paid as interest and principal to foreigners. Hence, this critique of Ricardian debt equivalence turns out to be a red herring.

6.1.6 Empirical evidence

The Ricardian equivalence theorem has been the subject of many tests ever since its inception by Barro (1974). The existing literature is ably surveyed in a recent paper by Seater (1993). There is a substantial part of the empirical literature that finds it hard to reject the Ricardian equivalence theorem. Nevertheless, the jury is still out as solid tests with microeconomic data still have to be performed. Even though Seater (1993) concludes that debt equivalence is a good approximation, Bernheim (1987) in his survey comes to the conclusion that debt equivalence is at variance with the facts. Even though debt equivalence is from a theoretical point of view invalid and according to most macroeconomists empirically invalid as well, one might give the supporters of Ricardian debt equivalence, for the time being, the benefit of the doubt when they argue that the Ricardian proposition is from an empirical point of view not too bad. Hence, in the following section we see what role there is for government debt if Ricardian equivalence is assumed to hold.

6.2 The Theory of Government Debt Creation

Is there any role for government debt if it barely affects real economic outcomes such as investment and consumption? According to the neoclassical view of public finance, there is still a role for government debt in smoothing intratemporal distortions arising from government policy. In particular, government debt may be used to smooth tax and inflation rates and therefore private consumption over time. Such neoclassical views on public finance give prescriptions for government budget deficits and government debt that are more or less observationally equivalent to more Keynesian views on the desirability of countercyclical policy. After a simple discussion of the intertemporal aspects of the public sector accounts, we review the principle of tax smoothing. In the light of this discussion we are able to comment on the golden rule of public finance.

6.2.1 A simple model of tax smoothing

Assume that the policy maker can only raise revenue by means of a distorting tax system (e.g. labour taxes). Assume furthermore, that there are costs associated with enforcing the tax system, so-called "collection costs", and suppose that we can measure the welfare loss of taxation (L_G) as a quadratic function of the tax rates

(t_1 and t_2), and a linear function of income levels in the two periods (Y_1 and Y_2).

$$L_G \equiv \tfrac{1}{2}t_1^2 Y_1 + \tfrac{1}{2}\frac{t_2^2 Y_2}{1+\rho_G}, \tag{6.56}$$

where ρ_G is the (policy maker's) political pure rate of time preference. We continue to assume that household income is exogenous. The government budget restriction is augmented somewhat by distinguishing between consumption and investment expenditure by the government, denoted by G_t^C and G_t^I, respectively ($t = 1, 2$). Instead of equations (6.6)–(6.7) we have:

$$(D_1 \equiv)\; rB_0 + G_1^C + G_1^I - t_1 Y_1 = B_1 - B_0, \tag{6.57}$$

$$(D_2 \equiv)\; rB_1 + G_2^C - R_2^I - t_2 Y_2 = B_2 - B_1 = -B_1, \tag{6.58}$$

where R_2^I is the gross return on public investment obtained in period 2, so that the *rate* of return r_G can be written as:

$$R_2^I = (1 + r_G)G_1^I. \tag{6.59}$$

Obviously it makes no sense for the government to invest in period 2 since the world ends at the end of that period (hence $G_2^I = 0$). Note furthermore that (6.57)–(6.58) also imply the following relationship between the deficits in the two periods and the initial debt level:

$$D_1 + D_2 + B_0 = 0. \tag{6.60}$$

To the extent that there is an initial debt ($B_0 > 0$), the sum of the deficits in the two periods must be negative (i.e. amount to a surplus). The consolidated government budget restriction can be obtained in the usual fashion:

$$(1+r)B_0 + G_1^C + G_1^I - t_1 Y_1 = \frac{t_2 Y_2 + (1+r_G)G_1^I - G_2^C}{1+r}\; [\equiv B_1] \quad \Rightarrow$$

$$[\Xi_1 \equiv]\; (1+r)B_0 + G_1^C + \frac{G_2^C}{1+r} + \frac{(r - r_G)G_1^I}{1+r} = t_1 Y_1 + \frac{t_2 Y_2}{1+r}, \tag{6.61}$$

where Ξ_1 is the present value of the net liabilities of the government. We immediately see the *golden rule of government finance*: as long as $r_G = r$, government investment expenditure can be debudgeted from the government budget constraint. In words, public investments that attain the market rate of return give rise to no net liability of the government and hence do not lead to present or future taxation. They can be financed by means of debt without any problem.

The growth rate of income in this economy is defined as $\gamma \equiv Y_2/Y_1 - 1$, so that we can write $Y_2 = (1+\gamma)Y_1$, and everything can be written in terms of Y_1. Specifically, the right-hand side of (6.61) can be rewritten as:

$$\xi_1 \equiv \frac{\Xi_1}{Y_1} = t_1 + \left(\frac{1+\gamma}{1+r}\right) t_2, \tag{6.62}$$

where ξ_1 is net government liabilities expressed as a share of income in the first period.

The policy maker is assumed to minimize the welfare loss due to distortionary taxation, subject to the revenue requirement restriction (6.62). The Lagrangean is:

$$\mathcal{L} \equiv \tfrac{1}{2}t_1^2 Y_1 + \tfrac{1}{2}t_2^2\left(\frac{1+\gamma}{1+\rho_G}\right)Y_1 + \lambda\left[\xi_1 - t_1 - \left(\frac{1+\gamma}{1+r}\right)t_2\right], \tag{6.63}$$

so that the first-order conditions are:

$$\frac{\partial \mathcal{L}}{\partial t_1} = t_1 Y_1 - \lambda = 0, \tag{6.64}$$

$$\frac{\partial \mathcal{L}}{\partial t_2} = t_2\left(\frac{1+\gamma}{1+\rho_G}\right)Y_1 - \lambda\left(\frac{1+\gamma}{1+r}\right) = 0, \tag{6.65}$$

and the third condition, $\partial\mathcal{L}/\partial\lambda = 0$, yields the revenue requirement restriction (6.62). By combining (6.64)–(6.65), the *"Euler equation"* for the government's optimal taxation problem is obtained:

$$\lambda = t_1 Y_1 = \left(\frac{1+r}{1+\rho_G}\right)t_2 Y_1 \;\Rightarrow\; t_1 = \left(\frac{1+r}{1+\rho_G}\right)t_2. \tag{6.66}$$

This expression is intuitive: a *short-sighted government* (ρ_G greater than r) would choose a low tax rate in the current period and a high one in the future. In doing so, the "pain" of taxation is postponed to the future. The opposite holds for a very patient policy maker.

Equations (6.62) and (6.66) can be combined to solve for the levels of the two tax rates:

$$t_1 = \frac{(1+r)^2\xi_1}{(1+r)^2 + (1+\gamma)(1+\rho_G)}, \tag{6.67}$$

$$t_2 = \frac{(1+\rho_G)(1+r)\xi_1}{(1+r)^2 + (1+\gamma)(1+\rho_G)}, \tag{6.68}$$

where the optimal path for government debt is also implicitly determined by equations (6.67)–(6.68). We observe that the existing debt exerts an influence on the optimal tax rates only via ξ_1. In that sense it is only of historical significance. The debt was created in the past and hence leads to taxation now and in the future. The optimal taxation problem is illustrated in Figure 6.5. The straight line through the origin is the Euler equation (6.66), and the downward sloping line is the revenue requirement line (6.62). The concave curves are iso-welfare loss curves (i.e. combinations of t_1 and t_2 for which L_G is constant, or $dL_G = 0$). The closer to the origin, the smaller the welfare costs of taxation. The given revenue is raised with the smallest welfare loss in a point of tangency between the revenue requirement line and an iso-welfare loss curve. This happens at point E.

A special case of the tax-smoothing theory is obtained by assuming that $r = \rho_G$. In that case, (6.67)–(6.68) predict that the two tax rates are equal in the two periods:

$$t_1 = t_2 = \left(\frac{1+r}{2+r+\gamma}\right)\xi_1. \tag{6.69}$$

Debt is used to keep the tax rates constant, hence the name "tax smoothing".

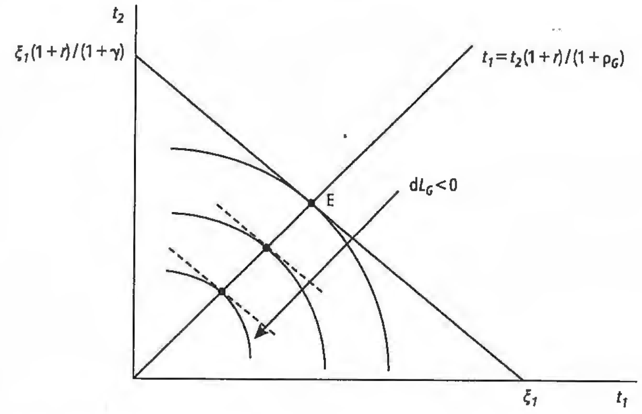

Figure 6.5. Optimal taxation

The left-hand side of (6.61) can also be expressed in terms of shares of current national income. After some manipulation we obtain:

$$\begin{aligned}\xi_1 &\equiv \frac{G_1^C}{Y_1} + \left(\frac{1}{1+r}\right)\frac{G_2^C}{Y_1} + \left(\frac{r-r_G}{1+r}\right)\frac{G_1^I}{Y_1} + (1+r)\frac{B_0}{Y_1}\\ &= g_1^C + \left(\frac{1+\gamma}{1+r}\right)g_2^C + \left(\frac{r-r_G}{1+r}\right)g_1^I + (1+r)b_0,\end{aligned} \tag{6.70}$$

where $g_t^C \equiv G_t^C/Y_t$, $g_1^I \equiv G_1^I/Y_1$, and $b_0 \equiv B_0/Y_1$. Furthermore, using (6.57), the deficit in period 1 can also be written in terms of national income in period 1:

$$d_1 \equiv \frac{D_1}{Y_1} = \frac{rB_0 + G_1^C + G_1^I - t_1 Y_1}{Y_1} = rb_0 + g_1^C + g_1^I - t_1. \tag{6.71}$$

The *spending point* is defined as the point where $D_1 = 0$, and is drawn as point E_0^S in Figure 6.6. The *optimal taxation point* is given by point E_0^T.

With the aid of this simple model a number of "rules of thumb" can be derived for the government's finances. First, as was mentioned above, government investment projects earning a market rate of return can be financed by means of debt. Second, consumption spending and losses on public investment projects should be financed by means of taxation. Third, tax rates should be smoothed as much as possible to minimize the welfare loss due to taxation. Fourth, a *temporary* rise in government consumption may be financed by means of debt. Formally, a temporary increase does not raise the revenue requirement of the government (ξ_1 is constant since $dG_2^C = -(1+r)dG_1^C$ implies that $d\Xi_1 = 0$), so that the revenue requirement line stays put. In terms of Figure 6.6, the spending point moves from E_0^S to E_1^S, the optimal taxes remain unchanged, and the temporary increase in government spending

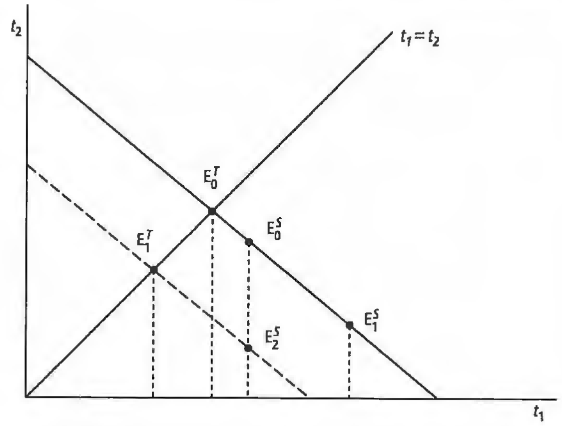

Figure 6.6. Optimal taxation and tax smoothing

is accommodated by an increase in the deficit (and hence debt) in the first period. This is a neoclassical policy prescription that looks a lot like old-fashioned Keynesian countercyclical policy. During (temporary) recessions there is no harm in letting the debt increase a little bit. Fifth, if it appears that the government's spending level has *permanently* increased ($d\xi_1 > 0$), tax rates should be increased immediately. For example, if we know that unemployment has permanently increased (and not due to a recession), taxes should be increased in order to finance the additional unemployment benefits. Sixth, if the government credibly announces that it is permanently lowering government spending, tax rates should be lowered immediately. This is a so-called "balanced decline" of the public sector. Seventh, if the government credibly announces that it will lower its consumption spending in the future ($dg_2^C < 0$), then the tax rates should be lowered immediately. In terms of Figure 6.6, the revenue requirement line shifts down and to the left, and the spending point moves from E_0^S to E_2^S directly below it. The deficit in the first period (and hence debt) increases as a result. Indeed, (6.69) and (6.70)–(6.71) predict that $dd_1/dg_1^C = (1+\gamma)/(2+r+\gamma) > 0$.

In Chapter 10 we shall return to the issue of debt management and the nation's finances. We do this in the context of models in which the political process is made endogenous, the so-called "endogenous politicians" or New Political Economy approach to macroeconomics. In that context it is much more natural to discuss the otherwise "hard to swallow" debt and deficit norms agreed upon by members of the European Community in the Maastricht Treaty. For those who cannot wait, the article by Buiter, Corsetti, and Roubini (1993) makes excellent reading.

6.3 Punchlines

In this chapter two concepts, both relating to the government budget constraint, are introduced and analysed, namely the so-called Ricardian equivalence theorem (RET) and the theory of tax smoothing.

Starting with the first of these, the RET can be defined as follows. *For a given path of government spending*, the particular financing method used by the government (bonds or taxes) does not matter. More precisely, when the RET is valid, the financing method of the government does not affect real consumption, investment, output, and welfare and government debt is seen as a form of delayed taxation. It must be stressed that the RET is not a statement about the effects of government consumption but rather deals with the way these expenditures are paid for by the government.

The intuition behind the RET is quite simple. If the government cuts taxes today and finances the resulting deficit by means of debt, then households will realize that, since total resources claimed by the government have not changed in present value terms, eventually the tax will have to be raised again sometime in the future. To ensure that it will be able to meet its future tax bills, the household reacts to the tax cut by saving it. The tax cut does not affect the lifetime resources available to the households and thus does not affect their consumption plans either.

Although the RET was not taken seriously by David Ricardo himself, it was (and still is) taken seriously by most new classical economists. A lot of objections have, however, been raised against the strict validity of the RET. First, if the Ricardian experiment involves changing one or more taxes which distort economic decisions (like a comprehensive income tax) then RET will fail. Intuitively, the lifetime resources available to the households will in that case depend on the particular time path of taxes and not just on the present value of taxes.

Second, if the household is unable to borrow freely, for example because future labour income cannot be used as collateral, then RET fails. Again, the reason for this failure is that the household choice set (and the severity of the household's borrowing constraints) is affected by the time path of taxes chosen by the government.

Third, if households have finite lives whilst the government (and the economy as a whole) is infinitely lived, RET may or may not be valid. It turns out that it matters whether the overlapping generations which populate the economy are altruistically linked with each other or not. Generations are altruistically linked if they care about each other's welfare (like children caring for their parents or vice versa). In the absence of intergenerational altruism, the RET fails. Intuitively, a tax cut now matched (in present value terms) by a tax hike later on will make present generations wealthier and future generations poorer. With intergenerational altruism it is possible that the RET holds because transfers between generations will take place. Intuitively, a tax cut today will be passed on to future generations in the form of an (additional) inheritance.