Public Debt as Private Liquidity

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There has been a great deal of public concern in the United States about the rapid growth of the public debt during the 1980s. Among economists, the grounds for concern most often stressed are that a higher public debt should reduce national savings (and, as a result, capital accumulation), with consequences for future income that are expected to lower welfare, at least in the long run. These consequences are predicted by what is often referred to (B. Douglas Bernheim, 1989) as the "neoclassical" model, a general equilibrium version of the "life cycle" model of consumption and savings developed by Modigliani and associates. Of course, according to the "Ricardian" view (Robert Barro, 1989), changes in the level of public debt should have no effect at all (except insofar as the higher future taxes implied by a higher public debt distort incentives), so that the concern is largely misplaced. But many economists are skeptical about the practical relevance of the Ricardian view, because of the apparent connection between government deficits and a variety of aspects of economic activity and financial market conditions (see, for example, Bernheim, and Robert Eisner, 1989). For example, the high real interest rates of the 1980s are often attributed to the rapid growth of the U.S. public debt in this period. As a result, the other predictions of the neoclassical model are widely accepted as well.

I wish to argue that the analysis provided by the neoclassical model may not be an adequate guide to policy, even if certain of its predictions are correct. Instead, I direct attention to an alternative explanation of the effects of changes in the level of public debt, which leads to very different conclusions about the welfare consequences of such policies. According to this view, "Ricardian equivalence" fails because of imperfect financial intermediation. Some economic units are liquidity constrained, which is to say that they are unable to borrow against their future income at a rate of interest as low as that at which the government borrows. Increased government borrowing can benefit such parties, insofar as they effectively receive a highly liquid asset, government debt, in exchange for giving the government an increased claim on their future income, their own claim to which represented a highly illiquid asset. A higher public debt, insofar as it implies a higher proportion of liquid assets in private sector wealth, increases the flexibility of the private sector in responding to variations in both income and spending opportunities, and so can increase economic efficiency.

There are several reasons to prefer the liquidity-constrained model to the neoclassical model as an explanation of the nonneutrality of government deficits. One is that the liquidity constraint hypothesis can explain the persistently low real returns on U.S. public debt relative to other kinds of assets.[1] Another is that the liquidity-constrained model is not vulnerable to the Barro critique, according to which altruistic bequests between generations should completely eliminate the nonneutralities associated with the neoclassical model. A third is the theoretical parsimony of an explanation of the long- and short-run effects of government deficits along essentially the same lines. In the pure neoclassical model, with efficient financial intermediation, government deficits, even

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[1] Models with a similar structure to the one described here are used to explain both the low real return on Treasury bills, and the occurrence of long-lasting shifts in that return as a result of shifts in monetary and fiscal policies, in Javier Diaz-Gimenes and Edward Prescott (1989), and Mark Huggett (1989).

when expected to result in a permanently higher level of government debt, should have negligible effects upon spending decisions in the short run (James Poterba and Lawrence Summers, 1987), even though the long-run effects may be significant due to the eventual effect on the capital stock. As a result, liquidity constraints are often invoked to explain apparent short-run nonneutralities. It is not clear, then, why one should not also emphasize the consequences of liquidity constraints for the long-run effects (that are the main focus of current policy discussions) as well.

Finally, the liquidity-constrained model predicts that variations in the public debt should be important as such, both in the short and in the long run. As Laurence Kotlikoff (1988) has observed, in the neoclassical model, government deficits are nonneutral only insofar as they are equivalent to a transfer of wealth between generations. Accordingly, it is not the public debt as such that matters in that model, but rather the degree to which such intergenerational redistribution occurs—an appropriate measure of which would have to take into account other aspects of fiscal policy as well. Indeed, Kotlikoff argues that once these other aspects of fiscal policy, such as changes in Social Security provisions, are taken into account, the 1970s would have to be judged a period of relatively "loose" fiscal policy, and the 1980s a period of relatively "tight" fiscal policy. This means that the neoclassical model cannot be used to explain *any* of the supposed effects of high deficits in the 1980s, while the liquidity-constrained model presented here can.

I. Public Debt in a Liquidity-Constrained Economy

Consider an economy made up of two types of infinite lived households, with the number of each normalized as one. Type A households have endowment $e_1(1+g)^t$ in all even periods and $e_2(1+g)^t$ in all odd periods, while type B households have endowment $e_2(1+g)^t$ in even periods and $e_1(1+g)^t$ in odd periods, where $e_1 > e_2 \geq 0$. Both types ($i = A, B$) seek to maximize an infinite horizon objective function

$$\sum_{t=0}^{\infty} \beta^t (1+g)^t v\left(C_t^i/(1+g)^t\right),$$

where v is an increasing, strictly concave function, and where C_t^i denotes consumption in period t by each household of type i. (We may suppose that each household is an infinite lived family whose members increase at the rate g, with per capita endowment remaining constant; the family pursues a joint consumption and savings program to maximize a discounted sum of individual family members' utilities.) Total lump sum tax collections in period t will be assumed to be equally divided across the two types, in the amount $T_t/2$ per household. For simplicity, there is no government consumption. Finally, each consumer has the opportunity each period to save by holding government bonds earning a real rate of interest r, or by accumulating capital, but is unable to borrow against his future endowments. The real value of the outstanding government debt at the end of period t will be denoted D_t. The goods produced in period t using capital are $Y_t = (1+g)^{t-1} f(K_t/(1+g)^{t-1})$, where K_t is the period t capital stock, and f is an increasing, strictly concave function. This can be interpreted as a constant returns to scale production technology with a fixed factor that grows at the same rate g as other endowments. It will be assumed for simplicity that households are all equally endowed with the fixed factor.

Let us consider a stationary equilibrium in which at the end of each period, the households that had a high endowment in that period (type A in even periods, type B in odd periods) save by holding both government debt and capital, but the consumers who had a low endowment are liquidity constrained (i.e., would borrow if they could at the rate of interest received by savers). By a stationary equilibrium, I mean one in which $C_t^i/(1+g)^t$ equals $\bar{c}$ in every period t in which type i households have a high per capita endowment, and $\underline{c}$ in every period in which they have a low per capita endowment, in which $K_t/(1+g)^t = k$, $D_t/(1+g)^t = d$ and $T_t/(1+g)^t = \tau$ are likewise constants, and in which the real interest rate on government debt is a constant r. In such an equilibrium, $\bar{c}$, $\underline{c}$, k, d, τ, and r satisfy

$$(1) \qquad v'(\bar{c})/v'(\underline{c}) = \beta(1+r)$$

$$(2) \qquad v'(\underline{c})/v'(\bar{c}) \geq \beta(1+r)$$

$$(3) \qquad f'(k) = 1+r$$

$$(4) \qquad \bar{c} = e_1 + [f(k)-(1+r)k]/2 - \tau/2 - d - (1+g)k$$

$$(5) \qquad \underline{c} = e_2 + [f(k)-(1+r)k]/2 - \tau/2 + d(1+r/1+g) + (1+r)k$$

$$(6) \qquad \bar{c} + \underline{c} = e_1 + e_2 + f(k) - (1+g)k$$

Here the expression $[f(k)-(1+r)k]$ represents the competitive returns to the fixed factor of production. We wish to compare alternative stationary equilibria corresponding to different permanent levels d of outstanding debt per capita. This requires us to solve (1) and (3)–(6) for $\bar{c}$, $\underline{c}$, k, r, and τ, given d, checking that the solution is also consistent with (2). Since (1) implies (2) if $1+r \leq \beta^{-1}$, and is inconsistent with (2) otherwise, we can replace (2) by the requirement that the equilibrium real interest rate be below that upper bound.

These equilibrium conditions are identical to those of a neoclassical model of the kind considered by Peter Diamond (1965), with an appropriate identification of variables. Let us define $\tilde{c}_1 = \bar{c}$, $\tilde{c}_2 = (1+g)\underline{c}$, $\tilde{e}_1 = e_1$, $\tilde{e}_2 = (1+g)e_2$, and $u(\tilde{c}_1, \tilde{c}_2) = v(\tilde{c}_1) + \beta(1+g)v(\tilde{c}_2/1+g)$. Then equations (1) and (3)–(6) correspond to the conditions for a stationary equilibrium of an overlapping generations model in which each consumer lives for two consecutive periods, has endowment $\tilde{e}_1$ in the first period of life and $\tilde{e}_2$ in the second, has access to the same production technology as above, has an endowment of the fixed factor of production that is $(1+g)$ times as large in the second period of life as in the first, and chooses a life cycle consumption plan $(\tilde{c}_1, \tilde{c}_2)$ to maximize $u(\tilde{c}_1, \tilde{c}_2)$, and in which lump sum taxes in the second period are $1+g$ times as large as in the first.

As a result, the liquidity-constrained model predicts *exactly the same* effects of changes in the size of the government debt on real interest rates as does the neoclassical model, although the former model is perfectly consistent with the Barro view that finite lived consumers belong to infinite lived families linked by bequests that, as a result, act as though they were jointly maximizing a single infinite horizon objective function. In particular, if consumption is sufficiently substitutable over time, a higher stationary debt per capita d will be associated with a higher real interest rate r, and hence (because of (3)) with a lower stationary capital stock per capita. Nonetheless, the two models make different predictions about other kinds of policy experiments. In particular, the liquidity-constrained model predicts no necessary effect upon interest rates, saving, or capital accumulation of a change in the size of Social Security transfers, assuming that age is uncorrelated with whether a consumer is currently a saver or a dissaver, while the neoclassical model predicts that variations in the size of Social Security transfers have effects that are formally *equivalent* to those of a variation in the size of the public debt.[2]

Furthermore, the welfare consequences of variations in the size of the public debt are not the same in the two models. In the neoclassical model with perfect financial intermediation and lump sum taxes, equilibrium is Pareto optimal as long as $r \geq g$ (the

[2]In the neoclassical model, the relation that exists between d and variables such as r and k depends upon the distribution of net tax collections between young and old, which is why Kotlikoff argues that the deficit as such is irrelevant. In the liquidity-constrained model, the relation that exists between d and r and k similarly depends upon the distribution of net tax collections between liquidity-constrained and unconstrained households, but, in this case, there is much greater reason to set aside the possibility of changes in that ratio when considering optimal fiscal policy (the liquidity constraints themselves may exist because of difficulty in observing differences in individual households' circumstances), and, in any event, the additional dimension of fiscal policy represented by that ratio has nothing to do with Social Security provisions.

case generally considered to be of empirical relevance, as discussed in Section III). And, comparing stationary equilibria satisfying this condition, all are Pareto optimal, but the stationary level of utility $u(\tilde{c}_1, \tilde{c}_2)$ is lower the higher is r, which is to say, the higher is d. The stationary level of utility is maximized by having a level of government debt only high enough to result in a rate of return $r = g$ (the Golden Rule case). But, in the model presented here, an efficient allocation of resources requires that $v'(\bar{c})/v'(\underline{c}) = v'(\underline{c})/v'(\bar{c})$ (i.e., that the liquidity constraints do not bind), which occurs only in an equilibrium with $1 + r = \beta^{-1}$. Thus efficiency requires that the real rate of interest be kept high enough, which, in the case of large enough intertemporal elasticity of substitution, requires that *the outstanding public debt per capita be maintained at a high enough level*. The level of real interest rates required for this condition to hold is higher than in the case of the neoclassical efficiency criterion, since (in order for the objective functions of the infinite lived households to be well defined) we must assume that $\beta^{-1} > 1 + g$. Furthermore, in the liquidity-constrained model, equilibrium is still inefficient (and a higher public debt is needed to achieve efficiency) *if it is still possible for an increased public debt to affect interest rates, saving, or investment*, since only when the liquidity constraints bind does Ricardian equivalence fail.

This result is not really a novel one. For the model is exactly the one in which Truman Bewley (1980) explains Friedman's doctrine regarding the "optimum quantity of money." Bewley postulates that money is held because it supplies liquidity in exactly the sense discussed here—it allows consumers to smooth consumption in the face of endowment fluctuations and an assumed inability to borrow against future endowment income. He compares alternative stationary equilibria with different constant rates of money growth and inflation, and argues that a policy that results in a higher level of real money balances and a higher real return to holding money improves efficiency. Specifically, he shows that a Pareto optimal allocation of resources occurs only when the real return on money is made as high as households' rate of time preference. This is just my result regarding the return on government debt. Note that my model has said nothing about nominal values; the above conclusions are independent of the rates of inflation and hence of nominal interest rates in the alternative stationary equilibria, and, in particular, continue to hold in the case of government debt bearing a zero nominal interest rate.

According to a common view, the Bewley-Friedman argument is relevant for money, but not for other government paper. However, Treasury securities (especially those with short maturities) also seem to enjoy a liquidity premium. This is shown by the fact that the yield on Treasury bills is lower than that on other assets, such as equities, to an extent that cannot plausibly be accounted for simply as a consequence of the assets' different degree of riskiness. But the existence of a liquidity premium implies perfect financial intermediation, and a fiscal policy that lowers this premium by bringing the rate of return on Treasury bills into line with those on other securities should increase efficiency.[3]

One disadvantage of the above model as an illustration of this view is that government debt and capital must earn the same rate of return, so that the liquidity services provided by government debt do not show up as a liquidity premium on government debt relative to other assets, and the increase in efficiency associated with a higher-debt policy is not reflected in the reduction of such a premium. However, as the following example shows, such effects can easily occur in a liquidity-constrained economy.

II. Public Debt May "Crowd In" Investment

I have presented an example above in which the effects of government debt on national saving and investment are exactly

[3]This conclusion is subject, of course, to the same sorts of second-best considerations that have been pointed out as qualifications to the Friedman argument. (See my forthcoming paper for a survey.)

the same as in the neoclassical model, to show that even if those predictions of the neoclassical model were found to be correct, the welfare conclusions of the model could be wrong. But, in fact, a higher public debt does not imply a lower capital stock under such general conditions in the case of economies with imperfect financial intermediation as in the neoclassical model. This is another significant difference between the two models. It is important to realize that acceptance of the view that the high real interest rates of the 1980s are largely a consequence of the change in U.S. fiscal policy does not require one to also believe that the higher government deficits have crowded out investment.[4] The following variant of the previous model shows how a higher public debt can actually bring about higher levels of national saving and investment, by reducing the extent to which people with access to productive investment opportunities are liquidity constrained.

Instead of assuming that consumers have access to the production technology in every period, let us suppose that a given household has access to it only in certain periods. The idea (represented here in an extreme form) is that particularly attractive investment opportunities come along for a given economic unit only at certain times, so that it has more use for funds on those occasions than at other times. An important function of liquid assets, in an economy without frictionless loan markets, is to allow such entities to concentrate their spending more in the periods when they have especially good opportunities. In order to focus upon this function, we can ignore altogether the need to smooth endowment fluctuations, by assuming a constant endowment stream.

Let us again suppose that there are two types of infinite lived households, with the same preferences and endowments as before, except that now $e_1 = e_2 = e$. The two types now differ instead in the times at which they have access to the production technology. Type A households can invest in physical capital in odd periods, and use that capital to produce in the following even periods; type B households have the opportunity to invest in even periods and to produce in the following odd periods. The production technology is the same as in the previous section. Again, the endowment of the fixed factor is equally divided across the two household types. Finally, let us assume again that private borrowing is impossible, but that all households are able to save by holding government debt. Taxes are again lump sum and equally distributed across household types.

Let us consider a stationary equilibrium in which all consumers are liquidity constrained in the periods in which they have investment opportunities (and as a result, hold no government debt in those periods), but not in the other periods (in which they save by holding government debt). Again, let $\bar{c}$ denote consumption per family member when the household is not liquidity constrained, and $\underline{c}$ consumption per family member when it is. Let d denote government debt held at the end of the period, and k denote the capital stock brought into the period, per non-liquidity-constrained family member, and let $\tau/2$ denote the taxes collected per family member each period. Then in such a stationary equilibrium, $\bar{c}$, $\underline{c}$, d, k, τ, and r must satisfy

$$v'(\bar{c})/v'(\underline{c}) = \beta(1+r) \tag{7}$$

$$v'(\underline{c})/v'(\bar{c}) = \beta f'(k) \tag{8}$$

$$f'(k) \geq 1+r \tag{9}$$

$$\bar{c} = e_1 + [f(k)-(1+r)k]/2 - d + (1+r)k - \tau/2 \tag{10}$$

$$\underline{c} = e_2 + [f(k)-(1+r)k]/2 + d(1+r/1+g)-(1+g)k - \tau/2 \tag{11}$$

$$\bar{c} + \underline{c} = 2e + f(k) - (1+g)k \tag{12}$$

[4]The other major industrial countries, that have on the whole pursued tighter fiscal policies, have suffered even greater declines in rates of private saving and domestic rates of investment (Barry Bosworth, 1990). He suggests that the reduced rates of saving and investment have resulted mainly from the slowdown in income and productivity growth since the mid-1970s.

Let us consider how the solution for $\bar{c}$, $\underline{c}$, k, τ, and r varies as the value of d is varied.

The most important difference between this model and that of the previous section is that (7) and (8) imply

$$(13) \qquad f'(k) = \beta^{-2}(1+r)^{-1}$$

so that the steady-state capital stock varies directly, rather than inversely, with the real return on government debt, which here is not equal to the return on capital. In fact, the spread between the return on capital and that on government debt is given by $f'(k) - (1+r)$, which by (13) is a decreasing function of r. As before, if consumption is sufficiently substitutable between periods, stationary equilibria with higher values of d (in the range where the liquidity constraints bind) will be associated with higher levels of the real interest rate r. But, now this implies a *higher* stationary capital stock per capita. A higher government debt can actually increase the steady-state capital stock, by improving the efficiency with which investment can be financed as a result of easing households' problem of the illiquidity of their claims to future endowment income.[5] Furthermore, in the case described, the spread between the return on capital and on government debt will be a decreasing function of the level of debt. Thus the increase in private sector liquidity due to an increase in public debt shows up in this case as a reduction of the spread between these two rates of return.

As in the previous section, in this economy Pareto optimality requires that $v'(\bar{c})/v'(\underline{c}) = v'(\underline{c})/v'(\bar{c})$, which again requires that $1+r=\beta^{-1}$. Again, keeping the real return on government debt high enough (in this case, high enough to eliminate the spread between the returns on the two assets) requires that the public debt be maintained at a high enough level.

[5]Hence Eisner's result suggesting that increases in the public debt tend to be associated with increases, rather than decreases, in investment is consistent with a fully "classical" theory of aggregate supply determination.

III. Higher Public Debt Need Not Imply Higher Taxes

An obvious qualification to the results of the previous two sections concerns the assumption of lump sum taxation. Equations (4)–(6), or equivalently (10)–(12), imply the relation $\tau = (r - g/1+g)d$. If $r > g$, this implies that a higher-debt stationary equilibrium must also have a higher level of tax collections. If, as assumed thus far, these taxes are lump sum, the size of tax collections has no effect upon welfare comparisons. But, it is more realistic to assume that the taxes must be raised in ways that will distort the allocation of resources. This would be a source of lower welfare in high-debt stationary equilibria, and would have to be weighed against the liquidity effects discussed above.

While this argument could well mean that it is not optimal to increase the size of the public debt to the point of "satiation in liquidity" (i.e., the point where liquidity constraints cease to bind), it remains likely, even when $r > g$, that some positive permanent level of public debt per capita will be optimal. This is in contrast to it being desirable to reduce the debt as much as possible. But, it is also important to realize that the extent to which a permanent increase in the ratio of public debt to national income requires an increase in future taxes need not be very great. Indeed, there may not have to be any increase in taxes at all.

Higher d implies higher τ only if $r > g$. Andrew Abel et al. (1989) argue that this is the empirically relevant case, in the context of a standard neoclassical model with efficient financial intermediation. In a stationary equilibrium with $r < g$, gross profits $k_t f'(k_t)$ should in each period be less than gross investment $(1+g)k_{t+1}$; but, in the U.S economy, gross profits are always about 25–28 percent of GNP while gross investment is only about 14–18 percent of GNP. But this evidence actually only shows that $f'(k) > 1+g$. In an economy with efficient financial intermediation, this would imply that $r > g$, but in a liquidity-constrained economy like that discussed in the previous section, it does not. Dynamic efficiency of the intertemporal production plan, established by Abel et al., does not rule out the possibility that an increase in the public debt can be simply rolled over forever without taxes ever having to be increased. Indeed, this appears to be a realistic possibility in the case of the U.S. economy. For the average real return on Treasury bills over the postwar period has been close to zero, while the average growth rate of real GNP has been over 3 percent per year. If this is so, the liquidity effects described in the previous two sections suggest that welfare could be increased by a permanent increase in the level of the public debt.

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