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WELFARE ASPECTS OF GOVERNMENT ISSUE OF INDEXED BONDS

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ABSTRACT

Government issue of bonds indexed to the price level has long been recommended by economists, to no observed effect. Recently skepticism has been expressed about the real effects of such government action, or indeed of any government financial intermediation. This paper examines two main approaches that might argue for government issue of indexed bonds. The first asks what financial intermediation can be provided by government that the private sector cannot provide. The answer is that the government can use its taxation powers to make possible intergenerational risk sharing that private markets cannot. This argument suggests government issue of bonds indexed to wage income. The second approach discusses optimal forms of government debt issue in light of the government's ability to manipulate the payoffs on debt which has an uncertain real return. In this context indexed debt has the potential advantage of enforcing consistency in government financing and actions.

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WELFARE ASPECTS OF GOVERNMENT ISSUE OF INDEXED BONDS

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Economists' discussions of the welfare aspects of government issue of indexed bonds are of less practical than intellectual interest. Governments in inflationary difficulties issue indexed bonds and those that can avoid it, do not. It is nonetheless worth discussing whether economic analysis provides any rationale for government issue of either indexed or nominal bonds, or in general for government financial intermediation.[1]

Recent analyses of government financial intermediation suggest government issue of indexed bonds is at best irrelevant (Levhari and Liviatan, 1976, and Wallace, 1981) and may well be harmful (Peled, 1978). In this paper I make two main arguments. First, there is a role for government financial intermediation to provide intergenerational risk sharing that private markets cannot--but this does not directly suggest government issue of price-level indexed bonds. Second, the question of why governments do not issue indexed debt is the wrong one to ask: the more appropriate question is why governments issue nominal debt. In this context, I argue that the presumption of stability of the price level combined with frictions that are associated with indexed debt, led to nominal debt as the standard form of government liability. As the presumption of price level stability disappears, indexed debt is more likely to be and should be issued.

Because the paper is directed to government issue of indexed bonds, I do not discuss private non-issue of such bonds. That question was taken up in an earlier paper (Fischer, 1977). It would be a mistake to build too convincing a theory explaining private non-issue of indexed bonds since price-level indexed mortgages have now been privately introduced in the United States.[2]

1. Review

It is well known that many of the most distinguished of past economists, including Jevons (1875), Marshall (1925), Keynes (1927) and Fisher (1934) advocated government issue of index bonds. Jevons, Marshall and Fisher spent more time discussing the virtues of creation of a reliable price index than those of issue of index bonds; they seem to have taken it for granted that once a reliable index was available, it would be used in both private and government transactions[3]--unless the price level was stabilized through appropriate monetary policy.

Subsequently other economists have argued for government issue of indexed bonds; few economists have shared the opposition of practical men and central bankers, though skepticism has recently become more common.

The arguments in favor are:

(i) Indexed bonds would provide the economy with a safe real asset it otherwise does not have, and which is needed for optimal risk sharing.

(ii) Monetary policy could operate more accurately if indexed bonds were introduced (Tobin, 1971). Indexed bonds are seen as a closer substitute for physical capital than are other government liabilities. Monetary policy should aim to control q, the market price of installed capital; such control is more accurately achieved through changes in the quantity of indexed rather than nominal bonds.

(iii) Government issue of an indexed bond would (a) encourage saving and reduce inflationary pressure, and (b) encourage portfolio holders to shift away from money toward bonds, implying that deficits can be financed at a lower real rate than is possible when nominal bonds are issued (Bach and Musgrave, 1941, in the context of wartime financing).

(iv) "...by imposing upon the government a contingent liability dependent on its failure to check inflation, the flotation of stable purchasing power bonds would exert a wholesome pressure upon Congress to adopt aggressive anti-inflationary policies" (Bach and Musgrave, op. cit.).

(v) By creating inflation, the government has systematically cheated purchasers of nominal bonds, particularly small savers. This is not desirable and would not happen if indexed bonds were made available to the public (Friedman, 1974, Tobin, 1971).

In this paper I concentrate on arguments (i), (iv), and (v), briefly commenting on the remaining points.

The recent skepticism about government issue of an indexed bond is based largely on a number of neutrality theorems for government finance and financial intermediation:

N1 (Barro, 1974) Debt financing of deficits has no different effects than tax financing.

N2 (Levhari-Liviatan, 1976) Government intermediation in indexed bonds has no real effects.

N3 (Wallace, 1981) Open market operations between money and bonds have no real effects.

N4 (Peled, 1978) Any efficient equilibrium attainable with indexed bonds can also be attained without them; if indexed bonds make a difference they make things worse.

An associated meta-theorem is

N5: If indexed bonds were a good idea, the private sector would already have invented them.

Theorems N1 and N2 turn on the internalization of the government's budget constraint by the private sector. Thus, for instance, when the government in Levhari-Liviatan issues index bonds in exchange for nominal bonds, it is simultaneously incurring a liability to pay out more in real terms and less in nominal terms in the future. These future liabilities will one way or another be paid off by the private sector, which therefore is not fundamentally in any different position than it was before. This argument assumes both types of debt were in existence before the government undertook its intermediating activities.

Theorems N3 and N4 depend on the interpretation of money as purely a store of value, the role it typically plays in overlapping generations models. When money acts only as store of value, there is little or nothing that bonds can do that money cannot, particularly when the stock of money can be adjusted to affect its real rate of return.

Assumptions other than those underlying N1 through N4 have been pursued. In particular, Helpman and Sadka (1979) derive rules for the optimal financing of the government's budget, where the choices are among taxes, bonds, and money. The choice between taxes and bonds is meaningful because it is assumed individuals maximize over a finite horizon and no lump-sum taxes are available. The choice between bonds and money is determinate because money is viewed as providing productive services that bonds do not. This notion is represented by putting money in the utility function. The Helpman-Sadka framework produces results that differ from N1, N3 and N4, though they do not explicitly discuss N3 and N4. Because their framework is one of certainty, they do not consider government financial intermediation.

In this paper I first examine the question of the government's potential role as financial intermediary (argument (i) above), and show that the government can indeed make a positive difference by issuing securities and using its taxing power to produce appropriate patterns of returns. The difference arises from the government's ability to use taxes to enforce intergenerational risk sharing.

I then briefly discuss using an optimal tax framework, like that of Helpman and Sadka, to analyze optimal forms of government debt issue when there is uncertainty. It is in this context that the Modigliani-Miller type neutrality theorems outlined above are relevant: the framework suggests that the government will optimally run deficits or surpluses on occasion, but it does not provide any guidance to the type of debt that should be issued or bought.

To understand government issue of nominal versus indexed bonds, it is necessary to move to arguments like point (iv) above. The paper therefore discusses government issue of nominal and indexed debt in a context where dynamic inconsistency of government policy is possible. I conclude with a brief discussion of the remaining arguments reviewed above for government issue of indexed bonds.

2. Government Financial Intermediation for Intergenerational Risk Sharing

In this section I outline a simple model in which government financial intermediation makes intergenerational risk sharing possible.[4] The assumptions are those of the Samuelson (1958) overlapping generations model. To begin with, assume there is only one type of person, N born each period. Each person lives two periods and has a utility function defined over consumptions in the two periods. Random non-storable endowments are received in each period.

The consumer maximizes expected utility:

$$(1) \qquad E[U(C_1^t, C_2^{t+1}) | I_t]$$

and receives endowments:

$$W_1(t) \geq 0, \quad W_2(t+1) \geq 0$$

in the two periods of life. The distributions of the endowments are identical over time and not serially correlated, with

$$(2) \qquad W_1(t) + W_2(t) \equiv W$$

C_1^t is the first period consumption of an individual born in period t; C_2^{t+1} is second period consumption of that individual. I_t is information available in period t.

In the simplest environment, all individuals within each generation are identical in tastes and endowment. There is no reason for trade among members of any one generation and nothing to trade with members of other

generations. Each generation therefore consumes its endowments. For convenience, assume the utility function is separable and logarithmic, in which case

$$(3) \qquad E[U(\ )] = \ell n\ W_1^t + \beta E\ \ell n\ W_2^{t+1}$$

is the utility of the representative individual.

Assume further that

$$(4) \qquad \bar{W}_1 = E(W_1(t)) > \frac{1}{1+\beta}\ ,\quad \bar{W}_2 = E(W_2(t)) < \frac{\beta}{1+\beta}$$

but that with finite probability $W_1(t)$ takes on values

$$W_1(t) < \frac{1}{1+\beta}$$

Intragenerational Trade

Trade within a generation can take place if there are differences in tastes or endowments. For instance, if endowments are identical and the function U( ) in (1) is the same for all individuals, but rates of time preference differ, the more patient will lend to the less patient. Markets in all second period contingent commodities may exist, and each individual can be thought of as maximizing subject to a wealth constraint given by the market value of the endowment. If tastes are homothetic, and given the same U( ) functions and distributions of endowments, a single second period composite asset can be created. But in general that will not be possible.

If the utility functions differ in risk aversion, the less risk averse will be willing at a price to destabilize their consumptions relative to the pattern of endowments in the second period, enabling the more risk averse to have a more stable pattern of consumption.

Will this intragenerational trading produce a safe real asset? A complete market equilibrium will call for a full menu of contingent commodities, with agents either buying or selling the contingent commodities in different proportions, depending on their tastes and endowments. If there is a full set of contingent commodities, then a safe real asset can be created, which will pay off one unit of consumption in each second period state of nature.

Whether such an asset will actually be created when there is a full set of markets depends on costs of transactions. Any type of model in which there is some type of fixed cost for dealing in an asset will lead to repackaging of contingent commodities in forms that fit the excess demand patterns of consumers for second period contingent commodities. For instance, a safe real asset is most likely to be produced if there is some notion of essential consumption, represented for example by the Stone-Geary utility function $U(C-\bar{C})$, $\bar{C} > 0$, where $U'(0)$ is infinite, and if many people have no second period endowment at all.

If there is not a full set of contingent commodities, then invention of a safe bond changes the consumption possibilities of economic agents. Assuming that transaction costs are ultimately the reason for nonexistence of particular markets, invention of a safe real asset would again be more likely under the circumstances outlined at the end of the previous paragraph.

The role of government in a model of this type is limited, perhaps to ensuring that contracts are carried out. There might be some difficulties in this regard if, for instance, the second period endowments are wages, and if human capital is not tradable. In that event the government ideally would want to intervene to reproduce the private sector equilibrium.[5]

Given the constraint of no intergenerational trade, the equilibrium attained in models of this type with a full set of contingent markets can be described as constrained Pareto efficient. But there may be possibilities for intergenerational trade, along grounds made familiar by Samuelson (1958).

Optimal Intergenerational Allocations

The possibilities for intergenerational trade depend on the pattern of endowments. For instance, if the desired pattern of trade always involves transfers from young to old, the introduction of money or government bonds will bring about a better equilibrium than is possible with purely intergenerational trade. The allocation is better in that every generation is made better off--so long as it is assumed that the horizon is infinite.

The assumed pattern of endowments here highlights the possibilities for intergenerational risk smoothing. Specifically, the assumption in (2) is that the total endowment each period is nonrandom and constant. It is only the division of the endowment between the generations that is uncertain.

Clearly allocations are possible in which every generation has a nonrandom pattern of consumption over its lifetime. But direct intergenerational trade is not possible. The introduction of money will not itself solve the problem since sometimes the optimal arrangements will call for transfers from old to young, which cannot be achieved with money held by the old.

Return now to the case where tastes of all agents are identical. An optimal allocation in some sense is one in which consumption in each period for each individual is certain, and in which the allocation between young and old reflects time preference. For instance, if the utility functions are logarithmic as in (3), consider the solution to the following problem:

$$\text{(5)} \qquad \underset{\{y\}}{\text{Max}}\ V(W,y) = \ell n\ (W-y) + \beta\ \ell n\ y$$

which implies

$$\text{(6)} \qquad y = \frac{\beta W}{1+\beta} = C_2^t$$

$$W-y = \frac{W}{1+\beta} = C_1^t$$

This allocation is optimal in the following sense: suppose individuals are told before knowing their first period endowments what the probability distribution of the endowments is, and what the technical possibilities for trade are. Then they will choose this allocation.[6] This optimality criterion may be objected to on the grounds that it seems to imply prior (to their existence) agreement by economic agents on the rules of resource allocation.

The issues here are deep and not simply resolved. But the criterion is appealing because it is clear that some criterion of this type is in practice used in establishing property rights, in the sense that it is assumed the rights will be binding on agents as yet unborn and that notions of fairness are used in discussing the establishment of the rules.[7] There is certainly

no presumption in most societies that anyone is free to opt out of paying taxes if benefits fall short of contributions, except in the limited sense that emigration is typically permitted.

There is need for some criterion of optimality since the allocation implied by (6) is not ex post a Pareto improvement for all generations. Some generation might have been lucky and had high drawings in both periods of their lives. They would lose under the allocation (6).

Institutional Arrangements: Can the Private Sector Do It?

How is this allocation to be achieved? There are several possibilities, all involving the use of taxes.

(i) The simplest in the present model is for the government to take command of all resources and allocate them between the generations as implied by (6).

(ii) The endowments of the old could be confiscated in each period and given to the young. At the same time the first old generation could be given fiat money, as in the original consumption loans model. The old sell money to the young in exchange for goods; the allocation is the same as (6).

(iii) The government could act as a financial intermediary, each period buying the rights to the second period endowment of the currently young, and paying out to the currently old the amount that generates the resource allocation (6). It may also be necessary to use taxes and transfers to effect the appropriate allocation.

The first two institutional arrangements require direct government intervention. The question pursued now is whether the third set of arrangements requires any government action, or whether alternatively a

private financial intermediary could produce the allocation (6), without a government role. The question is whether use of taxation is necessary to achieve (6) when financial intermediation is available. If not, a private financial intermediary could be set up that would generate zero cash flow each period, balancing its payments with its receipts. If taxes and transfers are needed, government action is necessary.

To study the operation of the financial intermediary, it is convenient to assume there is a discrete number of states of nature, indexed by j, $j = 1, \cdots, J$. Let $p_{2j}(t)$ be the price in terms of period t goods for delivery of one unit of the consumption good in state of nature j in period (t+1). The probability of state j occurring is q_j, and q_j is constant over time. Taxes in amount $T_j(t)$ are levied on the old in state of nature j in period t, and transferred to the young. The taxes may be negative.

The currently young maximize

$$E[U(\ )] = \ln C_{1i}(t) + \beta \sum_{j=1}^{J} q_j \ln C_{2j}(t+1) \tag{7}$$

subject to

$$C_{1i}(t) + \sum_{j=1}^{J} p_{2j}(t)C_{2j}(t+1) = W_{1i}(t) + \sum_{j=1}^{J} p_{2j}(t)(W_{2j}(t+1) - T_j(t+1)) + T_i(t)$$

$$\equiv Y(t)$$

The new notation is: $C_{2j}(t+1)$ is consumption by the old in state of nature j in period (t+1); $W_{2j}(t+1)$ is the endowment received by the old in state of nature j in period (t+1); $W_{1i}(t)$ is the endowment of the young in state of nature i in period t. It is known that state of nature i has occurred.

The optimization results in:

$$C_{1i}(t) = \frac{1}{1+\beta} Y(t) \tag{8}$$

$$C_{2j}(t+1) = \frac{\beta}{1+\beta} \frac{q_j}{p_{2j}(t)} Y(t) \qquad j = 1, \cdots, J \tag{9}$$

To attain the optimal allocation (6), it is necessary that

$$C_{1i}(t) = \frac{W}{1+\beta} \tag{10}$$

$$C_{2j}(t-1) \equiv \frac{\beta}{1+\beta} W \qquad j = 1, \cdots, J \tag{11}$$

From (8) and (10),

$$Y(t) = W \tag{12}$$

From (12), (9) and (11),

$$p_{2j}(t) = q_j \tag{13}$$

Thus actuarially fair prices should be charged for contingent commodities.

Using (13), we return to (12) to obtain

$$T_i(t) + W_{1i}(\ ) + \sum_{j=1}^{J} q_j(W_{2j}(t+1) - T_j(t+1)) = W$$

or

$$(14) \qquad T_i(t) + W_{1i}(t) = \bar{W}_1 + \sum_{j=1}^{J} q_j T_j(t+1)$$

On the right-hand side of (14), we have a term which is the expected value of second period taxation of the old. Assuming taxes are only state and not time dependent,

$$(14)' \qquad T_i + W_{1i} = \bar{W}_1 + \bar{T}$$

where $\bar{T}$ is the expected value of second period taxation.

From (14)' it is clear that the optimal allocation can be achieved for more than one value of $\bar{T}$. It is natural to set $\bar{T}$ to zero, in which case

$$(14)'' \qquad T_i = \bar{W}_1 - W_{1i} \qquad\qquad i = 1, \cdots, J$$

Thus the financial intermediation scheme cannot operate without use of taxes and transfers, though it can operate with expected taxes equal to zero.

Given the result that contingent commodity prices are, in the optimal allocation, actuarially fair, we can describe the operations of the financial intermediary quite simply. Its resource flows are shown in Table 1. Each

Table 1: Resource Flows to the Financial Intermediary

Inflows		Outflows	
Endowments of the old	$W_2(t)$	$\bar{W}_2$	Purchase of endowment of current young
Purchases of index bonds by current young	$B(t)$	$B(t-1)$	Payments to holders of index bonds (currently old)
		$T(t)$	Net transfers to the young

period it buys the second period endowments of the current young at their expected value, as prescribed by (13). It also pays out claims owned by the current old. These can be thought of as indexed bonds, paying the same amount in each state of nature. Resource inflows come from the endowments of the current old, which were purchased last period, and from sales of index bonds to the current young. Any excess of inflow over outflow is handled by making a distribution to the young; alternatively any excess outflow is paid for by taxing the young.

It is worth noting that the financial intermediation solves two allocational difficulties. First, the intermediation makes intergenerational risk sharing possible. Second, the government makes it possible for each generation to choose the optimal time profile of consumption. The first function can be performed without the second being satisfied. For instance, suppose that both generations alive at the same time can contract before their endowments are revealed. They will in general want to trade in contingent commodities. But such trading will still leave further gains from intergenerational trade, in that given the pattern of endowments described by (4), each generation would likely want the opportunity of saving in the first period.

Dynamics of the Financial Intermediary

The financial intermediation scheme can be instituted in a period in which the division of resources between the generations is about average, and in this case will make the first period old better off and raise the *ex ante* expected utility of all subsequent generations. For example, again using the logarithmic utility function (3), consider the introduction of the

scheme in period t, with purchase by the government of the rights to $W_2(t+1)$, for which it pays $\bar{W}_2$. It sells to the young an amount of bonds B(t) implied by

$$\text{(15)} \qquad \underset{\{B(t)\}}{\text{Max}} \; \ell n \, (W_1(t) + \bar{W}_2 - B(t)) + \beta \, \ell n \, B(t)$$

or

$$\text{(16)} \qquad B(t) = \frac{\beta}{1+\beta} \, (W_1(t) + \bar{W}_2)$$

The government's net resource flow in period t is

$$\text{(17)} \qquad B(t) - \bar{W}_2 = \frac{1}{1+\beta} \, [\beta W_1(t) - \bar{W}_2]$$

If $W_1(t)$ is equal to $\bar{W}_1$ or close to that level (see assumption (4) that $\bar{W}_1 > \frac{\beta}{1+\beta} W$), the scheme generates a first period surplus that can be given to the old.

The dynamics of first period consumption are given by

$$\text{(18)} \qquad C_1^{t+j} = \frac{W}{1+\beta} + \frac{(-\beta)^j}{1+\beta} \, (W_1(t) - \bar{W}_1)$$

This converges to (6). Provided $W_1(t)$ is close to $\bar{W}_1$, the scheme increases the ex ante expected utility of all generations. However, if the scheme were started when the first generation had very high $W_1(t)$, there would be a large demand for bonds. The next generation would accordingly have low first period consumption and could therefore be made worse off, in an expected utility sense, by the introduction of the scheme.

Choosing Among the Schemes

At the present level of abstraction there is nothing to choose between these schemes. Additional elements would have to be included in the model to make the choice determinate. If there are differences in tastes, and if the government cannot discriminate between economic agents, then the direct allocation method (i) is less likely to be optimal. The difficulty is that the total amount allocated to the young generation may be wrong. There will subsequently be trading within that generation, but there is no mechanism for them to trade with other generations. Neither of mechanisms (ii) nor (iii) suffers from this particular difficulty.

Choice between (ii) and (iii) requires more explicit modeling of the effects of taxation of second period endowments (in (ii)) as compared with purchase of the endowment (as in (iii)). If the endowments are lump sum, as so far assumed, there is again no basis for choice. However, we might assume that the endowments represent, for example, labor income and that labor supply responds to wages. In that case the imposition of taxes under scheme (ii) in general distorts the labor supply decision. But there is similarly a severe moral hazard problem under scheme (iii) where individuals have sold their labor income forward. In principle a contract could be drawn up that would specify the amounts to be worked in each state of nature; with such an agreement the optimal allocation could be attained. But if the government cannot discriminate between workers, it is difficult to see how such optimal agreements could ever be negotiated.

This is to say that it is very unlikely that there is a way of attaining the optimal allocations. There is no way the government can bring about that allocation without either buying claims on future

endowments (presumably human capital) or taxing. If it is not possible for the government in effect to deal in human capital, it will have to use taxation along with security issues to improve the allocation of resources. It will in general be able to improve the allocation of resources by engaging in intergenerational transactions, but because it does not have lump-sum taxes, it cannot achieve a first best allocation.[8] And because it cannot achieve the first best solution, it will not generally be optimal to eliminate uncertainty entirely.

Aggregate Uncertainty

To this point it has been assumed that the aggregate endowment is certain, although its distribution between the generations is not. Suppose now that W(t), the aggregate endowment, is uncertain. It will still be true, unless the endowments are perfectly positively correlated, that there will be risk-sharing grounds for government financial intermediation.

There are again J states of nature, j = 1, ···, J. The optimality criterion for the logarithmic utility function now becomes

$$(19) \qquad \underset{\{C_{1i}(t),\ C_{2k}(t+1)\}}{\text{Max}} \sum_{i=1}^{J} q_i \ln C_{1i}(t) + \beta \sum_{k=1}^{J} q_k \ln C_{2k}(t+1)$$

$$\text{subject to } C_{1i}(t) + C_{2i}(t) = W_i(t),\ i = 1, \cdots, J, \text{ for all } t.$$

The optimal allocation specifies the consumption levels for both generations in each state of nature. It is:

$$(20) \qquad C_{1i}(t) = C_{1i} = \frac{W_i}{1+\beta}$$

$$C_{2i}(t) = C_{2i} = \frac{\beta W_i}{1+\beta}$$

Here W_i is the aggregate endowment in state of nature i.

This allocation can once again be brought about through the three schemes, including government financial intermediation in scheme (iii), described above. Prices and transfers are chosen to replicate the allocation (20). These prices are no longer equal to the probabilities of the states of nature, but in addition reflect aggregate endowment in the state of nature. The financial intermediary will no longer buy second period endowments for an amount equal to their expected value. Nor is it natural any longer to think of the financial intermediary dealing in indexed bonds, since the amount consumed in each second period state of nature will depend on the state and no longer be state independent.

Of course, if the intermediary chooses to provide a full menu of contingent commodities, it is possible to buy an indexed bond in the sense of a financial asset that provides a payoff that is constant. But with the postulated patterns of endowments and utility functions, there is no one who will want to consume identical amounts in each state of nature.

If the financial intermediary wants to reduce the number of assets in which it deals, the natural index to use is the aggregate amount of goods available in each state, since consumption for each individual will be proportional to the aggregate endowment in each state. This is a result of the assumption of identical homothetic tastes.

3. Government Financial Intermediation and Indexed Bonds

The analysis above establishes that there may be a role for government financial intermediation that private markets cannot provide. It demonstrates that meta-theorem N5 above does not establish the optimality of the status quo in all situations.

But the role of government as financial intermediary has to be related to the source of the private sector's inability to provide the appropriate bundle of assets. If the government's advantage derives from its claims on future labor income, then it is likely optimal for the government to sell claims on labor income in different states. Claims on the income of capital are already tradable. The institution of social security does provide some, though nontradable, claims on future labor income.

The improvement that can be expected from financial intermediation of the type described in the previous section depends on the correlation of returns on human capital with returns on other assets. Those returns are in fact highly correlated. Further, the wages earned by different generations of labor alive at the same time are also strongly correlated. No great reduction of risk for the individual should therefore be expected from optimal risk-sharing arrangements provided by the government based on its ability to tax future labor income.

The case for government financial intermediation outlined above implicitly uses as its definition of an indexed bond, a bond that pays off the same amount of goods in each state of nature. But since there is no money and no price level, the bonds are not indexed in the conventional sense that the amount of money paid out to bondholders is related to the behavior of the price level. To discuss the issue of indexed bonds in this sense, the model has to include money and prices. I now discuss a framework that seems ideal for analyzing government financial policy in such a context.

4. Optimal Government Financing and Index Bonds

Consider a model in which individuals maximize over two period lifetimes, supplying labor services, using money, and able also to save by the accumulation of capital. The government has only distorting taxes at its disposal. Potentially, any asset could serve as medium of exchange. But it is technically difficult to pay interest on securities that change hands in the day-to-day process of exchange and for that reason there is a separate noninterest-bearing asset, money, that serves as medium of exchange. Technical innovations in the process of exchange occur randomly. This last assumption is an important one, for it means that there are specific risks associated with the return to money and that money therefore will not necessarily serve in such a model to produce exactly the same pattern of returns as real assets.

Consumers maximize an expected utility function of the form:

$$(21) \qquad E\left[V\left(C_1^t,\ C_2^{t+1},\ L^t,\ f\left(\frac{M_{t+1}}{P_{t+1}}\ \varepsilon_t\right)\right)\right]$$

where f( ) represents the services provided by the holding of money. L is the amount of labor supplied. Random variable ε_t is a technological factor representing the ability of money to perform its utility or labor-saving services; uncertainty about future values of ε generates uncertainty about future price levels as of any given values of the remaining variables in the economy. Inclusion of real balances in the utility function is a method of ensuring a demand for money even if interest is earned on other assets.

First, return to the optimal intergenerational risk sharing with aggregate certainty model of Section 2, omitting government and labor supply from (21). Suppose there is a given constant money stock. The constant money stock does not in this context generate efficient intergenerational risk sharing, since uncertainty about the rate of return on money does not provide the certain one-for-one intertemporal tradeoff that society faces between consumption of the generations.

This price level uncertainty provides a role for government in the model of Section 2, either as issuer of an indexed bond or to conduct monetary policy. Monetary policy will consist of transfers to the old that produce price level certainty. With money as a safe asset, there is no need for indexed bonds, provided appropriate resource transfers are made between the generations. If monetary policy cannot operate rapidly enough to stabilize the price level, money will be an unsafe asset and there will be room for indexed bonds. Indeed, the government might want to lend in nominal terms to the private sector, enabling it to hedge the risks of price level changes. At the same time the government would continue to issue the safe or indexed bond.

Analysis of optimal government policy in such a model requires full specification of the optimal tax problem. A model of the above type under certainty has already been analyzed by Helpman and Sadka (1979) who show, under the assumption of no lump-sum taxation, that the government optimally will sometimes want to use deficit financing. When uncertainty is introduced, we should think of the model in terms of contingent commodities. The optimal state-contingent taxing scheme for given patterns of government spending will involve purchases or sales of contingent commodities.

Borrowing implies merely that the government collects resources today that will be paid for by delivery of commodities in future contingencies--which commodities will be provided through taxation, money issue, or future borrowing. The positions that the government takes in various markets for contingent commodities can be viewed as determining the optimal financing of the debt. In this sense, the type of debt issued by the government matters: if it takes another position, the real equilibrium is changed.

Neutrality of Government Financial Operations

Once government positions in each market for contingent commodities have been optimally determined, the government can engage in financial intermediation by taking, at the equilibrium prices of contingent commodities, positions of zero net worth across contingent markets. For instance, it can buy contracts for future delivery of wheat and sell contracts for future delivery of corn. If the profits or losses are merely to be handed back to the private sector in a neutral way, then these further financial transactions have no real effects. For the government to return the proceeds in a neutral way, it holds constant optimally determined planned spending, taxes, and transfers within each state of nature, aside from those arising from its financial intermediation activities. Thus it disposes of its wheat by selling the wheat to the market and distributing the profits or losses--it is doing nothing except churning the market. Such financial intermediation cannot in a complete contingent market setup do any good.

What is the relationship between the public finance framework of optimal debt determination outlined above and the five neutrality theorems, N1 through N5? N1 does not apply because individuals maximize over only

two periods, and therefore cannot engage in intergenerational risk sharing. To the extent that the horizon is lengthened or effectively made infinite, more intergenerational risk sharing should be expected from within the private sector. The case for government issue of special types of debt would then depend on the absence of markets for human capital and the inability of individuals from different families to arrange smoothing that is possible through pooling of the risks of within-generation wage incomes.

There is a sense in which neutrality theorem N2 holds. Namely, there is under reasonable assumptions a determinate optimal pattern of government spending, taxation, and money issue in each state of nature. This optimal pattern implies net supplies of contingent commodities. It is possible to superimpose on this pattern a variety of government financial operations that have no real effects provided the underlying real activities of the government are unaltered. But it is precisely that underlying pattern of real activities that implies the optimal pattern of government financing.

Neutrality theorem N3 does not hold when it is optimal to pay interest on debt and when it is technically impossible to do so on money, as shown by Helpman and Sadka. Theorem N4 depends on the availability of lump-sum taxes. N5 was discussed extensively in Section 2 of this paper.

Government Issue of Indexed Debt

In the above framework, optimal government policy implies a particular pattern of net supplies and demands of contingent commodities by the government. The type of securities--that is, packages of contingent commodities--issued by the government will depend, as in Section 2, on the advantages the government has over the private sector in issuing valued securities, and on the small frictions associated with the packaging of assets. For instance, if many

investors have very high risk aversion and no future endowments, they would essentially want to buy only indexed bonds. Rather than require them to mix their own indexed bonds, or leaving the job for private financial institutions, it could be cheaper for the government to do so.

The framework is not, however, totally compelling, except as a way of organizing thought, for its fails to explain why governments have traditionally been assumed to have an obligation to issue safe debt. Nor does it handle the question of which markets in contingent commodities are in fact available at any time. Without knowing why markets are missing--and many are missing--we cannot in some ultimate sense pronounce on the desirability of alternative forms of government deficit finance.

5. Government Debt Issue: An Alternative Approach

The general presumption that government deficits should be financed by the issue of safe debt probably arises from the fear that the government is big enough to manipulate the returns on any other type of debt in a way that will be disadvantageous to the lenders. In more modern terms, the issue is one of the dynamic inconsistency of policy (Kydland and Prescott, 1977, Fischer, 1980). Given this view, indexed debt would be the standard form of government liability, particularly since the government is exceptionally well placed to affect the inflation rate.

From this perspective, the right question to ask about government debt is not why it is not indexed, but how it ever came to be nominal. One argument that may have some appeal is that the government by promising to pay off in dollars (or the currency of the country) is making the only promise it can with certainty keep, since it prints the dollars. However, nominal debt predates fiat currencies,[9] so this cannot be the explanation.

The predominance of nominal government debt in countries with relatively stable inflation histories derives from frictions associated with indexed debt. The first friction is the delay in the collection and publication of price data, which means that indexed debt is not conveniently used in short-term transactions. Second, as often pointed out, variations in relative prices imply that different price indexes are appropriate for different people and purposes[10]: when inflation rates are reasonably predictable, there is no assurance that the appropriate real value of indexed debt is more predictable than the value of nominal debt.

Once the economy has accustomed itself to using nominal debt and institutions, and given the frictions associated with indexed debt, there are costs to innovating by introducing an indexed bond, and no assurance

that the social surplus from doing so is appropriable by the innovator. There is no presumption, even if there were no government advantage in the issue of indexed debt, that indexed debt would be introduced by the private sector at precisely the right time. Indeed, given a nominal tax system, there is a presumption that some government action is needed to get the process under way.

Government innovation comes when the pressures to move away from nominal contracting become strong enough: these pressures arise in part from the exhaustion of devices for enforcing cheap nominal financing of deficits. They arise also from the dissatisfaction of existing lenders to the government who have suffered from the effects of unanticipated inflation on the real value of their assets.

The notion that indexed debt is an incentive for more consistent behavior by government, argued in point (iv) above by Bach and Musgrave, is appealing, particularly given that governments typically do not appear to behave in the ways that economists' models of optimizing governments suggest they should. However, it is interesting briefly to explore the question of whether governments should always honor past commitments. The existence of a nominal debt makes it possible for the government very cheaply to impose a capital levy (by inflating). The best of all possible worlds, if governments acted optimally, might be one in which governments had the option of imposing a capital levy in this way in emergencies, like wars. Provided there is a political cost to violating past obligations, it may be optimal to set up arrangements in which they can easily be violated.[11]

Taking this logic a step further, we note the argument by Levhari-Liviatan (1976) that the direction of the effect of past commitments on current actions is ambiguous. If, in an emergency, inflation is the first

line of increased government revenue, then the existence of indexed debt may make the government response to difficulties more rather than less inflationary.

Lest these speculations obscure the main message, I repeat the argument of this section. Given the ability of the government to affect the payoffs that it makes on debt whose return is uncertain, the general presumption would be that governments should finance themselves with indexed debt, as a means of encouraging consistent behavior. The predominance of nominal debt results from frictions associated with the use of indexed debt, and relies heavily on the presumption that price level behavior is reasonably predictable. Once that presumption is lost, governments will likely have to issue indexed debt in order to finance themselves.[12]

6. Concluding Comments

Finally I turn to arguments (ii), (iii) and (v) for government issue of indexed bonds. Argument (ii), that monetary policy could more accurately affect q if there were indexed bonds, assumes that real bonds are a closer substitute for capital than are nominal bonds. Empirically this turns out not to be the case. It would nonetheless be useful to know what a market real rate of interest is and how it varies through time, and for that reason issue of an indexed bond would be of assistance to monetary and fiscal policy makers.[13]

Argument (iii), that issue of indexed bonds would reduce the interest cost borne by the Treasury for financing the debt, and also promote saving, has been extensively investigated. If government debt issue is neutral, in the sense of N2, then government issue of indexed bonds would have no real effect. If the government issue of indexed debt changes its patterns of taxation and money issue, then the effects on interest rates and saving depend on how taxes and inflation rates are changed by the introduction of the indexed debt. An individual with given wealth, and given future tax payments, will be willing to hold indexed debt at a lower real return than nominal debt if the remaining assets available are on balance not hedges against inflation. Certainly, given the adverse effects of inflation on equity returns, the presumption is that individuals would be willing to hold indexed bonds at lower real rates than nominal bonds--holding constant future tax payments. The effects of the issue of indexed bonds on saving depend on the responses of saving and labor supply to changes in the real interest rate, topics on which there is little empirical knowledge.[14]

Finally, consider argument (v), that government issue of indexed bonds is desirable on distributional grounds. In the United States the adverse distributional consequences have been associated particularly with the U.S. savings bonds program. The ability of the government to continue obtaining financing through these instruments indicates a lack of access, for whatever reason, to higher yielding dominating assets, and strongly suggests that a part of the market would be made better off by government issue of indexed bonds, or alternatively as now proposed, floating rate notes.[15]

At the theoretical level, this paper should be viewed as an exploratory attempt to analyze the question of optimal government financial policy. Previous analyses have tended to take the types of assets to be issued by the government as given. There is as yet no satisfactory theory of what types of assets governments should issue, and such a theory may require further analysis of reasons for the absence of particular markets.

Because the analysis is exploratory, it cannot reach any firm conclusions on the desirability or otherwise of government issue of indexed bonds. There is no strong welfare argument for government issue of an indexed bond, at the abstract level of this paper. But nor is there a strong argument against such an issue. And the analysis certainly provides little explanation or justification for the issue of nominal bonds.

Footnotes

*Visiting Fellow, Hoover Institution and Research Associate, National Bureau of Economic Research, on leave from M.I.T. This is a revised version of a paper prepared for the Conference on Indexation and Economic Stability, Funacao Getulio Vargas, Rio de Janeiro, December 16-17, 1981. I am grateful to my discussants Eduardo Modiano and Stephen Ross and to participants in seminars at M.I.T., Stanford, and Berkeley for comments and suggestions, to Jeffrey Miron for research assistance, and to the National Science Foundation and Hoover Institution for financial support.

1. For earlier examination of the issues, see Fischer (1975), Levhari and Liviatan (1976), and Peled (1978), as well as references cited below.

2. See the Deseret News, September 10, 1981. I am indebted to J. Huston McCulloch for this information.

3. Eagly (1967) suggests that Jevons and Marshall advocated use of a price index in private rather than government transactions. However, reading of Jevons (1884) and Marshall (1925) supports the view outlined above. Collier (1969) and Fisher (1934) both survey the literature.

4. In his paper for this conference, Joseph Stiglitz (1981) independently makes very similar arguments.

5. For analysis of social security and taxation as methods of overcoming the absence of human capital markets, see the excellent paper by Merton (1981). Merton also discusses the case where the government has only distorting taxes at its disposal and cannot produce the first best allocation of resources.

6. Atkinson and Stiglitz (1980), p. 340, provide references and discussion. See also Peled (1978), who discusses the criterion under the heading Equal Treatment Pareto Optimality, referring to discussion by Muench (1977). Peled is wary of the criterion, arguing that it is not compatible with a requirement that individuals have the right to refuse to participate in a cooperative procedure if that is costly. He conjectures that whenever the optimality criterion used by economists is stronger than that used by individual agents, private equilibria are likely to be non-optimal.

7. Robert Barro, in his summary discussion at the conference, argued that use of this criterion was incompatible with the notion that individual utility is not affected by the utility of subsequent generations. However, the criterion can be thought of as follows. Suppose an intergenerational arrangement can be introduced that will make existing generations better off. How likely are future generations to repudiate the arrangement? Future repudiation is more likely if subsequent generations see that, at the time it was introduced, the scheme was known to benefit one generation at the expense of specific future generations. But if it was reasonable to think at the time of introduction of a new set of arrangements that future generations would be benefitted, the future generations are more likely to uphold the scheme. It will be seen below that introduction of government financial intermediation between generations can satisfy this criterion, benefitting the current generation and increasing the utility expected for all future generations.

8. Bhattacharya (1981) examines a related case.

9. Nor can it seriously be believed that government debt of any type is totally safe, in light of possible revolutions, debt repudiation and so forth.

10. Michael (1979) examines variations in consumption bundles and associated price indexes in a cross-section study.

11. Keynes, Essays in Persuasion, Harcourt Brace, 1932, is worth quoting:

> . . .the benefits of a depreciating currency are not restricted to the government. . . .Those secular changes. . .which in the past have depreciated money, assisted the new men and emancipated them from the dead hand; they benefited new wealth at the expense of old, and armed enterprise against accumulation. . . (p. 87)

Of course he was only half serious: he concluded that it would be better to handle redistributive and inheritance problems directly than through (unanticipated) inflation. (p. 92)

12. It is difficult to see why the Treasury should not undertake an experimental issue of indexed bonds, sold at auction. These could be discount bonds, promising payment of a given real sum on a specific future date. Tax treatment of the returns would have to be specified. The simplest arrangement would be to make the returns nontaxable. Such a bond could quite easily yield a negative real return in equilibrium.

13. This assumes that either monetary or fiscal policy decisions might optimally react to changes in the real interest rate, a position I hold.

14. Bhattacharya (1979) examines the theoretical arguments.

15. This argument takes the existence of the U.S. savings bonds program as given. Ronald McKinnon suggested that the program would lose its rationale if interest rate controls on financial intermediaries were lifted. In the last few years the outstanding volume of savings bonds has been falling. At the end of 1981 it was $68 billion, only about 6% of the value of total time and savings deposits at financial intermediaries.

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