

# Discussion of ‘Federal Government Debt and Interest Rates’ by Eric Engen and Glen Hubbard

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## 1 Summary

This article addresses a timely question of significant import for today’s policy makers: what is the effect of government debt on interest rates? This paper measures how much larger real interest rates have been when the federal government has run large deficits or had a large debt.

The received wisdom on this topic, is given by the following quote from the 2003 Economic Report of the President:

. . . the marginal product of capital rises by 0.67 percent when the capital stock falls by 1.0 percent. . . one dollar of debt reduces the capital stock by about 60 cents. . . A conservative rule of thumb based on this relationship is that interest rates rise by about 3 basis points for every additional \$200 billion in government debt. – Council of Economic Advisers (2003) pp 57-58.

Glen Hubbard was of course the Chair of the Council of Economic Advisers when this report was written. And the rule-of-thumb in this quote is a useful guide for policy makers because it makes the point that government debt can raise interest rates and reduce private investment and economic growth. Thus, the benefits of any policy that increases debt should be weighed against these costs.

As the paper describes, the received wisdom comes in part from the analysis of a Cobb-Douglas production function in which output ( $Y$ ) is produced from capital ( $K$ ) and labor ( $N$ ) with capital share of about a third, denoted  $\alpha$ . Cost minimization by firms implies that

$$r = \frac{\partial}{\partial K} F(K/N) = A\alpha k^{\alpha-1} \quad (1)$$

where  $A$  is the level of technology and  $k$  is the capital labor ratio. The authors take the net return on private capital to be 10%.<sup>1</sup> Differentiating both sides of equation (1) with

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<sup>1</sup>In this discussion, all percentages are given at annual rates and all interest rates are real.

respect to the level of government debt ( $D$ ), the change in the real interest rate for a change in debt is:

$$\frac{dr}{dD} = \left( \frac{\partial K}{\partial D} \frac{\partial}{\partial K} + \frac{\partial N}{\partial D} \frac{\partial}{\partial N} \right) \frac{\partial}{\partial K} F(K/N)$$

If  $dN = 0$ , multiplying both sides by  $Y$  gives

$$\frac{dr}{dD/Y} = A\alpha(\alpha - 1)k^{\alpha-2}y\frac{\partial K}{\partial D} = (\alpha - 1)r\frac{y}{k}\frac{\partial K}{\partial D} \simeq -2.2\left(\frac{\partial K}{\partial D}\right)\%$$

So if we assume, as above, that  $\frac{\partial K}{\partial D} = -0.6$ , then a 1% change in the debt to GDP ratio leads to a 0.013% change in the real interest rate. This is small relative to the volatility of the real interest rate. For change in debt of 4 trillion dollars, or 40% of  $Y$ , which is both about the current level of federal debt and about how much the Congressional Budget Office's forecast of debt 10 years in the future has increased from January 2001 to the present, the real interest rate is predicted to change by just over half a percent.

From this exercise, the authors take three points: if debt crowds out capital, it raises the real interest rate; it is the level of debt that determines the level of the real interest rate; and the magnitude of the effect is small.

All the empirical findings of the paper are consistent with Figures 11 and 12. There is a small but significant correlation between debt and real interest rates. And there is a larger and significant relationship between deficits and real interest rates. The former finding is consistent with a slightly larger effect than the above rule of thumb suggests. The regressions suggest that a 1% increase in  $Debt/Y$  is associated with a 0.03 percentage point increase in  $r$ . The latter – the larger relationship between deficits and interest rates – supports, informally at least, a significant short-term Keynesian effect of deficits: deficits increase the demand for goods and raise interest rates.

According to my reading of the literature and this paper, these findings are robust and correct. To reverse them would require cruel and unusual treatment of the data. The balance of my discussion therefore focusses on interpretation.

I make two points. First, we are less concerned with the effect of debt on interest rates than the effect on capital or other measures of future well-being. The curvature of the production function, which the authors use to argue that the interest rate effect should be small, also implies that there are large effects of debt on capital for only small interest rate movements. Second, the effect of debt on interest rates is determined by the structure of the economy and by the tax and spending policies pursued in response to debt. In terms of understanding the causal effect of tax and spending policies on the capital stock and interest rates, at best the deficit and debt are noisy regressors. At worst, they are concepts without economic content.

## 2 Do we care about the effect on interest rates?

Only indirectly. We care directly about the effect of debt on real variables and outcomes, which can be large even when the effect on interest rates is small.

In extreme, there can be no effect of debt on real rates, and yet debt might significantly depress economic activity. Thus small interest rate effects do not imply small welfare costs of debt.

For example, the capital-labor ratio determines wages as well as the return to capital according to  $w = f(k) - rf'(k)$ . If a policy that increases debt also lowers labor supply or the accumulation of human capital, then the policy can have no effect on real rates and yet decrease output. As another example, if production has features of learning by doing or if there are human capital spillovers, so that the aggregate production function has the  $AK$  structure, then policy choices that increase debt and decrease capital will not change the interest rate even though they may have detrimental effects on output and economic growth. Finally, the US is a reasonably open economy, and so capital inflows offset government debt. In extreme, a policy that increases debt can have no effect on the interest rate or the capital stock, but can significantly reduce the future income of households.

Even assuming away movements in labor, taking as given the Cobb-Douglas production function, and assuming no capital inflows, the curvature of the production function, which the authors use to argue that the interest rate effect should be small, also implies that there are large effects of debt on capital and output for only small interest rate movements. Above, I calculated what the rule of thumb implied about the effect of the current Federal debt on interest rates. We can also calculate the effect on output. The production function implies that we can write

$$\frac{dY}{dD} = \frac{\partial}{\partial K} F(K/N) \frac{\partial K}{\partial D} = r \frac{\partial K}{\partial D}.$$

The current debt is roughly 4 trillion, which is roughly 13,000 per person. For  $\frac{\partial K}{\partial D} = -0.60$ , output declines by about \$1,000/year/person given marginal product of capital of 10%.

Finally, the same point can be made in reverse: policies that lead to large debt can be quite beneficial, irregardless of their effect on the real interest rate. It is possible that some policies that raise the debt also have benefits that outweighed the costs of the debt. While more debt is bad because it requires lower spending on public goods and services or higher levels of distortionary taxation, there can be benefits from the tax cuts or spending increases that caused the increase in debt. And the benefits of a policy can outweigh the costs of raising debt. Depending on your politics, think Head Start, defense spending, or investment tax credits. What matters in each case is not the effect on interest rates, but the benefits and costs – inclusive of debt – that the policy causes.

### 3 Do we care about the effect of debt?

We certainly care about the impact of any policy, as just noted. But the definition of debt is arbitrary. I make this point first in the context of measurement, using the example of the liabilities of the Social Security system. Then I argue that economic theory is not even clear about what debt is.<sup>2</sup>

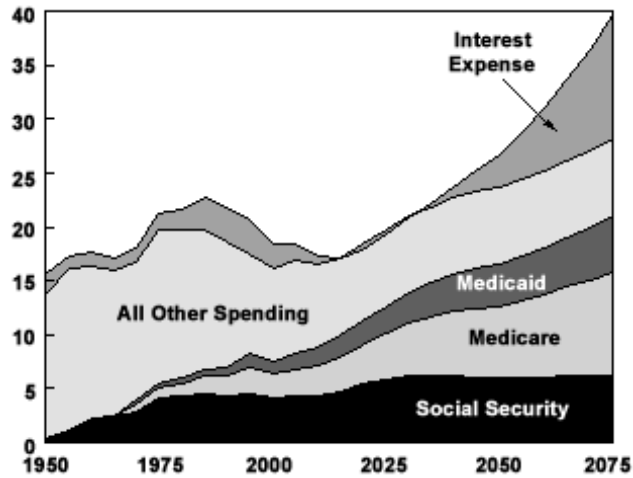
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<sup>2</sup>Kotlikoff (2002) presents the general argument in the context of an overlapping generation model.

Consider the US. Social Security and Medicare System (SSS). Households pay into the system and are promised in return a pension and health insurance when they retire. The government could set aside contributions and use these to fund the future benefits of the contributors. But it has not and does not, so that current benefits are paid from current contributions.<sup>3</sup> Thus the government has a commitment to pay resources to future retirees, and does not have the assets to cover these future liabilities.

Compare these promises made by the SSS to government debt. Debt is a commitment by the government to pay resources to bondholders, and the government does not have the assets to cover these future liabilities. Thus, the liabilities of the Social Security System are just like debt, with the one exception that the government does not count these liabilities as debt.

Figure 1: Federal Outlays by Type as a Percent of GDP



Source: Congressional Budget Office (2002).

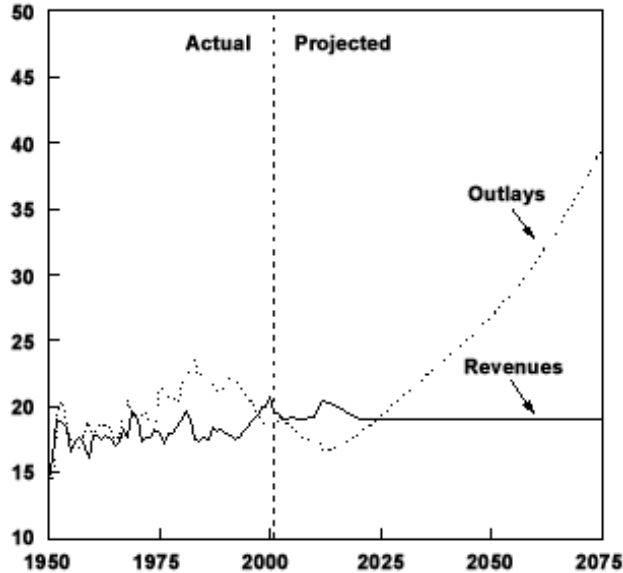
Is this a purely academic point? Not at all. The implicit liabilities in the SSS are larger than the current Federal debt. And Figure 1 shows that at current benefit rates, the SSS annual benefits are expected to increase dramatically. If the tax system remains stable, SSS expenses and interest on the official debt would exceed total federal government revenues in fifty years (Figures 1 and 2). Including SSS liabilities in debt measures would not only increase the official debt, but make it vary quite differently. The official debt is a political construction, not an economic concept, and it can be radically changed by a change of definition. This issue presents a significant problem for empirical work based on the official measure of debt.

Further, this issue – that the definition of debt is arbitrary – really means that to correctly measure the effect of a policy on interest rates requires a model of the future path of distortions and benefits of any policy. This requires many more assumptions about the structure of the economy than we can confidently make – making the case that historical correlations as studied by this paper are useful. But, the main ingredients

<sup>3</sup>There is a modest surplus in the current Social Security trust fund which is held in Treasury bonds.

at least are clear, and the parameter that the paper estimates is an amalgam of these ingredients.

Figure 2: Federal Revenues and Outlays as a Percent of GDP



Source: Congressional Budget Office (2002)

First, the correlation between debt and interest rates is determined by whether debt changes due to changes in government spending, lump-sum taxation, or distortionary taxation. As a basic example, consider deterministic variation in government defense purchases in a Ricardian economy with a fixed level of taxation. When government spending is high, deficits are high and the debt level rises, and there is high demand for goods today relative to goods tomorrow so that the real interest rate is high. But the debt is completely irrelevant for the capital stock and the prevailing interest rate. If instead, debt were being raised and lowered by fluctuations in taxes with a constant level of government spending, we would observe no correlation between interest rates and debt (*ceteris paribus*) because the interest rate would be constant (at least on the balanced growth path).

Second, how is the debt reduced? Bohn (1991) shows that historically just under two-thirds of U.S. has been eliminated by reductions in government spending (as a share of GDP) instead of increases in taxes. Thus, interest rates are raised by high debt because government spending is expected to be lower in the future and because taxes are expected to be higher.

Finally, the correlation between debt and interest rates depends on how distortionary taxes are. Other things equal, the presence of less distortionary taxes make fluctuations in debt less likely to affect interest rates. An extreme example is the opportunity – readily available right now in the US – to default on the debt. On the other hand, if all taxes were extremely distortionary, then debt could crowd out capital more than one-for-one if high debt meant that taxes had to be raised.

## 4 Conclusion: what is debt?

Consider a variant of the neoclassical model due to McGrattan and Prescott (2001), in which a price-taking representative household maximizes the present discounted value of utility ( $u$ ) from consumption ( $C$ ) and leisure ( $l$ )

$$Max \sum_t \beta^t U(C_t, l_t)$$

subject to an intertemporal budget constraint

$$\sum_t R_{0,t} \{C_t + V_t (s_{t+1} - s_t)\} = \sum_t R_{0,t} \{(1 - \tau_{div}) d_t s_t + (1 - \tau_{per}) (w_t N_t + INT_t) + T_t\}$$

where  $\beta$  is the discount factor,  $R_{0,t}$  is the gross real interest rate – the price of output at time  $t$  relative to time 0,  $V_t$  is the value of a share of the capital stock,  $s_t$  is the number of shares the household owns,  $\tau_{div}$  is the tax rate on dividends,  $d_t$  is the dividends per share,  $\tau_{per}$  is the personal income tax rate,  $w_t$  is the wage rate,  $INT_t$  is interest on government debt, and  $T_t$  are lump-sum transfers from the government to the household. We assume that  $U(C_t, l_t)$  is of the King-Plosser-Rebelo class of utility functions so that permanent changes in after-tax wages have no impact on labor supply ( $N$ ).

Firms maximize the present discounted value of dividends, where dividends are the profits of the firm after corporate taxes

$$d_t = (1 - \tau_{corp}) \{f(K_t, N_t) - w_t N_t - \delta K_t\} - K_{t+1} + K_t$$

where  $\tau_{corp}$  is the corporate tax rate and we assume that capital depreciates at rate  $\delta$ . Finally, markets clear:

$$\begin{aligned} l_t + N_t &= 1 \\ C_t + (K_{t+1} - (1 - \delta) K_t) + G_t &= F(K_t, N_t). \end{aligned}$$

Let the economy start in steady-state with fixed tax rates and  $Debt = 0$ , such that the intertemporal budget constraint of the government is met. And, as in the U.S., let the consumption share of output be greater than the labor share, so that net payments from firms to households are positive.

Consider a shock that raises  $Debt$  (or consider two otherwise identical economies with different initial levels of debt). Does debt raise interest rates and crowd out capital? Not necessarily. The following three policies to ‘balance the budget’ at  $t = 0$  do not affect the time path of  $\{Y, C, K\}$ .

1. A permanent increase in  $\tau_{div}$
3. A permanent cut in transfers
3. A one-time cut in entitlements: eliminate payments to bondholders

Under scenarios 1 and 2 the debt remains high for some time and is slowly reduced. Under scenario 3, the debt is eliminated at time zero (this policy can also be called

‘seigniorage’). Thus, among these policies, neither the debt shock nor the level of debt has any effect on the real outcomes of the economy.<sup>4</sup>

These claims follow almost directly from the following three equilibrium conditions (see also Bradford (1981)):

$$\begin{aligned} R_{t,t+1}^{-1} &= \frac{V_{t+1} + (1 - \tau_{div}) d_{t+1}}{V_t} \\ R_{t,t+1}^{-1} &= (1 - \tau_{corp}) (F_1(K_t, N_t) - \delta) + 1 \\ R_{t,t+1}^{-1} &= \beta \frac{u_{1,t+1}}{u_{1,t}} \end{aligned}$$

The third pins down  $R_{t,t+1}^{-1}$  as a function of the discount rate. The second gives the capital-labor ratio as a function of  $\tau_{corp}$  and  $R_{t,t+1}^{-1}$ . And the first gives the value of the capital stock as a function of  $R_{t,t+1}^{-1}$  and  $d_t$ , which in turn is given by the fixed steady-state level of  $N$ ,  $\tau_{corp}$ , and the already pinned down capital-labor ratio.

When are interest rates affected? The second equilibrium condition shows that debt would lead to an increase in the interest rate if households expected an increase in  $\tau_{corp}$  to balance the budget. The interest rate – the rate of return to capital – is reduced by the corporate tax rate. In steady-state, the capital stock is lower the higher  $\tau_{corp}$ .

So what is debt? Debt is only a plan to take money from some people and give it to some people. These can even be the same people. And the plan can be abandoned. There is nothing in “tastes” or “technology” that requires debt in the present to have any impact on the economy. But the interesting point for economic theory, is that it seems to.

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<sup>4</sup>It is also the case here that here permanent changes in  $\tau_{pers}$  are nondistortionary. But if we modelled human capital accumulation, then taxes on labor income would be capital taxes and so would be distortionary.