lower real returns from holding money will lead to a portfolio shift from money to real capital, thus destroying superneutrality, unless the demand for money is completely interest inelastic. Any change in fiscal parameters that changes the rate of inflation (because it leads to changes in the growth path of the money supply) will therefore have real effects, even if it were to have no direct structural effects or displacement effects. The next section considers debt neutrality and monetary superneutrality in an utterly classical overlapping generations world.

II. Debt Neutrality and Monetary Superneutrality in Fully Optimizing Models

DEBT NEUTRALITY IN AN OPTIMIZING MACROMODEL

In two recent studies (Buiter and Tobin, 1979; Tobin and Buiter, 1980), the authors concluded that debt neutrality—the property that the real trajectory of the economic system is invariant under changes in the financing mix, for a given level and composition of real government spending—is a theoretical curiosum. The assumptions required for it to be valid can easily be shown to be contradicted by practical experience. In a longer version of this paper (Buiter, 1979 b) a formal statement of the case against debt neutrality was presented. A summary of the analysis follows. The analytical framework is chosen deliberately to be as favorable as possible to classical invariance theorems. The model is a generalization of Diamond's (1965) version of Samuelson's overlapping generations model and allows for voluntary intergenerational gifts and bequests. (See Barro, 1974, and Buiter, 1979 c.) A comprehensive treatment of the subject can be found in Carmichael (1979). Except for one significant simplification, the treatment of the case of agents with "two-sided intergenerational caring" replicates the original work of Carmichael.

The overlapping generations model used to develop the nonneutrality theorems is classical in the sense that private actions are derived from explicit optimizing behavior, perfect foresight prevails, and all markets are in equilibrium all of the time. All private agents act as price takers. A study is made of the behavior of this decentralized, competitive economy when a given government spending program is financed by different combinations of lump-sum taxation or current borrowing. Without loss of generality, the level of government spending is assumed to equal zero, which allows the argument to be rephrased in terms of the real effects of alternative debt issue-taxation programs. The restriction to lump-sum taxes is necessary to give the neutrality proposition a chance. Non-lump-sum taxes on labor income, profits, wealth, or any other base will introduce real distortions, impose excess burdens, and, except in uninteresting special cases, have real effects.

Private, voluntary intergenerational gifts—from parents to children (bequests) or from children to parents—are essential for the debt neutrality property to prevail. Briefly, the argument for neutrality goes as follows. The stock of real government interest-bearing debt has no effect on private behavior because corresponding to every dollar's worth of income from these bonds is a dollar's worth of tax payments to finance the bond income. The value of the government bonds on the asset side of private portfolios is the present discounted value of these future income payments. The value of these bonds is, therefore, exactly matched by the present discounted value of the future tax payments required to service them. Even if it is granted that the future income stream and the future tax payments stream are identical and that both are discounted in the same manner, a shift from tax financing to borrowing could cause nonneutrality because of an intergenerational redistribution of resources. If the bonds are one-period bonds and each individual is supposed to live for two periods, the intergenerational redistribution that can be associated with such issues is immediately apparent. Let an extra dollar's worth of bonds be issued in period t and bought by the then young members of generation t. In the next period, interest payment and repayment of principal occur. The tax revenue required for the debt servicing could be levied on the then young members of generation $t + 1$. In that case, real resources have been redistributed from the young to the old. Also, consumption and capital formation will be affected. An unfunded social security program will have broadly similar effects. Longer-maturity bonds can be incorporated in the analysis without materially altering it.

Voluntary intergenerational gifts can remove the real consequences of involuntary intergenerational redistribution through the borrowing-taxation mechanism. Provided that the taxes are lump sum, such private intergenerational transfers will restore the original consumption-investment equilibrium as long as the private actions do not violate the constraints of nonnegativity on these voluntary intergenerational transfers. If before the extra dollar's worth of public debt is issued, the members of the older generation were all leaving positive bequests to their descendants, the option of redistributing resources from the young to the old through a cut in bequests was already open to them. Their decision not to exercise this option reflects that, at the margin, they receive greater utility from the well-being of their heirs than from their own consumption. The government's attempt to redistribute gross resources from the young to the old

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Within the bounds set by the constraints of nonnegativity on gifts and bequests, lump-sum redistribution through borrowing or unfunded social security schemes will be neutralized by voluntary intergenerational transfers, if bequest or gift motives are present. Private nonmarket transactions are required to neutralize public nonmarket transactions.

The policy conclusions of this theoretical investigation of debt neutrality are straightforward. While operative intergenerational gift and bequest motives turn finite-lived households into infinite-lived households in a certain sense, essential differences remain. In particular, if the child-to-parent gift motive is operative, the decentralized, competitive equilibrium is socially inefficient because it is characterized by a capital-labor ratio above the golden rule. The intuitive explanation of this result is that an operative child-parent gift motive is evidence of a very strong desire to save and accumulate. This high propensity to save depresses the marginal product of capital below the natural rate of growth of the economy—a privately rational but socially inefficient outcome. There is, therefore, a prima facie case for government intervention in the saving-investment process. The second conclusion concerns debt neutrality. Here, every neutrality theorem is matched by a nonneutrality theorem. If neither bequests nor gifts are operative, government borrowing crowds out capital formation. If child-parent gifts are operative, small increases in government borrowing are neutralized by reductions in gifts. If bequests are operative, small reductions in government borrowing (or increases in lending) are neutralized by reductions in bequests. There always exists a change in the amount of government lending or borrowing that will make the constraint of nonnegativity on bequests, respectively, on child-parent gifts binding. There always is a government financial strategy that forces the private sector into a zero gift and zero bequest corner solution, where financial policy will affect the

capital-labor ratio. In the simple formal model of Buiter (1979 b), all agents are identical, so that either everyone is at a corner or no one is. If, instead, a distribution of agents is visualized, by the strength of their bequest and their gift motives or by other parameters of their utility functions or of the constraints they face, increasing or reducing government borrowing can be expected to make the zero gift or zero bequest constraint binding for an increasing number of agents.

Even in this most classical of models, the conclusion emerges inexorably that the way in which the government finances its real spending program will have major consequences for saving and capital formation. Debt neutrality is not a plausible theoretical proposition. Future research should concentrate on empirical assessments of the extent and nature of nonneutrality.

MONETARY SUPERNEUTRALITY IN FULLY OPTIMIZING MACROMODEL

The overlapping generations model is also a convenient vehicle for analyzing the issue of superneutrality of money in an explicitly optimizing and fully rational model. Superneutrality is the invariance of the trajectories of the real variables of the economy under different proportional rates of growth of the nominal money stock. Money is defined as a noninterest-bearing (nominally denominated) liability of the government that has no intrinsic value in the sense that it is neither used as a consumption good nor as an input in the productive process. The two functions performed by this financial claim are the medium of exchange function and the store of value function. Carmichael (1979) developed a model in which both functions were incorporated. For simplicity, the analysis here shall be limited to a consideration of the store of value function of money. The anti-superneutrality result obtained in the simpler model carries over to the more complex model considered by Carmichael. Consider the introduction of money in a simple overlapping generations model without gifts, bequests, or interest-bearing government debt in which the only other store of value is real reproducible capital. Since money balances are not desired for their own sake but only for their purchasing power over real output, the real rate of return on money balances is the negative of the expected proportional rate of change of the price level: $-\Delta\hat{p}/p$. In the certainty model analyzed in Buiter (1979 b), the actual and expected rates of inflation are the same, if expectations are rational: $\Delta\hat{p}/p$

$= \Delta p/p$. Also, money and real capital are perfect substitutes as stores of value. They will both be held only if their rates of return are equal. Let $f'(k)$ denote the marginal product of capital; k is the capital-labor ratio. If the rate of return on money balances were below that on real capital, $-\Delta p/p < f'(k)$, no money would be held; if the rate of return on money balances were above that on real capital, $-\Delta p/p > f'(k)$, no capital would be held. Considering only those trajectories on which both assets are held:[6]

$$-\Delta p/p = f'(k) \tag{25}$$

Let μ denote the proportional rate of growth of the nominal money supply, $\mu = \Delta M/M$; M is the nominal stock of money. In steady-state equilibrium, the rate of change of the price level is the rate of growth of the money supply minus the natural rate of growth of the economy, n.

$$1 + \frac{\Delta p}{p} = \frac{1+\mu}{1+n} \text{ or, approximately, } \frac{\Delta p}{p} = \mu - n \tag{26}$$

Equations (25) and (26) are sufficient to refute the superneutrality proposition. Since $n - \mu = f'(k)$, an increase in the rate of growth of the money supply will lower the steady-state rate of return on money balances by raising the steady-state rate of inflation. Portfolio balance requires an equal reduction in the rate of return on capital. This is accomplished by a higher capital-labor ratio. Models, such as Sidrauski's (1967), that exhibit invariance of steady-state k under different values for μ are only superficially rational, optimizing models. By including real money balances as an argument in the direct utility function, on a par with consumption and leisure, the Sidrauski model violates the principle that money is wanted only for what it can buy. It is, therefore, not an interesting framework for analyzing monetary policy.

The absence of monetary superneutrality is an example of inflation-induced distortions in the real economy that occur whenever there is incomplete indexation of nominal contracts. A fixed nominal rate of return on outside money is one example of incomplete indexation. Interest ceilings on checking accounts and other controlled interest rates provide additional channels through which fully anticipated changes in the rate of monetary

[6] Since $f'(k) > 0$, this means that $\Delta p/p \geq 0$ is inconsistent with money being held in equilibrium.

expansion and the rate of inflation have real effects, provided the interest ceilings are a binding constraint. Perfect indexation of the financial system, including the rate of return on high-powered money, results in monetary superneutrality. An awkward by-product of such a policy is that the general price level then becomes indeterminate in the entire current array of macromodels. This probably reflects inadequacies in the modeling efforts rather than a potentially worrying feature of the real world.

The refutation of monetary superneutrality reinforces the conclusion reached after the evaluation of the debt neutrality proposition: equilibrium and rationality do not imply neutrality. The detailed consideration of these propositions in fully rational, optimizing models in Buiter (1979 b) also suggests that the ad hoc model of Section I is in many ways an acceptable parable for the purer models.

III. Stabilization Policy in Stochastic Non-Walrasian Models

A Walrasian economy has two essential features. The first is the existence of a complete set of contingent forward markets. This permits the interpretation of such an economy as a one-shot, static economy. At the beginning of time, $t = t_0$, equilibrium prices are established for the current and contingent future delivery of all goods and services. The rest of history then consists solely of the unfolding execution of the contingent forward contracts established at the initial market date. The second essential feature is that prices are competitive, market-clearing prices. This means that at the prevailing set of market prices demand does not exceed supply for any good, when these demands and supplies represent notional plans. Notional demands and supplies of households are derived from utility maximization subject only to the constraint of the households' endowments evaluated at parametric market prices. Notional demands and supplies of firms are derived from profit maximization subject only to the constraint of the production possibility set, with all planned sales and purchases evaluated at parametric market prices. All economic agents act as if, at the prevailing market prices, they can buy or sell any amount of any good or service. The demands and supplies derived under these conditions are consistent.

A non-Walrasian economy, by contrast, is a sequence economy—one in which transactions take place at different dates (see

Hahn (1973)). Prices for all contingent future goods and services are not established once and for all in some initial market period. Markets are incomplete and reopen, either continuously or at discrete intervals. The overlapping generations model of Section II is, according to this definition, a non-Walrasian economy. Forward contracts between those living today and the unborn are not feasible. Markets are incomplete. The factor markets that do exist reopen each period. In models with uncertainty and imperfect, asymmetric information, other natural reasons, such as moral hazard and adverse selection, can be found for the nonexistence of certain markets. The overlapping generations model maintains the second of the two essential Walrasian features. The incomplete set of markets is always in momentary competitive general equilibrium. No potential buyer or seller is rationed in any market or needs to consider any information other than the known set of parametric market prices and his endowment or technology set.

Following is a brief review of some of the issues surrounding stabilization policy in sequence economies when information is incomplete and when market prices are not automatically and instantaneously established at the values that balance notional demands and supplies. For simplicity, the analysis is limited to the consideration of monetary policy. All sources of monetary nonneutrality considered in Sections I and II are suppressed. This includes effects on capital formation via the real rate of return on money and wealth effects due to the presence of nominally denominated interest-bearing public debt.

STICKY NOMINAL PRICES AND REAL EFFECTS OF DETERMINISTIC MONETARY FEEDBACK RULES

It is well known that if a market is inefficient, in the sense that the market price does not fully reflect all available information, pure nominal shocks and disturbances, including anticipated changes in the money stock, can have real effects. The simple textbook IS-LM model with its exogenously fixed money wage and money price level is the best-known example. With the general price level given exogenously, an increase in the nominal stock of money represents an equal proportional increase in the real stock of money balances. By lowering the interest rate and/or via the Pigou effect, real effective demand will be altered. It may seem plausible to locate such inefficiencies primarily in the

goods and factor markets, while treating the financial markets as efficient, with financial asset prices or rates of return always adjusting instantaneously to new information about current or anticipated future events, so as to maintain equilibrium between demand and supply. Interestingly, some of the recent work by Stiglitz (1979) on nonmarket-clearing equilibria and the microfoundations of price and wage stickiness deals with financial markets.

Imperfect, costly, and asymmetric information characterize personal and corporate credit markets and insurance markets as much as the labor market, the housing market, or the market in secondhand cars. Work on this subject by Arkerlof (1970), Grossman (1976), Salop (1978), Stiglitz (1979), Wilson (1979), and others shows how privately rational, optimizing behavior can result in socially inefficient, quantity-constrained equilibria in which market prices are sticky in the sense that they do not always respond to the existence of excess demand or supply. The simple linear stochastic model described below imposes price rigidity, without explicitly deriving it, as Stiglitz has done, as the (momentary) equilibrium outcome of a process generated by optimizing economic agents. It is, therefore, ad hoc. The assumption of instantaneous and continuous competitive equilibrium, however, is equally ad hoc unless the process is specified through which this miracle of coordination is achieved. It is not enough to assert that all feasible trades that are to the perceived mutual advantage of the exchanging parties must be exhausted. What needs to be explained is how the price vector always assumes a value that renders feasible, in the aggregate, actions that appear feasible at the microlevel when each agent acts competitively. The microfoundations of competitive market clearing are not yet well developed. Essential ingredients are large numbers of potential buyers and sellers, specialized middlemen or brokers, easy identification of the relevant economic characteristics of the commodity in question, and other fundamental components of market structure, such as the laws, rules, and regulations governing the exchange of property rights over the commodity.

The ad hoc linear stochastic disequilibrium model is described in the following equations:

$$p^*_t = \alpha(Y_t - \overline{Y}_t) + \hat{p}_{t-1,t} \qquad \alpha > 0 \tag{27}$$

$$p_t - p_{t-1} = \beta(p^*_t - p_{t-1}) \qquad 0 \leq \beta \leq 1 \tag{28}$$

$$A_t = \gamma(m_t - p_t) + \epsilon_t^d \qquad \gamma > 0 \tag{29}$$

$$Y_t = A_t \tag{30}$$

$$\overline{Y}_t = \overline{Y} + \epsilon_t^s \tag{31}$$

where p^*_t is the equilibrium price in period t; p_t is the actual price in period t; $\hat{p}_{t-1,t}$ is the price anticipated, in $t-1$, to prevail in period t; A_t is effective demand; m_t is the nominal stock of money; Y_t is real output; $\overline{Y}_t$ is capacity output; and ϵ_t^d and ϵ_t^s are white noise demand and supply disturbances. All variables are in logs. Equation (27) is a version of the Lucas supply function. Deviations of output from its natural level are possible if and only if the equilibrium price level is different from the price level expected, in the last period, to prevail in this period. Equation (28) models sluggish adjustment of the actual price level to the equilibrium price level. Only if $\beta = 1$, that is, only if adjustment is instantaneous, do we have the strict surprise supply function, according to which the only source of departure of actual output from its natural level is a price forecast error. [7] Equation (29) models effective demand as an increasing function of the stock of real money balances and a white noise demand disturbance. Equation (31) models capacity output as a constant plus a random supply disturbance.

If expectations are rational, that is, if they are minimum mean-squared error forecasts, if economic agents know the true structure of the model (the values of α, β, γ, and $\overline{Y}$), if they know that the disturbances are mutually and serially independent and identically distributed random variables with zero means, and if they observe p_t at time t, the rational expectation of the price level is easily found to be

$$E(p_t|\phi_{t-1}) = \frac{\alpha\beta\gamma}{1-\beta+\alpha\beta\gamma} E(m_t|\phi_{t-1}) - \frac{\alpha\beta}{1-\beta+\alpha\beta\gamma}\overline{Y} + \frac{(1-\beta)}{1-\beta+\alpha\beta\gamma} p_{t-1} \tag{32}$$

[7] Equation (28) is reasonable only in an economy without an inflationary or deflationary trend. If there is a trend in the price level (but not in the rate of inflation), equation (28) can be modified to $(p_t - p_{t-1}) - (p_{t-1} - p_{t-2}) = \beta(p^*_t - p_{t-1} - (p_{t-1} - p_{t-2}))$.

Here, E represents the mathematical expectations operator and ϕ_t denotes the private sector's information set, written as a vector, available at time t, conditional on which private expectations are formed. Note that, because of the inertia in the price adjustment process, the past price level directly carries information about the current price level via the last term of equation (32), as well as possibly indirectly via $E(m_t|\phi_{t-1})$. When price adjustment is instantaneous, $\beta = 1$, the past price level has no direct influence on the current price level. Equation (32) becomes

$$E(p_t|\phi_{t-1}) = E(m_t|\phi_{t-1}) - \frac{1}{\gamma}\overline{Y} \tag{33}$$

The reduced form equations for the price level and for real output are, respectively,

$$p_t = \frac{(1-\beta)}{1-\beta+\alpha\beta\gamma} p_{t-1} + \frac{\alpha\beta\gamma}{1+\alpha\beta\gamma} m_t + \frac{\alpha\beta^2\gamma}{(1+\alpha\beta\gamma)(1-\beta+\alpha\beta\gamma)} E(m_t|\phi_{t-1}) - \frac{\alpha\beta}{1-\beta+\alpha\beta\gamma}\overline{Y} - \frac{\alpha\beta}{1+\alpha\beta\gamma}\epsilon_t^s + \frac{\alpha\beta}{1+\alpha\beta\gamma}\epsilon_t^d \tag{34}$$

$$Y_t = \frac{\gamma}{1+\alpha\beta\gamma} m_t - \frac{\alpha\beta^2\gamma^2}{(1+\alpha\beta\gamma)(1-\beta+\alpha\beta\gamma)} E(m_t|\phi_{t-1}) + \frac{\alpha\beta\gamma}{1-\beta+\alpha\beta\gamma}\overline{Y} - \frac{(1-\beta)\gamma}{1-\beta+\alpha\beta\gamma} p_{t-1} + \frac{\alpha\beta\gamma}{1+\alpha\beta\gamma}\epsilon_t^s + \frac{1}{1+\alpha\beta\gamma}\epsilon_t^d \tag{35}$$

The effect of an anticipated increase in the money supply, Δm^a, is given by

$$\frac{\Delta Y_t}{\Delta m^a} = \frac{\gamma(1-\beta)}{1-\beta+\alpha\beta\gamma} \tag{36}$$

The effect of an unanticipated increase in the money supply, Δm^u, is given by

$$\frac{\Delta Y_t}{\Delta m^u} = \frac{\gamma}{1+\alpha\beta\gamma} \tag{37}$$

Two propositions emerge: First, as long as the price level is not completely inflexible ($\beta > 0$), an unanticipated increase in the money supply will have a larger effect on real output than will an anticipated increase in the money supply.[8] Second, only if the price level is perfectly flexible ($\beta = 1$) will anticipated money supply changes have no effect on real output. Even then, unanticipated monetary disturbances will continue to have real effects.

Except for the recent papers by Stiglitz and others (mentioned above), most of the theoretical work on wage and price rigidity can be characterized as (implicit) contract theory (Azariadis (1975), Baily (1974), Fischer (1977), Grossman (1978), and Phelps and Taylor (1977)). Multiperiod employment contracts are viewed as mutually privately rational arrangements for shifting risk from risk-averse workers to risk-neutral or less risk-averse capitalists. Similarly, multiperiod price contracts between well-established suppliers and customers can be viewed as transactions and search cost minimizing as well as risk-sharing arrangements (Okun, 1975). What is not clear is why optimal multiperiod contracts would set (i.e., predetermine) nominal wages or prices, thus assigning the role of shock absorbers solely to quantities (employment and sales) even in the presence of purely nominal disturbances (Barro, 1979). A recent attempt to overcome some of the shortcomings of contract theory was made by Hall (1979), who rationalizes wage and price stickiness by developing a theory of the role of "prevailing prices and wages" in the efficient organization of markets.

If prices can adjust to clear markets with the same frequency with which new information accrues and with the same speed with which the monetary authority can respond to any new information, monetary policy will enter the reduced form for real output only via a term like $\sum_{j=0}^{\infty} w^j(m_{t-j} - E(m_{t-j}|\phi_{t-j}))$, that is, via a series of one-period-ahead forecast errors. With multiperiod nominal contracts, monetary policy will enter the reduced form for real output via a term like $\sum_{j=0}^{\infty}\sum_{i=0}^{\infty} w^{ij}(m_{t-j} - E(m_{t-j}|\phi_{t-j-i}))$, that is, via a sequence of forecast errors for m_{t-j} from different dates in the past. Thus, if money wages and prices are determined by a series of overlapping multiperiod nominal contracts and if the nominal money stock can be adjusted freely in each period, the information set available at the time of the current money supply decision will in general be larger than the information sets that were available when most of the currently prevailing money prices and wages were contracted for. The public sector does not have an informational advantage over the private sector at any moment of time, but only the public agent is able to change its control—the money supply—in response to any new information. Private agents are locked in by past nominal contracts. Given this differential ability to respond to new information, monetary policy can be used to stabilize (or destabilize) real output.

[8] This is not a general property of rational expectations models. Baily (1978) provides examples of anticipated fiscal policy having greater "bang per buck" than unanticipated fiscal policy.

DIFFERENTIAL INFORMATION BETWEEN PRIVATE SECTOR AND PUBLIC SECTOR

Equations (35), (36), and (37) make it clear that sluggishness in the adjustment of prices can be a sufficient reason for anticipated money supply changes to have real effects. Asymmetric information between the private sector and the monetary authorities can be another reason for effective monetary policy, even if the price level is market clearing (Barro, 1976). It is not necessary for the public sector to have uniformly superior information. All that is required is that different agents have differential access to (and ability to process and assimilate) different kinds of information. Let ψ_t be the information set of the monetary authority in period t; m_t will be some function, T_t, of ψ_t. For simplicity, T_t is taken to be linear.

$$m_t = T_t\psi_t \tag{38}$$

Consider the equilibrium version of equation (35), where $\beta = 1$.

$$Y_t = \frac{\gamma}{1+\alpha\gamma}(m_t - E(m_t|\phi_{t-1})) + \bar{Y} + \frac{1}{1+\alpha\gamma}\epsilon_t^d + \frac{\alpha\gamma}{1+\alpha\gamma}\epsilon_t^s \tag{39}$$

Substituting equation (38) into equation (39) gives

$$Y_t = \frac{\gamma}{1+\alpha\gamma}(T_t\psi_t - E(T_t\psi_t|\phi_{t-1})) + \bar{Y} + \frac{1}{1+\alpha\gamma}\epsilon_t^d + \frac{\alpha\gamma}{1+\alpha\gamma}\epsilon_t^s \tag{40}$$

$$y_t = \beta[p_t - E(p_t|\phi_{t-1})] + u^y_t \qquad \beta > 0 \tag{42}$$

The difference in the conditioning dates for the expected future price level in equations (41) and (42) is crucial for the policy effectiveness proposition. One interpretation of the specification is that nominal wage contracts for period t have to be concluded in period $t - 1$, while financial transactions in period t can be made instantaneously.

Feedback rules of the following kind are considered:

$$m_t = \sum_{i=1}^{\infty} [\mu_{i,1}u^y_{t-i} + \mu_{i,2}u^m_{t-i}] \tag{43}$$

Combining equations (41) and (42):

$$p_t = \frac{1}{1 + \alpha_1\beta + \alpha_2} m_t + \frac{\alpha_1\beta}{1 + \alpha_1\beta_2 + \alpha_2} E(p_t|\phi_{t-1}) + \frac{\alpha_2}{1 + \alpha_1\beta_2 + \alpha_2} E(p_{t+1}|\phi_t) - \frac{1}{1 + \alpha_1\beta_2 + \alpha_2}(\alpha_1 u^y_t + u^m_t) \tag{44}$$

From equation (44):

$$p_t - E(p_t|\phi_{t-1}) = \frac{1}{1 + \alpha_1\beta + \alpha_2}(m_t - E(m_t|\phi_{t-1})) + \frac{\alpha_2}{1 + \alpha_1\beta + \alpha_2}[E(p_{t+1}|\phi_t) - E(p_{t+1}|\phi_{t-1})] - \frac{1}{1 + \alpha_1\beta + \alpha_2}(\alpha_1 u^y_t + u^m_t) \tag{45}$$

and, for $j \geq 1$

$$E(p_{t+j}|\phi_t) - E(p_{t+j}|\phi_{t-1}) = \frac{1}{1 + \alpha_2}[E(m_{t+j}|\phi_t) - E(m_{t+j}|\phi_{t-1})] + \frac{\alpha_2}{1 + \alpha_2}[E(p_{t+j+1}|\phi_t) - E(p_{t+j+1}|\phi_{t-1})] \tag{46}$$

Since the feedback policy in equation (43) has m_t responding only to past values of the disturbances (which belong to ϕ_{t-1}), $m_t - E(m_t|\phi_{t-1}) = 0$ in equation (45). However, in equation (46), $E(m_{t+j}|\phi_t) - E(m_{t+j}|\phi_{t-1}) = \mu_{j,1}u^y_t + \mu_{j,2}u^m_t$ for $j \geq 1$. Assuming stability, the solution of equation (46) is

$$E(p_{t+j}|\phi_t) - E(p_{t+j}|\phi_{t-1}) = \frac{1}{(1 + \alpha_2)} \sum_{i=0}^{\infty} \left(\frac{\alpha_2}{1 + \alpha_2}\right)^i (\mu_{j+i,1}u^y_t + \mu_{j+i,2}u^m_t) \tag{47}$$

Substituting equation (47) into equation (45):

$$p_t - E(p_t|\phi_{t-1}) = \frac{\alpha_2}{(1 + \alpha_1\beta + \alpha_2)(1 + \alpha_2)} \sum_{i=0}^{\infty} \left(\frac{\alpha_2}{1 + \alpha_2}\right)^i (\mu_{1+i,1}u^y_t + \mu_{1+i,2}u^m_t) - \frac{1}{1 + \alpha_1\beta + \alpha_2}(\alpha_1 u^y_t + u^m_t) \tag{48}$$

Equations (48) and (42) show clearly that the price forecast error, and therefore real output, is a function of the parameters of the monetary feedback rule, $\mu_{i,j}$, $i = 1, 2; j = 1, 2, \ldots$. In fact, as Turnovsky shows, feedback policy can be used to completely eliminate the forecast error, or to completely eliminate the variance of real output. To see this, set $\mu_{j,1}$ equal to $\mu_{j,2}$ equal to 0 for all $j > 1$. Equation (48) can now be rewritten as

$$p_t - E(p_t|\phi_{t-1}) = \left[\frac{\alpha_2}{(1 + \alpha_1\beta + \alpha_2)(1 + \alpha_2)}\mu_{1,1} - \frac{\alpha_1}{1 + \alpha_1\beta_2 + \alpha_2}\right]u^y_t + \left[\frac{\alpha_2}{(1 + \alpha_1\beta + \alpha_2)(1 + \alpha_2)}\mu_{1,2} - \frac{1}{1 + \alpha_1\beta_2 + \alpha_2}\right]u^m_t \tag{49}$$

By choosing $\mu_{1,1} = \frac{\alpha_1(1 + \alpha_2)}{\alpha_2}$ and $\mu_{1,2} = \frac{1 + \alpha_2}{\alpha_2}$, we obtain $p_t - E(p_t|\phi_{t-1}) = 0$. Alternatively, we could choose $\mu_{1,1}$ and $\mu_{1,2}$ to set y_t equal to 0.

Feedback policy is effective because the error in the forecast for p_t made in period $t-1$, $p_t - E(p_t|\phi_{t-1})$ is a function of the revision in the forecast for p_{t+1} between periods t and $t-1$. $E(p_{t+1}|\phi_t) - E(p_{t+1}|\phi_{t-1})$ is orthogonal to ϕ_{t-1} and therefore to m_t if m_t is a function of ϕ_{t-1}. It is not, however, orthogonal to ϕ_t, nor to m_{t+1} when m_{t+1} is a function of ϕ_t because of the feedback policy. Expectations of future policy affect the future expected price level. This is reflected in the current price level. Feedback policy can therefore be used to influence (and in the example here eliminate) the gap between p_t and $E(p_t|\phi_{t-1})$.

INSUFFICIENCY OF PRICES IN SEQUENCE ECONOMIES WITH INCOMPLETE MARKETS AND RATIONAL EXPECTATIONS

There is an implication of the rational expectations approach that seems to have been overlooked by its advocates. One of the major virtues of a market system is supposed to be the role played by prices determined in efficient markets as effective aggregators of structural information. Decentralized, atomistic private agents need not worry about the behavior of the myriad other agents, about their tastes, technologies, and endowments. All information necessary for the optimal planning of consumption, production, and sales is contained in current market prices that are parametric to the individual agent: market prices are a sufficient statistic for efficient private choice. If markets are incomplete and expectations of future spot prices replace currently available prices established in forward markets, rational expectations are a strong reminder of the insufficiency of the price mechanism for efficient resource allocation. Rational expectations are optimal forecasts based on the forecasting agent's knowledge of the true structure of the economy. They require knowledge of the underlying structural parameters of public sector and private sector preferences, technologies, and endowments. The local, partial nature of the knowledge provided by prices in a real-world market economy with incomplete markets means that additional global, economy-wide informational demands are made on private agents with rational expectations. Such informational demands are often dismissed as unrealistic when central planning is discussed. The informational requirements of central planning are really no different from the informational requirements of decentralized rational expectations models of sequence economies with incomplete markets.

IV. Conclusion

The new classical macroeconomics has forced a thorough revaluation of the theoretical and empirical foundations of neo-Keynesian conventional wisdom. After the rhetoric is stripped away, however, the analytical implications of the new classical macroeconomics are surprisingly familiar to neo-Keynesians. Substitution of debt financing for tax financing crowds out saving in the short run and lowers the capital-labor ratio in the long run. A higher, fully anticipated rate of growth of the money supply will not be superneutral and is likely, *ceteris paribus*, to be associated with a higher steady-state capital-labor ratio. Monetary feedback rules will alter the trajectories of real economic variables. This confirmation of the importance of monetary, fiscal, and financial policy for the cyclical and the long-run behavior of the real economy is not necessarily a source of comfort. After all, policy neutrality would be most welcome when the conduct of policy is erratic, confusing, or incompetent. No such easy escape is available to the policymaker; policy can stabilize and it can destabilize, it can promote growth and prosperity or destroy it.

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