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ON THE RELEVANCE OR IRRELEVANCE OF PUBLIC FINANCIAL POLICY: INDEXATION, PRICE RIGIDITIES AND OPTIMAL MONETARY POLICY

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ABSTRACT

ON THE RELEVANCE OR IRRELEVANCE OF PUBLIC FINANCIAL POLICY:
INDEXATION, PRICE RIGIDITIES AND OPTIMAL MONETARY POLICIES

This paper is concerned with delineating conditions under which public financial policies have no real and/or price effects. In the absence of intergenerational distribution effects, public financial policy is irrelevant: an increase in government debt (whether indexed or not), an exchange of an indexed bond for a non-indexed bond, or an exchange of a short term bond for a long term bond has neither real nor financial effects. We also describe changes in financial policy in which the supply of bonds are increased and the nominal interest rate increases, which have an effect on the rate of inflation, but no real effects. We examine the implications of price and wage rigidities and the existence of a non-interest bearing financial asset used for transactions purposes for the validity of these irrelevance theorems.

In general, public financial policies have effects on intergenerational distribution; alternative financial policies have implications for the pattern of capital accumulation (an effect which was the center of the literature on money and growth) and on the sharing of risks among members of different generations. We examine the consequences of three alternative financial policies,a fixed supply of financial assets, a fixed price level, and a fixed real supply of government indebtedness; under some plausible conditions, the latter policy may provide for the least intergenerational variability in consumption.

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I. Introduction

Does it make any difference whether or not the government issues indexed bonds? Few governments have, in fact, issued such bonds, in spite of repeated calls from distinguished economists for them to do so. Is the failure to issue these bonds an example of lack of innovativeness of government officials? What difference would such bonds make to the equilibrium of the economy?

This question is part of a much broader question, of the effect of alternative public financial policies. The effect of any single policy, such as the issuance of indexed bonds, cannot be analyzed in isolation from the other aspects of public financial policy. Moreover, the effect of any change in government policy today cannot be assessed without specifying, at the same time, future governmental policies (or perhaps more accurately, specifying the beliefs of economic agents concerning those future government policies). Finally, it is our contention that a central aspect of public financial policy is the intertemporal (intergenerational) distribution of income and risk bearing which it generates.

In the absence of these intergenerational distribution effects, public financial policy is irrelevant. In Section I, we show that an increase in government debt (whether indexed or not), an exchange of an indexed bond for a non-indexed bond, or an exchange of a short-term bond for a long-term bond (which corresponds in our model to an open market operation), has neither real nor financial effects. The first result--on the irrelevance of government deficits--we have referred to (Stiglitz (1982)) as Say's law of government deficits: an increase in the supply of government bonds gives rise to an equal increase in the demand for government bonds.

These results are in marked contrast to those suggested, for instance, by the standard portfolio theories. In those models, an increase in the supply of one kind of financial asset and a decrease in the supply of another will have real effects: the risk properties of these different financial assets are different, and because of risk aversion, individuals will want to diversify their portfolios among the different assets. A change in the supply of different assets necessitates a change in the equilibrium prices, and these changes in equilibrium prices have real consequences (say, for the pattern and level of investment). Our analysis differs from these models in that they fail to take into account the implicit liability associated with government bonds, and the change in that liability with a change in the level or form of government bonds. When there are no intergenerational distribution effects of public financial policy, and when individuals do take their future tax liabilities into account, then it turns out that public financial policy, including the issuance of indexed bonds, is irrelevant.[1]

The more relevant case, however, is that where public financial policy has an effect on the intergenerational distribution of income. The literature on money and growth in the late 1960s emphasized this role of debt policy.[2] As such, the effects of debt policy cannot be analyzed separately

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1. Our result can thus be viewed as extending the well known Barro-Ricardo results to an explicitly stochastic environment. In the absence of uncertainty, all assets are perfect substitutes, and thus the question of the effect of public financial policy on the relative prices of different assets does not arise.

2. The original papers by Tobin (1965) and Johnson (1966) gave rise to a large literature; see, for instance, Shell, Sidrauski, and Stiglitz (1967). Although much of this literature employed ad hoc savings assumptions, the work of Sidrauski (1967) and the life cycle models of Diamond (1965) and Cass-Yaari (1967) showed how the results could be extended to models with explicit intertemporal utility maximizing individuals.

from those of social security and tax policy, as noted by Atkinson-Stiglitz (1980). These studies, however, analyzed public financial policy in a completely non-stochastic framework. When there is uncertainty, when there is a variability in the productivity of labor and capital, then public financial policy has an additional role: it is concerned not only with controlling the optimal rate of capital accumulation, but also with the sharing of risks among members of different generations. This notion appears in earlier discussions of the burden of the debt. Could the generation alive at the time of World War II manage to shift the burden of paying for that war to future generations, by financing the war by means of debt? For a period, the consensus, at least of textbook writers, was no: the resources foregone during the war were spent at that time. As long as we "owe the debt to ourselves" (i.e., we do not finance the war through borrowing abroad), how we finance it cannot make a difference. The view taken here is that the burden of the war can indeed be shared with succeeding generations,[1] and this sharing is implemented through public financial policies, including social security and debt policy. Though we will not address the question of how the costs of a particular event, such as a major war, should be shared among different generations, we will address the question of how public financial policy can be used to smooth out the variability in intergenerational welfare induced by variability in the productivity of labor and capital.

In the context of a life cycle model, where public financial policy affects the intertemporal distribution of welfare, public financial policy

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1. For instance, by increasing current consumption at the cost of investment in the war period, and transferring wealth from young to old in the peacetime periods that follow.

does, in general, matter. Some kinds of public financial policies have financial effects (i.e., affect price levels) but have no real effects. We discuss two important instances. First, an increase in the rate of interest paid on government bonds, with the ensuing deficits financed by the issuance of additional bonds, has no real effects. Secondly, if all members alive in one generation were identical, any intertemporal distribution of welfare that was desired could be attained through the use of a single financial asset; thus, adding additional financial assets--such as indexed bonds--makes no difference. Again, indexed bonds serve no function.

More generally, changes in public financial policies have real effects. For instance, when there is more than one type of individual alive in a given generation, then issuing indexed bonds can have a real effect, even if there is a complete set of intragenerational risk markets.

Once it is recognized that public financial policy matters, it becomes important to ascertain the effects of alternative policies. Although the characterization of the first-best policies, for any stochastic structure of general interest, is beyond the scope of this paper, we present some preliminary results comparing the welfare effects of three simple rules. The first attempts to keep prices constant, the second attempts to keep the value of real debt constant, and the third keeps the level of debt constant (this corresponds, in our model, to the Friedman rule of a constant growth in the money supply, since, in our model, we have no exogenous sources of growth).

Our analysis suggests that a policy of holding the value of the outstanding debt constant may be preferable to the other two. An outsider, not knowing that the government was following a policy aimed at maintaining a constant value of the outstanding debt, might be misled by the empirical observation that in such an economy the price level moves in proportion to debt, into believing that the level of debt determines the price level; in fact, both are responding to the exogenous shocks which the economy is experiencing.

For reasons that we detail below, for most of the analysis we assume a single short-term government financial asset, which normally is interest bearing. We focus on the role of government debt as a store of value, ignoring its potential role as a medium of exchange. In Section IV we show how the analysis can easily be modified to incorporate explicitly non-interest bearing government debt (money); if anything, the transactions demand for money strengthens our earlier results on the relevance of public financial policy.

Up to this point, the models we use are all neoclassical, assuming full employment of labor and capital. Yet one of the more important functions of public financial policy, as it is usually conceived, is to affect the level of national income and employment. Recent theoretical work using models of rational expectations has questioned the ability of the government to use financial policy to affect the level of national income (other than by adding noise, making it more difficult for economic agents to distinguish real shocks from monetary shocks, and as a result, making it more difficult for economic agents to respond efficiently to changed circumstances).[1] In

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1. Obviously, if the government has an informational advantage over the private sector, it could base its public financial policy on that information; public financial policy would thus convey information from the government to the private sector. But this is a peculiarly inefficient way of conveying information, and there is little evidence that the monetary authorities are privy to information that is not publicly available.

our neoclassical models, we assume rational expectations and symmetric information; yet alternative financial policies do have an effect, both on the level of capital accumulation and on the labor supply (through the income effects associated with the intertemporal distribution of income).[1]

In Section V, we show that public financial policy may be even more effective if wages and prices are not perfectly flexible, so that there is not full employment. Again, we postulate rational expectations. This result reemphasizes the result noted by others (see, e.g., Taylor (1980), Neary-Stiglitz (1982)) that the conclusion of the rational expectations models concerning the inefficacy of government policy does not depend so much on the expectational assumptions as on other features of the model; in particular, the assumptions concerning wage and price flexibility.

Before beginning the formal analysis, two remarks may be helpful. First, we limit ourselves throughout to public financial policies; real government expenditures are assumed to remain constant (at each date and in each state). Second, the question is sometimes posed, what can the government do that the private sector cannot do--or at least undo? There is a simple answer here: the government can enforce intergenerational redistributions. And there is, in the life cycle model, an implicit market failure. Individuals in one generation cannot trade with those of another generation; in particular, they cannot engage in the sharing of risks. (Of necessity, then, the set of Arrow-Debreu contingent claims markets must be

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1. We assume throughout that the only taxes imposed are lump sum taxes; if, more realistically, we had assumed a distortionary income or wage tax, then there would be further supply effects.

incomplete). The government provides a mechanism by which this kind of risk sharing can occur.[1]

For most of the analysis, we focus our attention on a model in which all individuals within a generation are identical; for those who are alive and can trade with each other, we assume that there are perfect markets.

II. Three General Irrelevance Theorems

In this section, we prove three very general theorems, establishing the irrelevance of a wide class of government financial policies. We establish the results in the context of a simple model of an economy with overlapping generations and a constant population. Following the proof of the first irrelevance theorem, we comment on the implications of this result for an economy with a single, infinitely lived generation.

2.1 The Model

Each generation lives for three periods; individuals work in the first two, and live off their savings in the third. (Later, we shall consider a simplification where individuals live for only two periods.) We thus write the utility function of an individual born at time t

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1. Similar remarks can be made about the role of the government in redistribution in general. If, behind the veil of ignorance, before individuals knew the endowments with which they were to be born they could sell enforceable insurance policies to each other, with the payoffs a function of what endowments they were presented with, or of observable variables which were a function of those endowments, then it might be argued that there would be no need for the government to take a role in redistribution. But such insurance markets do not exist, and hence the role of the government in redistribution. (This way of looking at matters has, of course, its problems: should we assume that, in the original state, the individual knows what preferences he is to be endowed with? How can we reasonably describe his behavior prior to being endowed with preferences?)

$$(1) \qquad U_t = U(c_{1t}, c_{2t}, c_{3t}, L_{1t}, L_{2t})$$

where

c_{1t} = the t^{th} generation's consumption in the i^{th} period of their life;

L_{1t} = the t^{th} generation's labor supply in the i^{th} period of their life.

For simplicity, we assume that the wage that an old individual receives is the same as the wage that a young person receives; both are random variables which are exogenously determined.[1]

We assume that the government can impose age-specific lump sum taxes,[2] but that all individuals within a generation must be treated the same. For the moment, we assume that all individuals within a generation are identical; and hence this constraint is of no consequence; later, when we assume that there are different individuals within a generation, this constraint will have some real consequences. We denote the lump sum tax imposed on the t^{th} generation in the i^{th} period of its life by T_{it}. (T_{it} may be negative, i.e., the government may provide a lump sum subsidy; thus a social security payment corresponds to $T_{3t} < 0$.)

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1. It would be easy to extend the model to allow the wage to depend, for instance, on the capital stock.

2. The assumption that taxes are non-distortionary is important; it implies, in particular, that what individuals are concerned about is only the present discounted value of their tax liabilities, not the timing of those liabilities. With distortionary taxes, say, on wage income, the time of the imposition of the tax is critical.

Individuals take their after-tax income and either consume it or invest it. There are three classes of securities in which they can invest:

(i) Capital (equity), the return to which is a random variable, $\tilde{\eta}$.

(ii) Government securities. We shall distinguish several government securities:

a. A short-term bond: In this model, we shall assume that there is a single non-indexed short-term government bond, and that it is (or at least may be) interest bearing: it may be thought of as interest bearing money. The price of this bond in terms of consumption goods is denoted by v , and $p = 1/v$ is the price level. The real return on holding a short-term bond purchased at time t with a nominal rate of i_t is[1]

$$(2) \qquad \frac{(1+i_t)\tilde{v}_{t+1}}{v_t} - 1 \equiv \tilde{\rho}_t \quad .$$

Even though the nominal interest is known, the real return on short-term bonds is risky, because the price level next period is unknown.

b. Short-term indexed bonds: These specify a real rate of return, r_{1t} . In other words, the nominal payment $\tilde{i}$ is whatever it must be so that[2]

$$\frac{v_{t+1}(1+\tilde{i}_t)}{q_{1t}} - 1 = r_{1t}$$

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1. At the time the individual buys a short-term bond, he knows i_t , but he does not know v_{t+1} . We follow the convention of denoting a random variable with a tilde, but will drop the tilde when the context makes clear the fact that the variable in question is stochastic.

2. If we denote the state of nature at time t by θ_t , then while the interest on short-term (unindexed) bonds is a function of θ_t , and the real return a function of θ_t and θ_{t+1} , for indexed bonds, the real return is only a function of θ_t .

where q_{1t} is the price, in terms of consumption goods, of a short-term indexed bond at date t.

c. Long-term bonds: For simplicity, we shall only consider here perpetuities, with a fixed interest payment $\check{i}$ per bond. (Other long-term bonds may be easily introduced into the model.) The real return on long-term bonds is a random variable, because the price at which the bond can be sold is uncertain. We denote the real rate of return by $\tilde{r}_{2t}$:

$$\frac{\tilde{q}_{2t+1} + v_{t+1}\check{i}}{q_{2t}} - 1 = r_{2t} \quad .$$

The aggregate supply of the short-term bonds is denoted by B. The aggregate supply of short-term indexed bonds is denoted by D_1, of long-term bonds by D_2; and the price of short-term indexed bonds in terms of consumption goods is denoted by q_1, and that of long-term bonds q_2.[1] The holdings of the young of the j^{th} security are denoted by D_{1jt}, and those of the old by D_{2jt}.

(iii) Exchange securities. These are trades between individuals both living over two periods (thus in our model, in which all individuals within a generation are identical, they are trades between the young and the middle aged);[2] the j^{th} exchange security promises to pay $e_j(\theta)$ the second period if state θ occurs, and costs Z_j the first period. Because the payment is state dependent, and because prices are state dependent, it makes

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1. The notation is chosen to make it clear how the analysis can be extended to additional government securities.

2. In a life cycle model with individuals living only two periods and all individuals within a generation being identical, there is no scope for exchange securities.

no difference at this level of generality whether we denominate the payments in consumption goods or in dollars (short-term bonds). It is more convenient to denominate them in terms of consumption goods. An exchange security which pays $e(\theta)$ in terms of consumption goods pays $e(\theta)p(\theta)$ in terms of dollars. (An Arrow-Debreu security is one which pays in only one state of nature; in all other states $e(\theta) = 0$.) An indexed loan (ignoring the possibility of default) has the property that $e(\theta)$ = constant for all θ. An unindexed loan has the property that $e(\theta)$ varies inversely with $p(\theta)$. N_{1jt} is the quantity of the j^{th} security purchased by the young at time t; N_{2jt} is the quantity purchased by the middle aged.

The individual's budget constraints. The individual maximizes his expected utility subject to his budget constraints:

a. His wage income the first year of his life is either consumed, invested, or paid to the government in lump sum taxes.

(3a) $$w_t L_{1t} = c_{1t} + A_{1t} + T_{1t}$$

where w_t is the real wage rate at t and where A_{1t} is his asset holdings the first period of his life, which consist of capital, government securities, or exchange securities.

(3b) $$A_{1t} = K_{1t} + v_t B_{1t} + \sum_{j=1}^{2} q_{jt} D_{1jt} + \sum_j Z_{jt} N_{1jt}$$

where B_{1t} is the holdings of short-term bonds by the young, and K_{1t} is their holdings of capital.

b. At the beginning of the second period, his portfolio is worth

(3c) $$W_{2t} \equiv (1+\eta_t)K_{1t} + v_t(1+\rho_t)B_{1t} + \sum_{j=1}^{2}(1+r_{jt})q_{jt}D_{1jt} + \sum_j e_{jt}N_{1jt}$$

This, plus his wage income, is either consumed, invested, or paid out in taxes:

(3d) $$W_{2t} + w_{t+1}L_{2t} = c_{2t} + A_{2t} + T_{2t} \quad ,$$

where again, his asset holdings consist of capital (K_{2t+1}), government securities (B_{2t+1}) , or exchange securities:

(3e) $$A_{2t} = K_{2t+1} + v_{t+1}B_{2t+1} + \sum_{j=1}^{2} q_{jt+1}D_{2jt+1} + \sum_j Z_{jt+1}N_{2jt+1} \quad .$$

c. In the third period of his life, he consumes his savings less any taxes (plus any social security receipts):

(3f) $$c_{3t} = (1+\eta_{t+1})K_{2t+1} + v_{t+1}(1+\rho_{t+1})B_{2t+1}$$
$$+ \sum_{j=1}^{2}(1+r_{jt+1})q_{jt+1}D_{2jt+1} + \sum_j e_{jt+1}N_{2jt+1} - T_{3t} \equiv W_{3t} - T_{3t} \quad .$$

We can thus derive the individual's consumption functions and demand for asset equations. These are of the form

$$y_1 = y_{1t}(w_t, T_{1t}; \tilde{X}_t, \tilde{X}_{t+1}; \tilde{w}_{t+1}; \tilde{T}_{2t}, \tilde{T}_{3t})$$

$$y_2 = y_{2t}(w_{t+1}, T_{2t}; W_{2t}; \tilde{X}_{t+1}; \tilde{T}_{3t})$$

where

$$y_1 \equiv \{c_{1t}, L_{1t}, K_{1t}, v_t B_t, \{q_{jt} D_{1jt}\}, \{Z_{jt} N_{1jt}\}\}$$

$$y_2 \equiv \{c_{2t}, L_{2t}, K_{2t+1}, v_{t+1} B_{2t+1}, \{q_{jt+1} D_{2jt+1}\}, \{Z_{jt+1} N_{2jt+1}\}\}$$

and

$$X_t \equiv \{\tilde{\eta}_t, r_{1t}, \tilde{r}_{2t}, \{e_{jt}\}\}$$

and where $\underset{\equiv}{w}_{2t}$ is defined by (3d), and c_{3t} is given by (3f). Consumption, labor and portfolio decisions depend on wealth and the joint probability distribution of future wages, returns on assets, and taxes.[1]

The government's budget constraint and the national income identities. Each period, the government makes decisions concerning its expenditure (G), the supply of bonds of various sorts, the interest rate which it will pay, and the taxes it will impose. It must do this within its budget constraint, which says that its expenditures (including interest payments) must be equal to its receipts (taxes plus issue of new debt).

It is easiest if we first express the budget constraint in terms of dollars, and then rewrite it using our consumption numeraire. Since government expenditures, G_t, and taxes

$$T_t = T_{1t} + T_{2t-1} + T_{3t-2}$$

are both expressed in real terms, the dollar deficit of the government is

$$p_{t+1}[G_{t+1} - T_{t+1}] + i_t B_t + \tilde{i}_t D_{1t} + \check{i} D_{2t}$$

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1. If utility functions are not intertemporally separable, then past consumption and labor decisions also are relevant.

which must be financed by new debt,

$$B_{t+1} - B_t + p_{t+1} \sum_{j=1}^{2} q_{jt+1}(D_{jt+1} - D_{jt}) \quad .$$

Dividing through by p_{t+1} and rearranging terms, we arrive at the "real" budget constraint

(4)
$$G_{t+1} - T_{t+1} = v_{t+1}B_{t+1} - (1+i_t)v_{t+1}B_t + \sum_{j=1}^{2} q_{jt+1}(D_{jt+1} - D_{jt})$$
$$- v_{t+1}(\tilde{i}_t D_{1t} + \check{i}_t D_{2t})$$
$$= v_{t+1}B_{t+1} - (1+\rho_t)v_t B_t + \sum_{j=1}^{2} (q_{jt+1}D_{jt+1} - (1+r_{jt})q_{jt}D_{jt})$$

where we have made use of (2).

Market Equilibrium

Market equilibrium requires that the demand for each kind of government security add up to its supply, and that the net demand for exchange securities be zero:[1]

(5a) $$B_{1t} + B_{2t} = B_t$$

(5b) $$D_{1jt} + D_{2jt} = D_{jt} \qquad j = 1,2$$

(5c) $$N_{1jt} + N_{2jt} = 0 \quad .$$

1. In addition, we require, of course, that the demand for labor equals the supply.

Walras' law assures us that if each individual's budget constraint is satisfied, and the government's budget constraint is also satisfied, then the national income constraint is satisfied:

$$(6) \qquad \underbrace{c_{1t} + c_{2t-1} + c_{3t-2}}_{\text{consumption}} + \underbrace{K_t - K_{t-1}}_{\text{investment}} = \underbrace{w_t(L_{1t} + L_{2t-1})}_{\text{wage income}} + \underbrace{\eta_{t-1}K_{t-1}}_{\text{return to capital}}$$

where K_t is the aggregate capital stock,

$$(7) \qquad K_{1t} + K_{2t} = K_t \quad .$$

In formulating their consumption-investment strategy, individuals must form expectations concerning the joint probability distribution of future wage rates, taxes, and returns on different securities. A rational expectations equilibrium is one in which those subjective probability distributions (conditional on whatever is observable at the time the expectations are formed) correspond to the conditional probability distributions actually generated in the equilibrium.

2.2 Neutrality Propositions

There are two classes of neutrality propositions: those which establish that a particular perturbation in the financial policy of the government has no real affects <u>and</u> no effects on the level of prices, and those which establish that a particular perturbation in the financial policy of the government has no real effects, but has effects on the level of prices. (The classical proposition concerning the neutrality of money was of the second kind; it asserted that doubling the money supplied doubled the price level, but had no further real effects on the economy.)

2.3 The First Irrelevance Theorem (Say's Law of Government Deficits)

An increase in short-term government debt, with the proceeds used to finance a reduction in lump sum taxes on the young or middle aged, followed by a decrease in the government debt, financed by an increase in taxes of the middle aged and the aged (in proportion to the reduction in taxes which they experienced the previous period) has neither real nor financial effects. An increase in the supply of government bonds gives rise to an exactly equal and offsetting increase in the demand for government bonds, provided that there are no intergenerational distributional consequences of the government policy.

Assume we are initially in an equilibrium, denoted by

$$\{y^*_{1t},\ y^*_{2t-1},\ c^*_{3t-2},\ \underline{\underline{p}}^*_t,\ \phi^*_t\}$$

where $\underline{\underline{p}}_t \equiv (v_t,\ \{q_{jt}\},\{Z_{jt}\})$ is the vector of prices, and $\phi^*_t \equiv (B^*_t,\ \{D^*_{jt}\},\ T^*_{1t},\ T^*_{2t-1},\ T^*_{3t-2},\ \{N_{jt}\})$ is the corresponding vector of government debt and taxes and private securities. Then the first irrelevance theorem is concerned with the following change in government policy: at $\hat{t}$, the government increases $B_{\hat{t}}$ by an amount $\Delta B_{\hat{t}}$, and generates thereby a surplus $v_{\hat{t}}\Delta B_{\hat{t}}$ which it distributes to the young and the middle aged, so that

$$\Delta T_{1\hat{t}} + \Delta T_{2\hat{t}-1} = -v_{\hat{t}}\Delta B_{\hat{t}} \tag{8}$$

where ΔT denotes the change in the lump sum tax liability.

Then, next period it returns the debt to its original level. To do this, it must raise additional taxes, in the amount of (measured in consumption good numeraire)

$$(1+i_{\hat{t}})v_{\hat{t}+1}\Delta B_{\hat{t}} \quad .$$

It does this by levying lump sum taxes on the middle aged and the aged in proportion to their previous tax reduction, so

(9) $$\frac{\Delta T_{1\hat{t}}}{\Delta T_{2\hat{t}}} = \frac{\Delta T_{2\hat{t}-1}}{\Delta T_{3\hat{t}-1}} \quad .$$

Thus, if a fraction α of the tax revenues the first period went to the young

(10a) $$\Delta T_{1\hat{t}} = -\alpha v_{\hat{t}}\Delta B_{\hat{t}} \ ,$$

then later they pay the same fraction of the subsequent increase in taxes

(10b) $$\Delta T_{2\hat{t}} = -\alpha(1+i_{\hat{t}})v_{\hat{t}+1}\Delta B_{\hat{t}} \quad .$$

To establish the result, we first will show that if prices remain unchanged, then the feasible consumption sets remain unchanged. If the feasible consumption sets remain unchanged, then clearly each individual will choose the same consumption plan as in the initial situation. We will then establish that when they do this, the demand for all assets (including the demand for short-term government bonds) equals the supply of all assets, and all markets clear.

To see that if prices remain unchanged the set of feasible consumption plans remain unchanged, denote by a single caret a feasible consumption investment strategy in the initial situation, and by a double caret one in the new situation. Let

(11a) $$\hat{\hat{c}}_{it} = \hat{c}_{it}; \ \hat{\hat{L}}_{it} = \hat{L}_{it} \qquad \text{all } i,t$$

(11b) $\hat{\hat{N}}_{ijt} = \hat{N}_{ijt}$ all i,j,t

(11c) $\hat{\hat{D}}_{ijt} = \hat{D}_{ijt}$ all i,j,t

(11d) $\hat{\hat{B}}_{1t} = \hat{B}_{1t}\ (1+\Delta T_{i\hat{t}}/v_{\hat{t}})$

$\hat{\hat{B}}_{2t} = \hat{B}_{2t}\ (1+\Delta T_{2\hat{t}-1}/v_{\hat{t}})$

$\hat{\hat{B}}_{it} = \hat{B}_{it}$ all i,t except i = 1,2 and t = $\hat{t}$.

Individuals do exactly what they would have done in the initial situation, except that those whose tax liability is reduced spend their extra income to purchase short-term (unindexed) government bonds.

Direct substitution into the budget constraints (3a) - (3f) makes it clear that if the first set of consumption-investment plans is feasible in the initial situation, the second set of consumption-investment plans is feasible in the new situation.

The reason for this can be easily seen. The bonds which the young have purchased with the extra revenues they receive the first period increase their assets the next period by the amount

$$v_{t+1}(1+i_{t+1})\Delta T_1 = v_{t+1}(1+i_{t+1})\alpha\ \Delta B \quad .$$

But this is exactly equal to their increased tax liability (given by (10b)).

This establishes that individuals can do as well under the new public financial policy as under the old. Exactly the same arguments can be used to establish that any consumption sequence which is feasible under the new public financial policy is feasible in the original situation. Thus, the two consumption opportunity sets are identical.[1]

Since the consumption opportunity sets are identical, it is clear that if individuals chose the single-careted values of variables in the initial situation, they will choose the double-careted values in the new situation. We now need only check that all markets clear.

Since the demand for all securities except short-term bonds has remained unchanged, if the demand for each kind of security equals the supply in the initial situation, it does in the new situation.

Similarly for all consumption and capital goods. By Walras' law, if all but one market clears, the last market must clear, thus establishing that the double-careted values do represent an equilibrium.

It may be useful, however, to examine in somewhat greater detail the market for short-term bonds.

From (11d), the total increase in the demand for short-term bonds the first period is

$$\frac{\Delta T_{1t} + \Delta T_{2t-1}}{v_t}$$

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1. In this analysis we have assumed that there are no borrowing limitations. More generally, since the real position of the individual is unaffected, one might argue that if in the new situation the individual is called upon to borrow more (to replicate the same pattern of consumption), he should be able to do so at the same terms as he borrowed previously. But this argument is not quite correct if there is any possibility of bankruptcy (in any of the relevant points in the consumption opportunity set). Full equivalence would require, for instance, that an individual could sell a claim on a (contingent) future lump sum payment. This is presently not possible. More generally, the considerations which are relevant here are analogous to those which arise in the case of the Corporate Irrelevance Theorems (Stiglitz (1969, 1974)).

which is just equal to the increase in the supply of bonds (using (8)). Hence, the demand for short-term bonds is equal to the supply of short-term bonds: the increase in government debt has given rise to an exactly equal and offsetting increase in the demand for bonds.

Several comments are in order. First, if all of the proceeds of the increased debt went to reduce the tax liabilities of the young, the reduction in the debt could have occurred either the next or the following period; the reduction in the debt would have to be financed, of course, by a levy on the same generation (the middle aged, if done the period immediately following the increased deficit; the aged, if done the following period). More generally, if each generation lives for n periods, the deficit need not be reduced until n periods later. All that is required for the validity of the irrelevance theorem is that there be no intergenerational redistribution; that is, those who benefit from the increased deficit, through lower taxes, must be the same ones who pay for the subsequent reduction in the government debt (and who pay for the interest in the intervening periods). By the same token, as we shall emphasize in the next section, whenever there are intergenerational redistributions effected through the deficit policy, then public financial policy is not irrelevant; it has real effects.

It is important to observe that the individual, when he decides to buy the additional short-term bonds, does not know the real return on these bonds; there is uncertainty concerning the price level. He does not spend the increase in his purchasing power, made possible by the reduction in his lump sum taxes, in a "balanced" way, keeping, say, the relative proportions of safe and risky assets (capital, indexed bonds, long-term bonds, short-term unindexed bonds) unchanged. The individual knows that there is risk associated with his tax liabilities in the future, and he chooses his portfolio to take this risk into account. When he does this, it turns out that he increases his demand for the securities which have increased in supply by exactly the amount that they have increased in supply.

Arguments analogous to those presented for changes in the short-term bond supply can be made for changes in the supply of other bonds. Rather than repeat the argument, we consider, in the next section, the consequences of a change in the structure of the public debt.

2.4 The Second Irrelevance Theorem

A temporary change in the structure of the government debt has no real or financial effects, provided it is accompanied with the appropriate lump sum taxes/subsidies to avoid the change having any distributive effects. The change in the structure of the debt this period means, of course, that its interest obligations next period will be altered; and this necessitates some change, either in taxes or in debt.

The perturbation in public financial policy considered in the second irrelevance theorem can be easily described. We increase, say, the supply of indexed bonds and decrease the supply of short-term (unindexed) bonds in such a way as to leave the government budget constraint still satisfied. Thus, denoting the change in the supply of indexed bonds by $\Delta D_{1\hat{t}}$ and the change in the supply of short-term (unindexed) bonds by $\Delta B_{\hat{t}}$, we require

$$(12) \qquad q_{1\hat{t}} \Delta D_{1\hat{t}} + v_{\hat{t}} \Delta B_{\hat{t}} = 0, \quad \Delta D_{1\hat{t}} > 0 , \quad \Delta B_{\hat{t}} < 0 \quad .$$

The next period, the increase in indexed bonds gives rise to additional interest payments of $\tilde{i} \Delta D_{1\hat{t}}$, while the decrease in (unindexed) short-term bonds reduces interest payments by $i\Delta B_{\hat{t}}$. Since we are concerned with temporary changes in the structure of the government debt, we assume that the next period the government decides to reduce the indexed bonds by the amount that it had increased them the previous period, and increase the (unindexed) short-term bonds by the amount it had reduced them the previous period. (The analysis for the case where the return to the ex ante structure of the government debt is postponed follows along similar lines.)

This gives rise to a deficit (or surplus) in the government budget. To finance this deficit, we impose a lump sum tax on the middle aged and the aged. The exact pattern of the imposition of this tax makes no difference. All that is required is that the individuals know the preceding period what fraction of the tax burden they will bear, i.e.:

(13) $$\Delta T_{2\hat{t}} = \alpha\,[(1+i)v_{\hat{t}+1}\Delta B_{\hat{t}} + q_{1\hat{t}+1}\Delta D_{1\hat{t}} + \tilde{i}v_{\hat{t}+1}\Delta D_{1\hat{t}}]$$

(14) $$\Delta T_{3\hat{t}-1} = (1-\alpha)[(1+i)v_{\hat{t}+1}\Delta B_{\hat{t}} + q_{1\hat{t}+1}\Delta D_{1\hat{t}} + \tilde{i}v_{\hat{t}+1}\Delta D_{1\hat{t}}]$$

To see that such a perturbation in public financial policy has no effects, we again assume that all prices remain unchanged. We then show that individuals' consumption opportunity sets are completely unaffected. Hence, they will choose the same point in the consumption opportunity set as they chose in the initial equilibrium. We then show that, when this point in the consumption opportunity set is chosen, the demand for all securities--including those whose supply has changed--equals the supply. The change in the structure of the government debt has given rise to an exactly offsetting change in the demand for different financial instruments.

To see that the consumption opportunity set remains unchanged, we again use a single caret to denote values of variables in the initial situation, and double carets to denote values of variables in the new situation. Let

(15a) $\hat{\hat{c}}_{it} = \hat{c}_{it}, \quad \hat{\hat{L}}_{it} = \hat{L}_{it}$ all i,t

(15b) $\hat{\hat{N}}_{ijt} = \hat{N}_{ijt}$ all i,j,t

(15c) $\hat{\hat{D}}_{ijt} = \hat{D}_{ijt}$ all i,j,t except j=1, <u>and</u> $t=\hat{t}$

(15d)
$$\hat{\hat{B}}_{1\hat{t}} = \hat{B}_{1\hat{t}} + \alpha \Delta B_{\hat{t}}$$

$$\hat{\hat{B}}_{2\hat{t}} = \hat{B}_{2\hat{t}} + (1-\alpha) \Delta B_{t}$$

$$\hat{\hat{D}}_{1\hat{t}} = \hat{\hat{D}}_{1\hat{t}} + \alpha \Delta D_{\hat{t}}$$

$$\hat{\hat{D}}_{2\hat{t}} = \hat{D}_{2\hat{t}} + (1-\alpha) \Delta D_{\hat{t}}$$

To check that such a policy is feasible, first observe that at time $\hat{t}$, the increased expenditures on indexed bonds, less the decreased expenditures on (unindexed) short-term bonds adds up, for the young, to

$$\alpha[v_t \Delta B_t + q_{1t} \Delta D_t]$$

which, by (12) is identically zero. Similarly for the middle aged. Second, notice that with the perturbation in their portfolios "corrected" next period, the change in the wealth of the young the second period of their life is

$$\alpha[(1+i) v_{\hat{t}+1} \Delta B_{\hat{t}} + q_{1\hat{t}+1} \Delta D_{1\hat{t}} + \tilde{i} v_{\hat{t}+1} \Delta D_{1\hat{t}}]$$

exactly enough to pay off the extra tax liabilities which they will face (equation (14a)). (Similarly for the middle aged-turned-aged.) It is thus immediate that this change in portfolio leaves them in a position to pay their extra tax liabilities and have their consumption completely unaffected (in every state of nature).

To complete the argument that the consumption opportunity sets are identical, we must again show that any point which is feasible with the new public financial policy was feasible under the original public financial policy. This follows by exactly parallel arguments. (Again, we need to point out that the two consumption opportunity sets will be equivalent if there are no binding non-negativity constraints. Since it may be more difficult for individuals to issue indexed bonds or perpetuities than to issue short-term bonds, non-negativity constraints may be more relevant here than in the previous case.)

Since the consumption opportunity sets are the same, if the individual chooses the careted values of variables in the original situation, he will choose the double-careted values in the new situation.

The total increase in the demand for indexed bonds at time $\hat{t}$ is

$$\alpha \Delta D_{1\hat{t}} + (1-\alpha)\Delta D_{1\hat{t}} = \Delta D_{1\hat{t}} \quad ,$$

the increase in the supply of indexed bonds, while the total decrease in the demand for short-term (unindexed) bonds is

$$\alpha \Delta B_{\hat{t}} + (1-\alpha)\Delta B_{\hat{t}} = \Delta B_{\hat{t}} \quad ,$$

just equal to the decrease in the supply. Since the demand for all other securities (and for all commodities) remains unchanged, if in the initial situation all securities and goods markets cleared, they do in the new situation.

This result has an important implication. It means that changes in the number of indexed bonds have no consequences, either real or financial. Only if the issuance of indexed bonds opens up trading opportunities for individuals who are alive contemporaneously over two periods to exchange risks which they otherwise could not can the provision of indexed bonds by the government have any real effects. It is obvious that a sufficient condition for the government provision of indexed bonds to have no real effects is that there be a complete set of securities at date t whose payoffs are contingent on the state at $t+1$ (a condition which is far weaker than a complete set of Arrow-Debreu securities markets). An alternative sufficient condition is that the private market provide an indexed bond (or that there exists a linear combination of securities which provides a safe real return).

A third set of circumstances in which the public provision of indexed bonds does not matter, even when such bonds are not provided in the private market, are those in which, were there an exchange market for indexed bonds, there would be no trade in them; in such situations, we say that an indexed bond market is redundant.[1] A sufficient condition for the redundancy of the indexed bond market is that individuals be risk neutral.[2]

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1. Newbery and Stiglitz (1982) introduce the concept of redundant markets in their analysis of the constrained Pareto optimality of markets with rational expectations but an incomplete set of risk markets.

2. That is, individuals' utility functions are of the form $c_1 + c_2 + c_3$. If the indirect utility function corresponding to $u(c_1, c_2, c_3)$ can be written as $v(I, g_1, g_2)$, where g_1 is the intertemporal price between the first and second period, and g_2 is the intertemporal price between the first and third period, and I is (the present discounted value of) lifetime income, income risk neutrality implies that $v = I\psi(g_1, g_2)$. In general, this is not sufficient to ensure the redundancy of indexed bond markets. (Cf. Newbery-Stiglitz (1982), Stiglitz (1982).)

It should be equally obvious that, in general, if for some inexplicable reason an indexed bond (or its equivalent) were not provided in the exchange market, and such a security is not redundant, then the government provision of this security will have real effects. Provided the government has sufficient flexibility in its imposition of lump sum taxes and subsidies, the provision of these indexed bonds will be a Pareto improvement.

2.5 The Third Irrelevance Theorem

An increase in the nominal interest rate on short-term (unindexed) government bonds financed by an increase in the supply of short-term bonds has financial effects, but no real effects. The price level (v) changes, and consequently the price of other securities relative to the short-term bond changes; but the price of these other securities relative to consumption goods remains unchanged.

Assume the government increases the interest rate on short-term bonds outstanding at date t from $\hat{i}_t$ to $\hat{\hat{i}}_t$. This generates a deficit the next period of $(\Delta i_t)B_t$, where

$$\Delta i_t = \hat{\hat{i}}_t - \hat{i}_t \quad .$$

Now we assume that the real return on all securities remains unchanged, $q_{j\tau+1}$ $(j = 1,2)$, all τ is unchanged, v_t remains unchanged, and the real value of government debt at all subsequent dates is unchanged, i.e.:

$$\hat{\hat{v}}_\tau \hat{\hat{B}}_\tau \equiv \hat{v}_\tau \hat{B}_\tau \quad . \tag{16}$$

It is immediate from (4) that under these conditions the government's budget constraint is satisfied now if it was satisfied originally. Since from the structure of the demand functions individuals' real demands for securities at all dates (e.g., $v_\tau B_{i\tau}$) is a function only of real returns, taxes and wages (all of which remain unchanged), real demands are unchanged. Since by hypothesis real supplies are unchanged, if demand equalled supply initially, it still does. Note that for $\tilde{\rho}_\tau$ to remain unchanged requires (from (2)) that

$$(17) \qquad \frac{v_{\tau+1}}{v_\tau}$$

remain unchanged, for $\tau \geq t+1$. This, together with our earlier result ((16)-(17)), implies that an increase in the interest rate at time t increases prices (decreases v) at all subsequent dates proportionately, and increases the supply of bonds in proportion to the decrease in the price of short-term bonds (v) .

It immediately follows that any sequence of changes in the interest rate paid on short-term bonds has no real effects.

2.6 Combinations of Policies

The three irrelevance propositions can be combined to consider a variety of financial policies of the government which can be viewed as combinations of the three particular policies considered. Thus, if the government decides to issue indexed bonds at time t , to be retired at time $t+1$, then, provided the appropriate lump sum taxes are imposed to offset any distributional consequences, the policy has neither real nor financial (price) effects.[1]

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1. We can also make a direct argument for the irrelevance of this financial policy, as we noted earlier.

Such a change can be decomposed into two steps. The government issues short-term unindexed bonds, with the proceeds used to reduce lump sum taxes on the young or middle aged. By the first irrelevance theorem, such a change has neither real nor financial consequences. Then the government temporarily exchanges the increase in the short-term unindexed bonds for short-term indexed bonds, again imposing taxes (the next period) on the (then) middle aged and old to finance the deficit which will then result. By the second irrelevance theorem, such a change has no real or financial consequences.

As a second example, suppose that the government simultaneously increases the supply of short-term bonds and increases the interest rate it pays on these bonds (perhaps because it mistakenly believes that it must in order to sell the increased supply of these bonds). Assume that at the same time it increases the supply of bonds it announces that it will shortly retire the additional bonds, in such a way as to have no intergenerational distributional effects. Then, such a change can be thought of as a combination of a temporary increase in the supply of short-term bonds (which, by the first irrelevance theorem, has no effects) and an increase in the interest rate (which, by the third irrelevance theorem, has no real effects but does increase the rate of inflation).

2.7 An Alternative Interpretation

Note that if individuals believe that the rate of inflation is going to be higher as a result of the increase in the supply of short-term bonds, then equilibrium can be restored (and their beliefs confirmed) if the interest rate which the government pays rises in accord with their expectations.

To put it another way, though we have presented the analysis as if the government sets the interest rate on government bonds, we could have phrased the analysis in a slightly different way; rather than announcing interest rates which the government will pay at different dates in different contingencies, we could have announced the corresponding bond supplies, and let the market determine the interest rates which are consistent with equilibrium. (This way of looking at the matter has a slightly greater sense of realism, since the interest rates on short-term bonds are determined in competitive auction markets, in response to government announcements concerning the supply of bonds.)

III. The Relevance of Public Financial Policy

In general, any financial policy other than those presented in the preceding section will have both real and financial effects. Public financial policy is not irrelevant. Since public financial policy matters, it is important to ask what are the relative merits of alternative financial policies. The objective of this and the next section is to show that financial policy is relevant and to provide some insights into the consequences of alternative policies.

To do this, we simplify the general model presented in the preceding section. We assume individuals live for only two periods (which eliminates the possibility of exchange securities), working only in the first.[1]

We illustrate our general proposition concerning the relevance of public financial policy by considering the kind of financial policy discussed in the

1. Thus, the model which we analyze here is a slight extension of that presented in Atkinson and Stiglitz (1980).

first irrelevance theorem. The government increases its debt at one date, t_1, with the proceeds distributed as lump sum payments (either to the young or the old); and at some later date, t_2, reduces the debt. To do this, it again raises taxes. The dates t_1 and t_2 are sufficiently far apart that quite different generations are involved; there are intertemporal redistribution effects. (In intervening periods it increases the short-term bond supply to pay the additional interest costs.) The question is, under what conditions will the change in debt policy have no real effects, e.g., on the rate of capital accumulation?[1]

There is one special case that may be helpful in developing our intuition as to why public financial policy is, in general, relevant. Assume that there is no risk, and bonds and capital are thus perfect substitutes. Clearly, they must yield the same return. This in turn implies that if the change in debt policy is to have no effect, the price level in the new equilibrium must be the same as the price level in the old equilibrium at every date t. But this implies that the real supply of bonds must have increased in the period $t_1 < t < t_2$. But for those generations between t_1 and t_2, neither their taxes[2] nor wages are changed, and thus their savings must remain unchanged at each date. But if savings are unchanged, while real debt is increased, capital accumulation must be decreased. It is impossible for financial policy not to matter.

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1. There is a prima facie case that such a change will have a real effect on the intergenerational distribution of welfare, except if there are exactly offsetting changes in private bequests, as Barro has argued. For several theoretical objections to Barro's conclusions, see Stiglitz (1982).

2. Except to the slight extent necessary to finance the interest on the additional bonds.

Similarly, if the real debt remained unchanged (so v_t changes inversely to B_t),[1] at t_1-1 individuals would recognize that the return to holding bonds will be lower for the next period as a result of the increased debt. But this would decrease their demand for bonds. Market equilibrium at t_1-1 would then require that bond prices change at that date; but then the real bond supply at that date is altered, and this would have real effects, e.g., on capital accumulation.

Exactly parallel arguments hold if there is uncertainty, so that debt and capital are not perfect substitutes. To see this most vividly, we restrict ourselves to policies which leave i_t unchanged, and leave the mean real return to short-term bonds unchanged (so that the mean rate of inflation also remains unchanged).[2] The government announces that at some date $t+1$ in the future it will alter the financial policy from what it had previously planned. It will increase the short-term debt in some state, and decrease it in another. (In all other states and dates, financial policy is unchanged.) Moreover, the surplus (deficit) thus generated will be distributed to the young of the $t+1^{st}$ generation. We show that, unless the marginal utility of income in the two states is identical (the individual is risk neutral), such a policy has real effects.

If we simplify our general model and assume that the individual has a separable utility function of the form

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1. This corresponds (for our model) to the quantity theory, i.e., the price level is inversely proportional to the supply of outside short-term bonds (money).

2. It should be clear that our analysis extends to more general changes in public financial policy.

$$U_1(c_1, L) + U_2(c_2) \quad ,$$

and for notational simplicity we assume the government only issues short-term bonds (there are no long-term or indexed bonds), then we can write the t^{th} generation's first-order condition for the optimal investment portfolio

$$EU_2' \; [(1+\eta_t)K_t + (1+\rho_t)B_t - T_{2t}](\rho_t - \eta_t) = 0 \tag{18}$$

(where, it will be recalled, η_t is the real return on capital).

We shall consider two cases. In the first, the price of bonds at $t+1$ changes in the two states, so ρ_t changes. Then, the individual's portfolio condition (18) will still be satisfied if and only if[1]

$$\Delta\{U_2'^{a}[c_2^a] \; (\rho_t^a - \eta_t^a)\} + \Delta\{U_2'^{b}[c_2^b] \; (\rho_t^b - \eta_t^b)\} = 0 \tag{19}$$

(where the superscripts a and b denote the two states with altered prices). Recalling our hypothesis that the mean return is the same, this implies for a small change in ρ_t, that[2]

$$B_t U_2''^{a}[\rho_t^a - \eta_t^a] + U_2'^{a} = B_t U_2''^{b}[\rho_t^b - \eta_t^b] + U_2'^{b} \tag{20}$$

This will not, in general, be satisfied, except if $U'' = 0$, i.e., the individual is risk neutral.

Assume, on the other hand, that the price of bonds at $t+1$ does not change. The increase in the supply of bonds results in an increase in the demand for bonds by the young (because of the lump sum transfer payment made

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1. Assuming the two cases are equally likely. The modification for the more general case is straightforward.

2. We are making use of the assumption that the mean rate of inflation remains unaltered.

to the young with the proceeds of the bonds), but the increase in the demand for bonds will be less than the increase in supply provided only that first period consumption and equities are normal. (That is, we require that a decrease in the lump sum taxes by $\Delta T_{1t+1} = -v \Delta B_{t+1}$ leads to an increase in the real demand for short-term bonds by an amount less than $\Delta T_{1\tau+1}$, a natural assumption.)

Hence, except under the strong and unrealistic hypothesis of risk neutrality, a mean inflation preserving change in financial policy has real effects.

3.1 Financial Policy and Intergenerational Risk Sharing

In the preceding section we established that, except under the special conditions specified in theorems 1 through 3, public financial policy has important redistributive consequences, and whenever public financial policy has intergenerational redistributive consequences, public financial policy matters. The level of capital accumulation, for instance, will depend on public financial policy.

Different public financial policies will have different implications for how the risks faced by society are shared among different generations. The intergenerational redistributions to which variations in debt policy give rise can be used to provide a kind of insurance which the market cannot provide (since members of one generation cannot make contracts with members of another generation, except through the government). The intertemporal distribution of risk is presumably one of the objectives of a well designed social security program; as we have asserted before, it is impossible to separate out debt policy from social security. All public financial policies must be examined together.

Thus, if the present generation is lucky, and experiences, say, a high wage or a high return on capital, it can share this "luck" with succeeding generations. In return, generations which have particularly bad luck (say, a low wage), can be partially compensated by an increase in social security payments to the elder individuals in that generation. (It should be clear that this insurance argument involves no altruism, and thus is distinctly different from the considerations which motivate intergenerational transfers of income based on children's welfare entering parents' utility functions.)

In this section we shall show how different financial policies give rise to different stochastic processes for prices (and the other relevant variables in the economy), and how, as a result, different financial policies affect the extent to which intertemporal risks are shared among different generations.

We shall consider three polar policies: the first and simplest keeps the real value of debt (vB) fixed; the second keeps the price level (v) fixed and has the debt supply change by whatever amount is necessary to ensure that; and the third keeps the debt fixed (and corresponds to the Friedman rule for this economy, where there is no growth).

There is a widespread belief that the last rule is the best rule. Variations in the debt (money supply) lead to variability in the level of economic activity, and make it difficult for firms to distinguish variations in demand arising from variations in, say, tastes (real changes in the economy) from variations in demand arising from monetary disturbances. In the simple model which we have developed in this paper, these beliefs are shown to be incorrect. A constant supply of government debt (or money) forces individuals to absorb a considerable amount of risk which could be shared better (among different generations) by alternative financial policies. Thus, if the next generation has a high wage, this leads to a high demand for assets in general, including financial assets; as a result, the value of government bonds (relative to goods) increases; but conversely, if the next generation has a low wage, the demand for financial assets is reduced, and the price of bonds (relative to consumption goods) is reduced; some of the consequences of variations in the $t+1^{st}$ generation's wages are effectively borne by the members of the t^{th} generation. This, we will see, is also true of the other financial policies which we consider. The issue is thus not whether one policy or another eliminates risk; rather, the issue is, which of the simple policies being considered is most effective in sharing the risks among different generations. We shall show that for the model investigated here, the policy of a constant real debt is preferable to the other two policies.

a. Constant real money supply. This is the easiest policy to analyze. To generate a constant real money supply, the government imposes a lump sum tax on the young, used to retire the government debt, whenever the wage exceeds $\bar{w}$, the mean wage, and conversely when the wage is less than $\bar{w}$.[1] For simplicity, we set $i_t = 0$ for all t. Thus, the government sets

$$(21) \qquad -\Delta B = (w_t - \bar{w})/v_t \quad .$$

As a result, the net income (after paying lump sum taxes) of each generation is constant, at $\bar{w}$. Notice that this implies that the debt follows a random walk. Since $Bv = k$,

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1. For simplicity, throughout this section we assume that labor supply is fixed.

$$\frac{\Delta B}{B_t} = -\frac{w_t - \bar{w}}{v_t B_t} = -\frac{w_t - \bar{w}}{k} .$$

Moreover

$$\frac{v_{t+1}}{v_t} = \frac{v_{t+1} B_t}{v_t B_t} = \frac{v_{t+1} B_{t+1} - v_{t+1} \Delta B}{v_t B_t} = 1 + \frac{w_{t+1} - \bar{w}}{k} .$$

The probability distribution of the return to debt is the same every period, and hence, since income (after tax) is the same, the real demand for government debt is indeed fixed.

One might be tempted, in this situation, to say that the change in debt (government deficits) causes the change in prices; but this would be misleading. The exogenous event in the model is the level of wages; government policy adjusts to the change in wages in such a way as to result in prices moving proportionately to the debt; but prices would change, as we have emphasized, even in the absence of a change in the debt supply.

The variability of consumption may be easily calculated. Since real income is fixed the first period, there is no variability in c_1 . A given fraction of income, s , will be saved,[1] and of this, a particular fraction α will be invested in capital and the remainder in government bonds. Thus,

$$(22) \qquad c_{2t} = s\bar{w}[\alpha(1+\eta_t) + (1-\alpha)(1+\rho_t)]$$

$$= s\bar{w}[\alpha(1+\eta_t) + (1-\alpha) \frac{v_{t+1}}{v_t}]$$

1. Since net income, after taxes, is constant, and since the rate of return to bonds and equities is constant, savings rates and portfolio allocations do not change over time.

$$= s\bar{w}[\alpha(1+\eta_t) + (1-\alpha)\left(1 + \frac{w_{t+1} - \bar{w}}{k}\right)] \quad .$$

Note that consumption in the second period of the t^{th} generation individual depends not on his own wages, but on the wages of those working when he is old. The higher their wages, the greater his consumption. We can now calculate

(23) $$\text{var } c_{2t} = s^2\bar{w}^2[\alpha^2 \text{ var } \eta + (1-\alpha)^2 \frac{\text{var } w}{k^2}]$$

$$= s^2\bar{w}^2 \alpha^2 \text{ var } \eta + \text{var } w$$

(since $Bv = (1-\alpha)s\bar{w} = k$). There is an alternative way of calculating the variance of c_{2t} . Since c_1 and K are fixed, the variance of c_{2t} is simply the variance of national income.

(24) $$\text{var } c_{2t} = \text{var } w + K^2 \text{ var } \eta \quad .$$

b. Constant price level. Assume the government adjusts the deficit every period in such a way as to keep the price level constant; it uses the proceeds (finances the deficit) with a lump sum distribution to (tax upon) the aged. The individual saves a fraction s of his first period income, and of this he invests a fraction α in capital and the remaining in debt.[1] We allow s to be a function of w, s(w) . Without loss of generality, let $p = v = 1$ for all t . For the demand for government bonds to equal the supply, we require that

(25) $$s(\tilde{w}_t)(1-\alpha)\tilde{w}_t = \tilde{B}_t \quad .$$

1. In contrast to the previous case, where we proved α and s constant, here we simply assume that α is constant and s a function of w . But see fn. 2, p. 40.

It immediately follows from the government's budget constraint that if the changes in debt are offset by changes in payments to the aged,

(26) $$-T_{2t} = B_{t+1} - B_t - i_t B_t = (1-\alpha)[s(w_{t+1})w_{t+1} - s(w_t)w_t] - i_t B_t$$

and hence

(27a) $$c_{1t} = (1-s_t)\tilde{w}_t$$

(27b) $$c_{2t} = s_t\, \alpha\tilde{w}_t(1+\eta_t) + (1-\alpha)s_{t+1}w_{t+1}$$

$$= K_t(1+\eta_t) + w_{t+1}s_{t+1}(1-\alpha)$$

(from the national income identities). Now, there is variability in the individual's income in both the first and second periods of his life, and his consumption the second period depends both on his wage and the wage the next period. For small variances, we can calculate the variance of c_{1t} and c_{2t} in a straightforward manner:

(28a) $$\text{var } c_{1t} = \text{var } (1-s(w))w \simeq (1-s - s'\bar{w})^2 \text{ var } w$$

(28b) $$\text{var } c_{2t} = (1-\alpha)^2(s + s'\bar{w})^2 \text{ var } w + \bar{K}^2 \text{ var } \eta + (1+\bar{\eta})^2 \text{ var } K$$

$$= (s + s'\bar{w})^2(\alpha^2(1+\bar{\eta})^2 + (1-\alpha)^2) \text{ var } w + (\alpha s w)^2 \text{ var } \eta \quad .$$

Suppose the government chooses i (the rate of return on government debt) in such a way as to make the average value of K the same as it is in the situation with a constant real debt. Since $\bar{K}$ is the same, and average income of the young is the same in this regime as in the previous, $s\alpha$

must be the same. We postulate that α is the same, implying that the average values of c_{1t} and c_{2t} are the same. But while the variance of c_1 is higher with the constant price rule, the variance of c_2 may be higher or lower with the constant real debt rule. (Compare (23) and (28).)

Consider first the limiting case with $s = 1$. Then straightforward calculations show that the variance of c_{2t} is lower with the constant real debt policy provided only that

$$1+\bar{\eta} > \frac{\sqrt{1-(1-\alpha)^2}}{\alpha}$$

If government debt constitutes 15% of individuals' savings, this implies that when the mean real return on capital exceeds 16%, the policy of a constant real debt is unambiguously preferable.

More general comparisons require a specification of the utility function. Assume we have a utility function of the form

$$U = U(c_1) + \frac{U(c_2)}{1+\delta} .$$

Then, the loss in welfare from the consumption variability can be approximated by, assuming $U''(c_1)/U'(c_1) \approx U''(c_2)/U'(c_2)$ (which will be true if $\bar{\eta} \approx \delta$ and var η is small)

$$\frac{a}{2}\left[\text{var } c_{1t} + \frac{1}{1+\delta}\text{ var } c_{2t}\right] \approx \frac{a}{2}\text{ var } w\{(1-s-s'\bar{w})^2$$

$$+ \frac{(s+s'\bar{w})^2((1-\alpha)^2 + \alpha^2(1-\bar{\eta})^2)}{1+\delta}\} + \frac{\bar{K}^2 \text{ var } \eta}{1+\delta}\Big]$$

where

$$a = -\frac{U''}{U'}\,, \quad \text{the Arrow-Pratt measure of absolute risk aversion.}$$

This should be contrasted with the loss of welfare in the preceding case. The loss of welfare is greater with a policy of a constant price level than with a policy of a constant real debt, under even weaker conditions than those derived for $s = 1$.[1,2,3]

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1. We require

$$(1-s - s'\bar{w})^2(1+\delta) + (s + s'\bar{w})^2((1-\alpha)^2 + \alpha^2(1+\bar{\eta})^2) \geq 1$$

i.e, $(s + s'\bar{w})^2 (1+\delta)$

$$+ (s + s'\bar{w})^2(1-2\alpha + \alpha^2 + \alpha^2(1+2\eta + \eta^2)) - 2(s + s'\bar{w}) - 2\delta(s + s'w)$$

$$+ \delta \geq 0 \ .$$

2. While in the previous analysis of the constant real debt policy the result that the savings rate was a constant held for all utility functions, here we have simply assumed a savings function, without deriving it. The difficulty in deriving the optimal savings behavior arises from the random lump sum tax imposed on the individual in the second period of his life. Still, it is easy to show that if the distribution of w_{t+1} is either independent of w_t or a function only of w_t , that s_t and α_t will simply be functions of w_t . It is possible to analyze some special cases.

(i) If individuals obtain utility only from consumption in the second period, $s = 1$. α will then be a constant if the individual has constant relative risk aversion, and the distribution of w_{t+1}/w_t is independent of t . (We thus need to assume that w_t is a random walk, in contrast to the rest of this paper, where we have assumed that w_t are independently and identically distributed random variables.) Alternatively, if there is constant absolute risk aversion, then the demand for risky assets is a constant, so that instead of (25) we obtain

$$w_t - \bar{K} = B_t \quad .$$

In this limiting case, the variance associated with the constant price rule and that associated with the constant real debt rule are identical.

(ii) If there is no capital--a pure consumption-loans model--then $\alpha = 0$. Then if individuals have a quadratic utility function, consumption will be a linear function of w_t so that, instead of (25) we obtain

$$\beta + b\, w_t = B_t$$

and

$$c_{1t} = (1-b) w_t - \beta$$

$$c^{2t} = b\, w_{t+1} + \beta \quad .$$

3. We have limited our discussions to the case where the proceeds of the increase in the government debt are used to finance a lump sum subsidy to the aged. It is possible to show that with the alternative financial policy, of distributing the proceeds of the increased government debt to the young, it is not possible to maintain (forever) a constant price level, under plausible utility functions.

   Assume first that all individuals have constant absolute risk aversion. Then the demand for capital is fixed, independent of income. Thus, the variations in the debt must be large enough to accommodate the variations in income, i.e., if $v_t = 1$, $i = 0$,

$$B_t = w_t + B_t - B_{t-1} - \overline{K}$$

$$B_{t-1} = w_t - \overline{K} \quad .$$

But since there is no way, at t-1 to know w_t , this policy is not implementable: there is no policy of the form considered here which can maintain a constant price level. The reason for this is simple. Increases in the supply of debt generate an increase in demand on a dollar-for-dollar basis.

   Assume, in contrast, that all individuals have constant relative risk aversion. Then

$$B_t = \{w_t + B_t - B_{t-1}\}(1-\alpha)$$

$$= \frac{(1-\alpha)}{\alpha} (w_t - B_{t-1})$$

and

$$K_t = \frac{\alpha}{1-\alpha} B_t$$

so

$$\Delta K_t = \frac{\alpha}{1-\alpha} \Delta B_t \quad .$$

Define $B^*_t = B_t - (1-\alpha)\overline{w}$.

Then

$$(29) \quad B^*_t = \frac{(1-\alpha)(w_t - \bar{w}) - B^*_{t-1}}{\alpha}$$

The process (29) can best be studied by taking a continuous time approximation, which generates a process of the familiar Ornstein-Uhlenbeck form. In steady state, ΔB^*_t has zero mean and variance $\frac{1}{2}\sigma_w^2(1-\alpha)^2/\alpha^2$. This ignores, of course, the non-negativity constraints on K and on c . Taking these into account, it is apparent that a policy of keeping price constant is not, in the stipulated circumstances, feasible. Even before the policy breaks down, however, the variance in income to which it gives rise is likely to be greater than for the policy of constant real money supply.

(c) Constant nominal money supply. Though this is purportedly the "simplest" policy, it is not the simplest policy to analyze. The probability distribution of the return to bonds will not be the same at each date, and hence, even if the utility functions have constant elasticity, the demand for bonds will not be a constant proportion of savings. To see this most simply, assume there are two equally likely states with wages w_1 and w_2. For simplicity, assume the probability distribution of the return to capital is the same in both. For simplicity, let us assume $s = 1$ (individuals get no enjoyment out of consumption the first period of their lives). Equilibrium is characterized by a value of v^a, K^a, v^b, and K^b satisfying

$$EU'(K^a(1+\eta) + v^a B)((1+i) - (1+\eta)) + EU'(K^a(1+\eta) + v^b B)((1+i)\frac{v^b}{v^a} - (1+\eta)) = 0$$

(30)
$$EU'(K^b(1+\eta) + v^a B)(\frac{v^a}{v^b}(1+i) - (1+\eta)) + EU'(K^b(1+\eta) + v^b B)((1+i) - (1+\eta)) = 0$$

$$K^a + v^a B = w^a$$

$$K^b + v^b B = w^b$$

Where we have assumed interest payments are financed by lump sum taxes on the aged. In the good state, the demand for bonds is high because savings are high. However, if the economy moves to a poor state next period, there will be a fall in the value of bonds. Hence, although individuals normally invest more in bonds in the good state, as a proportion of savings, they invest less. Thus K_t is more variable than w_t, e.g., c takes on four values, depending on the "state":

$$c^{aa} = (w^a - v^a B)(1+\eta) + Bv^a$$

$$c^{ab} = (w^a - v^a B)(1+\eta) + v^b B$$

(31)
$$c^{bb} = (w^b - v^b B)(1+\eta) + Bv^b$$

$$c^{ba} = (w^b - v^b B)(1+\eta) + v^a B$$

Since

$$\text{var } c \approx (1+\bar{\eta})^2 (\text{var } w + B^2 \text{ var } v - 2B \text{ cov } (w,v))$$

$$+ B^2 \text{ var } v + \bar{K}^2 \text{ var } (1+\eta)$$

and it is clear that the policy of a constant debt (B) induces a greater variance in consumption than does the policy of constant real money supply, provided $\bar{\eta}$ is large enough.

In this section, we have compared three alternative, simple financial policies. None of these policies are, however, optimal. In Stiglitz (1982), I show how the optimal intertemporal distribution of welfare can, in fact, be implemented through the appropriate set of public financial policies. I show, moreover, that to implement the optimal financial policy, one needs only to have sufficient flexibility in the structure of social security payments and a single public financial instrument; additional bonds (including indexed government securities) make no difference. However, if there are restrictions on the extent to which social security payments (taxes) may vary from year to year, then additional financial instruments are necessary in order to implement the optimal intertemporal distribution of welfare.[1]

IV. Monetary and Debt Policy

In this paper, I have assumed that there is a single, interest bearing financial asset, which presumably can be used for transactions purposes as well as a store of value. Recent developments in monetary institutions (interest bearing checking accounts) makes this assumption not as unreasonable as it might have seemed a decade or so ago. How important is it that (until recently) demand deposits did not earn interest? Will the widespread use of CMA accounts have a fundamental effect on the structure of the economy? It is plausible that what remains of non-interest bearing financial assets--cash and currency used to pay those taxi cabs who still do not take VISA cards or checks--will be the driving force in the determination of economic behavior that monetarists have claimed in the past?

These questions cannot be settled by theoretical arguments. Theoretical analyses can establish whether the presence of a non-interest bearing financial asset which is used to facilitate transactions has qualitative effects; they cannot, however, assess the quantitative importance of any effects noted.

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1. The characterization of the optimal intergenerational scheme for risk sharing is not an easy matter. In one case, we can borrow results from the theory of optimal buffer stocks to provide a fairly complete characterization. Assume that the return to capital is not random, that individuals have an inelastic labor supply, and that they only consume the second period of their lives. Assume, moreover, that w_t is i.i.d. Then the stock of resources available for consumption or investment at date t is $S_t = w_t + K_{t-1}(1+\overline{\pi})$, where $K_t = S_t - c_t$. The optimal intertemporal consumption plan entails a rule which maximizes $E\Sigma U(c_t)(1/1+\delta)^t$ s.t. $K_t \geq 0$. It is known that the optimal savings rule is highly non-linear. Note that none of the financial rules we have considered are of the required form. See Newbery-Stiglitz (1981).

If there were only one financial asset, non-interest bearing money, our analysis would be completely unaffected. We established earlier that corresponding to any equilibrium, with a particular interest rate at each date, and a particular level of prices at each date, there were an infinity of equivalent (in a real sense) equilibria, which differed in the interest rate they paid and in the price level. Among the set of equilibria is one with the nominal interest rate equal to zero.

However, if there are two financial assets, one of which is non-interest bearing while the other yields a return, it is obvious that, if the former asset is to be held by anyone, it must have some property which makes it more attractive (at the same yield) than the interest bearing asset. It is conventionally postulated that the non-interest bearing financial asset can be more readily used for transactions purposes. We write the demand function for money as

$$(32) \qquad M_t^d = M(p_t, p_{t+1}, \ldots; w_t, w_{t+1}, \ldots; i_t, i_{t+1}, \ldots; \eta_t, \eta_{t+1}, \ldots; I_t, I_{t+1}, \ldots; T_t, T_{t+1}, \ldots) \quad .$$

The demand for money is a function of prices at date t and at all subsequent dates, the yield on interest bearing assets at date t and at all subsequent dates; the yield on equities at date t and at all subsequent dates; taxes and transfers at date t and at all subsequent dates; and the levels of real income at date t, I_t, and at all subsequent dates.

Two properties of this demand function should be noted. First, the level of income appears explicitly to remind us of the transactions motive for holding money, but it should be emphasized that this is probably not an adequate reduced form representation; for instance, changes in tax or debt policy may induce changes in the sets of transactions that occur; these generate changes in the demand for money which are quite distinct from the change that they might induce in real income; similarly, changes in risk will not only have a direct effect on portfolio composition, but also may have an effect on the transactions demand for money. Since our main objective is to argue that the introduction of a second, non-interest bearing asset implies that government financial policy will not be neutral, the oversimplified version of the demand for money which we will employ will suffice for our present purposes.

Second, we postulate that the demand for money is homogeneous of degree one in all prices. Increasing prices at all dates leaves unchanged the return on money, and is simply a change in units. This is, of course, well known. But it should also be noted that the demand for money is <u>not</u> homogeneous of degree one in the current price. Changing the current price does increase the transactions demand for money; but if subsequent prices remain unchanged, the real return on money is reduced, and the "asset" demand for money will, in general, decrease. There may, of course, be some special specifications of utility functions and transactions technology for which the return on money does not affect its demand, but for which the only determinant of the demand for money (besides the level of income) is the opportunity cost associated with holding the non-interest bearing asset (money) rather than the interest bearing financial asset (i_t).

Under further restrictions, we might be able to derive a demand function for money in which the entire impact of future events (taxes, interest rates, yields on equities) on the demand for money could be summarized in, say, a wealth variable. We could then write down a demand function for money

$$\frac{M_t^d}{P_t} = M^d(I_t, i_t; W_t) \tag{33}$$

which is of the kind conventionally seen in undergraduate texts. It is important to emphasize, however, that a large number of not clearly articulated assumptions had to be introduced into the analysis to reduce the general demand function for money down to the simple form postulated above.

Consider now the impact of an open market operation which entails the government exchanging a bond at t_1 for money, which it will subsequently undo at a later date t_2. We focus our attention on an economy with infinitely lived individuals, to avoid the intertemporal distribution issues raised earlier. We wish to show that such a change will, in general, have real effects on the economy.

Assume that it has no real impact, i.e., real incomes and real returns are unchanged. This necessitates that the price level at time t increases proportionately (so real holdings of money remain unchanged; otherwise, real expenditures on transactions would change). The price level needs to change proportionately not only at t_1, but at all dates between t_1 and t_2. This, in turn, implies that if the real return to holding bonds is to be unchanged at t_1 and t_2, i_{t_1} and i_{t_2} must change to offset the change in the rate of change in prices. But a change in i_{t_1} and i_{t_2} will, in general, generate a change in the demand for money. Only if the demand for money is invariant to the financial opportunity cost of holding money (i.e., the demand for money is interest inelastic) will it be neutral. This is, of course, what monetarists have assumed all along. The question is, is there any reasonable specification of utility functions and transactions technologies which generates this? One can, of course, write down models with the individual needing a fixed amount of money to engage in each transaction; but such models really do little more than assume what is to be proved. The recent innovations in financial institutions (CMA accounts) suggest that significant changes in the opportunity cost of holding money will indeed result in significant changes in the amount of non-interest bearing financial assets which individuals are willing to hold for transactions purposes.[1]

We have ignored so far the possibility that there is another financial asset, produced in the private sector, which can be a substitute, for transactions purposes, for the non-interest bearing government financial asset. For simplicity, let us assume it is a perfect substitute. For both of these assets to be held, it must yield a return of zero. The return to the suppliers of this asset is thus i_t . Assume they have a horizontal supply schedule, at i^* . Then, for an interior solution, the market equilibrium rate of interest must initially be at i^* , and must remain so after the perturbation. Assume the change in the private supply of money just offsets the change in the public supply of money, so that the price level remains unchanged. But now, the supply of bonds is reduced. In our earlier analysis, corresponding to any change in the supply of bonds, there was a corresponding change in the

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1. Some of these changes may not be completely reversible: even if the opportunity cost declines, individuals will have discovered that they "need" less non-interest bearing money than they had previously thought.

demand for bonds. This will be the case here only if money and bonds are perfect substitutes, for asset purposes, in individuals' portfolios, i.e., if individuals are indifferent about whether they receive the return on their assets directly or through savings in transactions costs. In any case, there will be a real effect on the economy through the increase in resources spent on transactions costs (the private money supply). Only if the private money supply is costless to produce (so i^* is zero), will there be no impact, but then the equilibrium return on bonds will be zero.[1]

We can similarly show that an anticipated money rain (a lump sum distribution of money to individuals in the economy) will, in general, have real effects. For again, assume it does not. Then, at t_1, the date of the money rain, prices must rise above what they would have been otherwise; hence the return to money has been altered. For the real return to bonds to remain unchanged, the rate of interest (i) must change; but unless the demand for money is completely interest inelastic, this will change the demand for (real) money at time t_1.[2]

If the private money supply acts as a perfect substitute for the public money supply, then it is possible that the price of money remains unchanged, and since the supply of bonds has not been altered, the bond market is still in equilibrium. Under these extreme assumptions, again the only real effect

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1. Neutrality can be restored if costs of the government supplying money are identical to the costs of the private sector producing money. If we assume, in contrast, that the private money supply remains unchanged, but the price level changes to keep the real money supply fixed, then we are back to our earlier analysis with no private money supply.

2. A similar observation has been made by Stanley Fischer in his excellent paper, "Anticipations and the Nonneutrality of Money," where he details the effects of a change in the money supply for a particular parameterization of the economy.

of a money rain is on the expenditures of resources on the production of private money. Ignoring this effect, it should again be noted that in this instance, the change in the money supply has had neither an inflationary effect nor a real effect.

The skeptical reader may well have misgivings about the quantitative significance of all of this. Is it not a good enough approximation to ignore the costs associated with producing money?

In macro-economics (as in any other branch of economics) we make simplifications, idealizations, approximations. It is not always obvious what are the most appropriate simplifications. Macro-economics is replete with models where attention is centered on qualitative effects of phenomena whose quantitative importance is at best dubious. There are, obviously, transactions costs[1] and, in certain situations they are significant. There have been times, such as in some recent years in Italy, where the shortage of small denomination coins caused minor inconvenience. It may have had some real effects on the economy: the consumption of small candies (given in change) may have risen. Here, as elsewhere, resourceful firms and individuals should be--and are--able to find effective substitutes or to adapt their behavior to make a given money supply "go further." It seems implausible that individuals, who are presumed to be so flexible and rational in some dimensions, should be as rigid and irrational with respect to their demand for money as some naive monetarist theories seem to suggest. The adaptations of behavior may indeed not be in-

1. Transactions costs, for instance, are often cited as explaining why the private sector (the non-banking institutions) cannot provide a set of exchange media which are close substitutes to money. But the empirical evidence on the transactions costs associated with CMA accounts and other mutual funds suggests that this is not a plausible explanation. See, also, Bryant and Wallace (1980).

stantaneous; and the institutional changes which facilitate the changes in behavior may take even longer. But if the discrepancy between the return to holding money and to bonds becomes significant enough, the economy will adapt, to reduce the holdings of money or to enable "money" to become interest bearing.[1]

I am thus dubious whether the real effects of monetary policy that I have analyzed in this section are of any quantitative significance. This is not to say, however, that monetary policy may not have an important effect on the economy (particularly in the short run, in the presence of short-run individual and institutional rigidities); but the major mechanism by which this may work arises not from a transactions or asset demand for money, but rather from the central role of the banking system in supplying credit, and the linkages between monetary policy and credit availability.[2]

V. Fixed Prices and Public Financial Policy

The models considered throughout this paper have assumed that prices are completely flexible and that, as a consequence, there is always full employment. Each generation faces risks--there is variability in the productivity of labor and of capital--but there is no risk of unemployment. Much of the

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1. I made this prediction a decade ago, before the advent of NOW and CMA accounts; recent events have borne this theory out. Thus, although money and bonds are clearly not perfect substitutes (otherwise, no one would be willing to hold non-interest bearing currency), the approximation I have employed seems at least as plausible as the alternative polar assumption that individuals' demand for money is invariant to the difference between the return to money and the return to bonds.

2. A preliminary version of this "credit" theory of monetary policy, based on considerations of imperfect information in the credit market, is set forth in Lecture 3 of Stiglitz (1977). See, also, Stiglitz-Weiss (1981, 1982).

earlier literature on public financial policy focused on the effect of monetary and debt policy on aggregate demand and the level of employment. We can use a slight modification of the model we developed earlier to show how debt policy can be used to affect the variability in employment.

We assume that the price level is fixed; it is well known that price rigidities can give rise to unemployment equilibria. For simplicity, we specialize our model, assuming a logarithmic utility function. This implies that the savings rate is fixed at s^*.[1] Moreover, since with fixed prices financial assets are perfectly safe, the proportion of his savings that the individual invests in government debt $(1-\alpha)$ is a function only of the nominal rate of interest: $\alpha^*(i)$ is the solution to

$$(34) \qquad E \frac{\eta - i}{\alpha(1+\eta) + (1-\alpha)(1+i)} = 0 \quad .$$

We assume that the interest payments are financed by a lump sum tax on the young. Hence, if the debt supply is fixed at $\bar{B}$, the demand for debt is given by

$$(35) \qquad s^*(1-\alpha)) \, [w_t N_t - i\bar{B}] = \bar{B}$$

when N_t is the level of employment. If we assume that in equilibrium the demand for bonds must be equal to the supply (but equilibrium is consistent with the demand for labor not equaling supply), then the level of employment is given by

1. In the absence of variability in taxes the second period.

$$(36) \qquad N_t = \frac{\bar{B}[1+is^*(1-\alpha)]}{s^*(1-\alpha)w_t} \quad .$$

In this highly simplified model, if the government fails to vary either the debt supply or the interest rate, then variations in the level of productivity of labor, w_t , lead to exactly offsetting variations in the level of employment.

Variations in B can be used to stabilize the level of employment. Consider the extreme case where $i = 0$. If the government varies its debt according to the difference equation

$$(37) \qquad B_t = s^*(1-\alpha^*)[w_t\hat{N} + B_t - B_{t-1}] \quad ,$$

where $\hat{N}$ is full employment, then there will be full employment; for the demand for bonds will then be

$$(38) \qquad s^*(1-\alpha^*)(w_t\hat{N} + B_t - B_{t-1}) \quad ,$$

which will just equal the supply. This implies that

$$(39) \qquad \Delta B_t = \frac{s(1-\alpha)(w_t - \bar{w})N_t - (B_{t-1} - B^*)}{1-s(1-\alpha)}$$

where

$$\bar{w} = Ew_t$$

and

$$B^* = s(1-\alpha)\bar{w}\hat{N} \quad ,$$

the equilibrium level of debt, in the absence of wage variability. This is, of course, exactly the difference equation we analyzed earlier (fn. 3, p. 40) in our discussion of the financial policy which would sustain a constant price level (with the variations in government revenue being used to finance lump sum distributions to the young). When wages are high, the government expands the debt (an accommodating public financial policy). There is, however, a force returning the debt to its long-run equilibrium level B^* .[1]

Concluding Remarks

In this paper, we have attempted to set the question of the effect of government indexed bonds into the much broader context of the effect of alternative public financial policies. Whether a change in public financial policy has any effect depends simply on whether the change has an effect on the intertemporal distribution of income. We have shown that there are some important classes of public financial policies which, when appropriately implemented, have no effect on the intergenerational distribution of welfare. Some of these policies--such as an increase in the supply of government debt or a change in the maturity structure of the government debt--have neither real nor financial effects; while others, such as an increase in the interest paid on government bonds, have financial effects but no real effects. On

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1. Note that by lowering i it may not be possible to lower the demand for financial assets enough to restore full employment. If individuals believe that there is a significant probability that $\eta < 0$ (they will make a loss on their investment in capital), then even at $i = 0$, $(1-\alpha)w_t N < \overline{B}$. (This is analogous to Keynes' liquidity trap.)

   Recall in our earlier discussion of the difference equation (39) that the relevant non-negativity constraints will eventually be violated. This suggests that to maintain full employment may require combining interest rate policies with policies of debt expansion.

the other hand, if the public financial policy has an effect on the intergenerational distribution of welfare--and virtually all changes in public financial policy other than those spelled out in our three basic irrelevance propositions will have an effect on the intergenerational distribution of welfare--the change in public financial policy will have important effects on the economy, e.g., on the pattern of capital accumulation.

Thus, the question of the effect of the provision of government indexed bonds comes down to whether a switch from, say, unindexed to indexed government securities would have any redistributional effect. We have shown how, under certain circumstances, an increase in the supply of indexed bonds will have neither real nor financial effects on the economy.

Once it is recognized that government public financial policy can have important effects on the intergenerational distribution of welfare and the sharing of risks among generations, it becomes important to ascertain the consequences of alternative policies. We have shown that while none of the simple rules commonly discussed--keeping the money supply or debt fixed; keeping the price level fixed; or keeping the real value of the government debt fixed--is optimal, the policy of keeping the real value of the government fixed appears to provide for the least intergenerational variability in consumption.

Although most of our analysis has been conducted under the assumption that prices are perfectly flexible, and that there is a single, interest bearing short-term security (which can be used for transactions purposes), we have shown that when these assumptions are removed, the case for the relevance of public financial policy is even stronger. For instance, only in the limiting cases where the demand for money is perfectly interest inelastic can an open market operation have no real effects if there is no inside money;

and if there is inside money, an open market operation can have no real effects only if the costs of the government supplying money are identical to the costs of the private sector producing money.

If prices are rigid, then financial policy can serve the additional function of reducing the variability in employment, a role which was traditionally ascribed to public financial policy but which it has lost in the context of the currently fashionable neoclassical models.

Two important questions still need to be addressed. First, we need to formulate a model synthesizing the two roles of public financial policy, of intergenerational risk sharing and income and employment stabilization. Second, we have assumed throughout that only lump sum taxes are imposed. In that case, the timing of taxes affects the intergenerational distribution of welfare, but nothing more. But when taxes are distortionary, the timing of taxes also affects the total dead weight loss imposed by the tax system. Thus, whenever the changes in financial policy which we analyzed in our basic irrelevance propositions entail a change in the lump sum taxes imposed at different times, then, in general, those changes in financial policy will have real effects. The implication of this for the optimal debt-tax structure is an important question which we hope to address on another occasion.

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