Notes on Optimal Debt Management

Robert J. Barro, Harvard University, May 1999

Consider the finance of an exogenous path of public expenditure, G(t), with taxes and public debt issues. In the absence of unexpected default, borrowing does not allow the government to escape taxes in a present-value sense. But the choices of how much to borrow and in what form affect the timing of tax collections and the ways in which these collections are contingent on economic outcomes. This note assesses these choices from an optimal-tax perspective. That is, the government is assumed to manage its debt to minimize the expected present value of the distortions from financing its expenditures.

The optimal-tax solution can be analyzed in three stages. In the first stage, the conditions hold for Ricardian equivalence, so that choices between debt and taxes do not matter. Sufficient conditions for this result are lump-sum taxes; certainty about future levels of income, public spending, rates of return, etc.; perfect capital markets; and infinite horizons for households. Under these conditions, the known present value of taxes is fixed by the given path of government spending. This result—the absence of a free lunch for the government—applies as long as the government cannot pursue Ponzi schemes or chain letters in which the public debt can grow faster than the economy forever. In this case, public borrowing can change the timing of taxes but not the present value. Therefore, the issue of an extra dollar of debt to cut current taxes by one dollar implies an increase by one dollar in the present value of future taxes.

With lump-sum taxes, infinite horizons, and perfect capital markets, the representative household cares only about the present value of taxes. The timing of these levies does not matter. Since a deficit-financed tax cut does not alter this present value, the tax cut does not affect consumer demand. It follows that the extra government bonds issued to finance the tax cut are willingly held by households without any changes in market interest rates. That is, the additional dollar of public dissaving is met by an added dollar of private saving, so that national saving does not change. In this world of Ricardian equivalence, the problem of optimal debt management is uninteresting. Not only the form, but also the quantity, of public debt is irrelevant.

The Ricardian proposition still holds with some modifications of the basic conditions. First, the irrelevance proposition is valid if households have finite lives, as long as the typical household is connected to future generations by a network of active intergenerational transfers based on altruism. For example, a tax cut financed by a budget deficit would appear to shift wealth from later to earlier generations. But the typical parent does not value this shift of resources away from children if the parent is already providing voluntary transfers to the children (through bequests or *inter vivos* payments). Hence, there is no effect on parents' wealth in a full sense and, consequently, no changes in consumer demand.

The result also remains valid with the existence of foreign debt. The present value of taxes paid by domestic residents is invariant with a current budget deficit even if some debt is held by foreigners. However, it may be true that the existence of foreign debt influences the government's incentives to default on its outstanding obligations. This effect could emerge if governments attach less cost to expropriating foreigners, rather than domestic residents.

The most important reason for the failure of Ricardian equivalence is probably the distortionary effect of real-world taxes. For example, labor-income taxes influence choices of how much and when to work. Similarly, taxes on expenditures or production—say consumption taxes or value-added taxes (VATs)—affect decisions on how much and when to spend and produce. In these cases, economic choices depend not only on the prospective present value of taxes but also on their timing. For example, people would be motivated to work little when labor-income tax rates were high and a lot when they were low.

In this second stage of the analysis, the government is typically motivated to arrange its debt issues so that the required taxes—say on labor income or consumption—are smoothed over time. This pattern avoids distortions that arise from irregular patterns of tax rates. Specifically, the government does not arbitrarily induce time variations in work and consumption that would result from irregular patterns of tax rates.

From an empirical and policy standpoint, the tax-smoothing approach generates two key implications. First, the government should run budget deficits at times of temporarily high public outlays. The classic situation is wartime deficit finance, as practiced, for example, by Britain from the late 1600s through World War I. The high levels of spending during wars are paid mostly by borrowing, rather than current taxation. Then the future financing of the accumulated debt implies correspondingly higher taxes during the later peacetime periods. Thus, taxes are raised by roughly the same amount during and after a war. Correspondingly, the government should run surpluses in peacetime. A similar situation arises for natural disasters, such as the recent hurricane in Central America, when public spending for infrastructure investment is temporarily high. These outlays should be financed mostly by public borrowing, unless a country can get some foreigners—such as the United States or the World Bank—to pay for the emergency expenditures through foreign aid.

The policy of paying for added public spending with debt issue works only if the extra spending is temporary. If the expansion of the public sector is permanent, then deficit finance means that taxes must be raised even more in the future—partly to pay for the added government expenditure and partly to finance the extra debt. Thus, the proper response to a permanent expansion of the public sector is a corresponding rise in tax revenues.

The second important result is that budget deficits should be high at times of temporary economic distress and low (typically negative) in good times. If public outlays do not fall proportionately with real income during a recession, a balanced-budget policy would require higher than normal tax rates. This policy would therefore violate the principle that tax rates should be smoothed over time. To avoid this outcome, the government has to borrow during recessions to keep tax rates relatively stable. This policy works because future periods with renewed economic activity will provide better times to raise tax revenues. However, the policy does not work if the depression in economic activity is permanent. In that case, if government expenditures are not cut, the proper response to an economic downturn is higher tax collections, not more public borrowing.

In this second stage of the analysis, the choice between public debt and taxes is important, and Ricardian equivalence does not hold. However, the selections among types of debt instruments—short- versus long-term, nominal versus real, domestic currency versus foreign currency—still do not matter. With perfect certainty for interest rates, price levels, exchange rates, etc., the rational pricing of each instrument on financial markets ensures that each option entails the same time path of real interest payments on the public debt. To assess the optimality of the composition of the public debt, one has to go to a third stage of the analysis in which uncertainty is introduced.

The important uncertainties are those that impinge on the government's budget—levels of public outlay, G(t); levels of real GDP, Y(t), which affect the government's tax base; and rates of return, r(t), payable on public borrowing. The government's optimal tax problem is now to minimize the expected present value of deadweight losses from financing the budget, subject to these uncertainties.

If the government and the private sector have access to the same menu of financial assets, then the problem considered here does not concern a country's overall risk position. For example, start from an optimal solution for public finance and then assume that the government arbitrarily issues some foreign currency bonds and retires some domestically denominated bonds. This change would, if not offset by the private sector, typically add to the country's overall risk position. This increase in risk results if real depreciations of the domestic currency tend to occur during bad economic times. In this case, the real amount owed on foreign currency debt is greater when the domestic economy is doing worse. The private sector would, however, avoid this risk by shifting its portfolio away from domestic currency bonds and toward foreign currency bonds. This response keeps the country's overall risk position with respect to the real exchange rate invariant to the government's arbitrary switches between foreign and domestic currency debt. This result means that the risks to be considered here involve only the effects of uncertainty in G(t), Y(t), and r(t) on the expected present value of the deadweight losses from raising taxes.

To begin, the uncertainties tend to motivate the government to issue securities whose payoffs are contingent on the relevant risks. For example, the government would like to issue bonds that pay off badly when G(t) is high and well when G(t) is low. It is

often argued, however, that the existence of these G-contingent government bonds creates moral-hazard problems. Specifically, the government is motivated, *ex post*, to overspend, perhaps even to fight too many wars. (Adam Smith and David Ricardo made arguments of this sort for Britain in the late 18th and early 19th centuries.) For this reason, we may not observe government bonds for which the payouts are explicitly contingent on the levels of public expenditure.

The government would also like to issue securities that pay off badly during recessions, when the tax base represented by Y(t) is low, and well during booms. This pattern could be achieved by issuing GDP-contingent bonds. These securities tend not to exist, but the reason for this omission is unclear. Errors and delays in national-accounts measurements may be explanations.

Finally, the government would like to issue securities whose payoffs are contingent on required rates of return for future debt issues. The idea here is to insulate the public budget from variations in these rates of return. The argument developed in the following is that this part of the government's objective can be accomplished by issuing indexed government bonds—linked, for example, to the consumer price index—and then choosing an appropriate maturity structure for the debt.

Let r(t) be the short-term real interest rate on indexed government bonds. If the government has a lot of short-term, indexed debt outstanding, then fluctuations in r(t) lead to corresponding variations in refinancing costs. These changes impinge accordingly on the government's budget and require changes in future taxes. For example, in 1994, when Mexico had a large amount of short-term indexed (and foreign currency denominated) debt outstanding, the sharp rise in r(t) associated with adverse political events created great pressure on the government's budget. Similarly, large quantities of short-term debt outstanding were problems for Russia in 1998 and Brazil in 1999. (Note that the relevant concept of short term is not the stated maturity of the debt but, rather, the degree of sensitivity of debt payments to fluctuations in short-term market real interest rates, r(t).)

The problems of fluctuating refinancing costs can be avoided by making the maturity structure of the public debt long term. The idea is to structure the debt so that similar and small quantities of government bonds are rolled over in each period. In a baseline case, where the expected values of G(t) and Y(t) are the same in each period, the best thing is for the government to use bonds whose real payouts are the same in each period. For a coupon bond, this construct corresponds to an indexed perpetuity or consol (as issued by Britain in the 18th and 19th centuries). This form of government bond is very long term, although the duration is not so different from those observed for indexed bonds issued currently by advanced countries, such as the United Kingdom, Sweden, Canada, and the United States. In these countries, debt tends to be short term mainly when it is nominal, rather than indexed. Nominal bonds are considered below.

If G(t) and Y(t) were known with certainty (or if debt payouts were contingent on the realizations of G(t) and Y(t)), the use of perpetuities would imply no rollover of public

debt and, hence, full insulation of refinancing costs from shifts in r(t). More generally, uncertainty about future values of G(t) and Y(t) (together with the absence of G- and Y-contingent bonds) implies that future refinancings or retirements of public debt must occur. Therefore, variations in r(t) have some impact on the public budget. However, the use of long-term debt makes the budget less sensitive than otherwise to fluctuations in r(t).

One possible argument against the issue of long-term bonds is that the government has more incentive, *ex post*, to default on its sovereign obligations the longer the maturity of the debt. However, the government can also default on short-term bonds, and it is unclear why default risk is more serious for long-term obligations.

What about nominal bonds denominated in domestic currency? For these securities, the real payouts decline when inflation rates, $\pi(t)$, rise. Hence, fluctuations in $\pi(t)$ cause variations in real financing requirements and, hence, in future taxes. Since the government is trying to smooth taxes, this property makes nominal bonds less attractive than indexed bonds if there is randomness in inflation.

If indexed bonds are unavailable and the government is forced to issue nominal bonds, then the solution for the optimal maturity structure of the public debt is different from that derived before. Fluctuations in inflation and, hence, nominal interest rates tend to affect the value of long-term nominal bonds more than that of short-term nominal bonds. Therefore, the government can lessen the impact of inflation on the public budget by shortening the maturity structure of the nominal debt. This shortened maturity—while a reasonable response to the constraint that bonds have to be nominal—has the drawback of increasing the sensitivity of the public budget to variations in real interest rates. The desire to insulate the budget from these variations in real rates was the rationale for long-term debt in the previous analysis.

Random fluctuations in inflation imply that nominal bonds are less attractive for public financing than indexed bonds. However, this consideration may be offset by the existence of correlations between $\pi(t)$ and the real variables—G(t) and Y(t)—which enter the government's budget. The usual view is that $\pi(t)$ is positively correlated with G(t) (inflation is, for example, high during wars) and negatively correlated with Y(t) (inflation is a signal of bad economic times). The last correlation, while likely accurate, conflicts with the Phillips-curve view in which inflation is high during booms.

Given the usually assumed correlations, nominal bonds tend to pay off badly when G(t) is high and Y(t) is low. These patterns are the ones that the government wished to exploit by issuing bonds with payouts that were explicitly contingent on G(t) and Y(t). If bonds with these explicit contingencies are unavailable, then it might be thought that nominal government bonds would be attractive. These bonds achieve some of the desired contingency patterns even if at the cost of introducing random fluctuations to the public budget due to uncorrelated variations in inflation.

If the reason for the absence of G-contingent public debt is the moral-hazard problem, then this argument for nominal government bonds is invalid. To the extent that $\pi(t)$ and $G(t)$ are positively correlated, the existence of nominal debt motivates the government to overspend in the same way as the G-contingent bonds. Thus, nominal bonds have the same moral-hazard problem as G-contingent real bonds and are otherwise inferior (because of the random fluctuations in inflation). If the moral-hazard problem is serious enough to make the issue of G-contingent bonds unwise, then this problem would also be strong enough to make nominal bonds less attractive for the government than non-contingent real bonds.

The argument about Y-contingent bonds is less clear. If the reasons for the non-existence of these securities are technical problems concerning the measurement of real GDP, then nominal bonds might be attractive when $\pi(t)$ and $Y(t)$ are negatively correlated.

Finally, what about government bonds denominated in foreign currency? In contrast with indexed domestic debt, foreign currency bonds introduce effects from variations in real exchange rates. If the domestic currency tends to depreciate in real terms during bad economic times, then foreign currency obligations affect the public budget adversely just when the tax base, $Y(t)$, tends to be low. Hence, the use of foreign currency debt makes the government's public-finance problem more difficult. Probably the main reason that developing countries issue dollar or other foreign-currency bonds is that the world financial markets operate primarily in these units. Hence, the extra premium required on domestically denominated issues (even if indexed) may justify the extra riskiness of the foreign currency debt. Otherwise, indexed domestic debt would be more attractive for the government than foreign currency debt.

Readings

Barro, R.J., "The Ricardian Approach to Budget Deficits," *Journal of Economic Perspectives*, Spring 1989.

Barro, R.J., "Optimal Management of Indexed and Nominal Debt," National Bureau of Economic Research, working paper no. 6197, September 1997.

Bohn, H., "Why Do We Have Nominal Government Debt?," *Journal of Monetary Economics*, January 1988.

Bohn, H., "Tax Smoothing with Financial Instruments," *American Economic Review*, December 1990.

Calvo, G. and P. Guidotti, "Indexation and Maturity of Government Bonds: An Exploratory Model," in R. Dornbusch and M. Draghi, eds., *Public Debt*

Management: Theory and History, Cambridge University Press, 1990.

Giavazzi, F. and M. Pagano, "Confidence Crises and Public Debt Management, "in R. Dornbusch and M. Draghi, eds., *Public Debt Management: Theory and History*, Cambridge University Press, 1990.