

Ricardian Equivalence

- We seek to answer the following question: Suppose that the government raises government spending. The extra spending can be financed either by raising taxes now, or by raising public debt. Does the mixture of financing matters for economic activity? E.g., should we run budget deficits along with fiscal stimuli, or should we strive for balanced budgets?
- Note that we are not examining here the costs and benefits of higher government spending. Instead, we take for granted that G increases and asks merely whether it matters how this increase in G gets financed.
- To start, we will answer this question assuming that taxes are non-distortionary (as with lump sum taxes) and that financial markets are perfect (households can freely lend and borrow as much as they wish).
- Thus consider a neoclassical economy as in the Ramsey model and in the equilibrium business cycle model we have studied. Take the representative household. This household chooses consumption, saving, and labor supply (or leisure).

- The household's preferences are given by

$$\max \sum_{t=0}^{\tau} \beta^t U(c_t, l_t)$$

were c_t is consumption, l_t is labor supply, β is the discount factor, and U is a utility function. The latter increasing and concave in c (people like consuming) and decreasing and convex in l (people dislike working).

- It's per-period budget constraint is given by

$$c_t^j + a_{t+1}^j = (1 + R_t)a_t^j + w_t l_t^j - T_t^j \quad \forall t$$

where a_t are the assets of the household and T_t are the taxes its pays to the government (net of any transfers it receives from it).

- Finally, household assets are given by

$$a_t = k_t + b_t$$

where k_t is the capital stock and b_t is the stock of government debt.

- Following similar steps as when we studied optimal consumption smoothing (see my lecture notes on consumption), we can show that the sequence of per-period budgets is equivalent to the following intertemporal budget constraint:

$$\sum_{t=0}^{\tau} q_t c_t \leq x_0$$

where

$$q_t \equiv \frac{1}{(1 + R_0)(1 + R_1)\dots(1 + R_t)} = \frac{q_t}{1 + R_t}.$$
$$x_0 = (1 + R_0)a_0 + \sum_{t=0}^{\tau} q_t w_t l_t - \sum_{t=0}^{\tau} q_t T_t$$

and $a_0 = k_0 + b_0$.

- Recall that q_t represents the price of period- t consumption relative to period-0 consumption (I have normalized $q_0 = 1$) and x_0 represents the total present-value wealth of the household.

- Consider now the government. It's per-period budget is given by

$$R_t b_t + g_t = (b_{t+1} - b_t) + T_t$$

On the left-hand side, we have government spending plus the interest on outstanding debt. On the right-hand side, we have tax revenue (net of any transfers) plus the money raised by new debt issuances.

- Similarly to the case of the household, the sequence of the government's per-period budget constraints is equivalent to the following intertemporal budget constraint:

$$\sum_{t=0}^{\tau} q_t g_t + (1 + R_0) b_0 = \sum_{t=0}^{\tau} q_t T_t$$

That is, the present value of tax revenue (on the right hand side) must be just enough to cover the present value of government spending plus the initial value of outstanding debt.

- Substituting for $\sum_{t=0}^{\tau} q_t T_t$ from the government's intertemporal budget into the household's intertemporal budget, we infer that the present-value wealth of the household is given by

$$x_0 = (1 + R_0)k_0 + \sum_{t=0}^{\tau} q_t w_t l_t - \sum_{t=0}^{\tau} q_t g_t$$

It is then immediate that the household's wealth is independent of either the outstanding level of public debt or the financing of government spending: x_0 is independent of $\{b_t, T_t\}_{t=0}^{\tau}$. All that matters is the present value of government spending, not how this is financed.

- Since the representative household's budget constraint is independent of $\{b_t, T_t\}_{t=0}^{\tau}$, its optimal consumption, saving, and labor supply decisions are also independent of this. Furthermore, the representative firm's decisions are also independent. But if neither the households' nor the firms' decisions are affected, then the equilibrium prices are also unaffected. We conclude:

Ricardian Equivalence. *Suppose that markets are perfect and taxes are non-distortionary. Then, equilibrium allocations and prices are independent of either the initial level of public debt, or the mixture of deficits and taxes that the government uses to finance government spending.*

- What's going on. Suppose that the government decides to finance an increase in g_t with a increase in debt instead of an increase in T_t . This means that the government de-saves (i.e., it runs a deficit). The households do not change their consumption, but they have to pay less taxes to the government. This means that they are saving more. In fact, private saving increases by exactly the same amount as the reduction in government saving. A public-sector deficit is thus perfectly offset by a private-sector surplus.
- Note however how this argument hinges on the household's ability to save and lend freely. In particular, suppose that households face tight borrowing constraints. These constraints may force private consumption to be lower than the optimum. Think, e.g., of young or unemployed households who would like to borrow against their future labor income, but can't do so because of borrowing constraint. Suppose then that the government runs a deficit now, which means that it shifts taxes from today to the future. Once again, the present-value wealth of the households still doesn't change. Nevertheless, because the households have to pay less taxes today, they are now able to afford higher consumption without having to borrow more. Since before the change in government policy consumption was depressed due to the borrowing constraint, consumption may now increase.

- In effect, when the government runs a deficit, it relaxes the bite of the borrowing constraint faced by the household. It follows that private consumption may now increase, and Ricardian equivalence breaks. In this sense, tax rebates, transfers, and deficits may help stimulate consumption and “aggregate demand”.
- Alternatively, suppose that household face tight borrowing constraints and the government decided to run a deficit, not by reducing taxes today, but rather by increasing government spending. Will this stimulate consumption? Or will it crowd out consumption? If it is the later case, will the crowding out be full or partial?
- Finally, Ricardian equivalence breaks also when taxes are distortionary. In this case, when the government runs a deficit, it effectively substitutes less distortions today against more distortions in the future. As in the case of a consumer who seeks to smooth its consumption, a benevolent government may then find it optimal to smooth tax distortions over time. This is what is often called “tax smoothing.” We will study this issue next.
- To recap, as long as financial markets are perfect (no borrowing constraints) and taxes are no distortionary, the timing of taxes and the financing of government spending are irrelevant.

Tax smoothing and debt management

- As anticipated, the dynamic pattern of taxes and deficits ceases to be indeterminate once taxes are distortionary.
- To capture this idea, let's us abstract from capital and labor supply, and let us capture the distortionary effects of taxation by assuming that collecting taxes is a costly activity (it wastes resources). This is meant to be a metaphor for the broader idea that higher taxes, by distorting incentives for work and saving, end up reducing economic activity.
- We thus assume that real income is given by

$$y_t = Y - \Lambda(T_t)$$

where Y is a constant that defines the level of income in the absence of taxation, T_t is tax revenue, and Λ is an increasing and convex function representing the resources wasted because of taxation (with $\Lambda(0) = 0$, $\Lambda(.)' > 0$, $\Lambda(.)'' > 0$).

- The government budget constraint:

$$R_t b_t + g_t = (b_{t+1} - b_t) + T_t$$

- The household budget:

$$c_t + b_{t+1} = (1 + R_t)b_t + y_t$$

- Combing the two, and using the definition of y_t , we reach the following representation of the resource constraint of the economy:

$$c_t + g_t = Y - \Lambda(T_t)$$

- Suppose now that the preferences of the household are linear in consumption:

$$\mathcal{U} = \sum_t \beta^t U(c_t)$$

with

$$U(c) = c$$

- From the Euler condition we then immediately get that

$$U'(c_t) = \beta(1 + R_{t+1})U'(c_{t+1})$$

$$1 = \beta(1 + R_{t+1})$$

and therefore

$$R_{t+1} = R = \rho \quad \left(\rho \equiv \frac{1-\beta}{\beta} \right)$$

That is, the interest rate is constant over time and equated to the household's subjective discount rate.

- Now, let us take the sequence of government spending as given, and let us consider the problem of a benevolent government that chooses the sequence of taxes and public debt so as to maximize social welfare (the life-time utility \mathcal{U} of the representative household).
- Using the facts that

$$U(c_t) = c_t = y_t - g_t = Y - \Lambda(\tau_t) - g_t$$

we can express welfare as

$$\mathcal{U} = \sum_t \beta^t [Y - \Lambda(\tau_t) - g_t]$$

- Next, using the fact that $\beta(1 + R_t) = 1$, or equivalently

$$q_t = \beta^t,$$

and setting $b_0 = 0$ for simplicity, we can restate the intertemporal government budget constraint as

$$\sum_t \beta^t g_t = \sum_T \beta^t T_t$$

- We can thus state the policy problem as

$$\max_{\{T_t\}} \mathcal{U} = \sum_t \beta^t [Y - \Lambda(\tau_t) - g_t]$$

subject to

$$\sum_T \beta^t T_t = \sum_t \beta^t g_t$$

- Clearly, since both Y and $\{g_t\}$ is exogenous, the above problem is equivalent to the following:

$$\min_{\{T_t\}} \sum_t \beta^t [\Lambda(\tau_t)]$$

subject to

$$\sum_T \beta^t T_t = \hat{G}$$

where $\hat{G} \equiv \sum_t \beta^t g_t$ is the present value of government spending.

- The above problem has a simple interpretation: the government must choose the sequence of taxes (and deficits) so as to minimize the present value of the social cost of tax distortions, pretty much as a consumer chooses the sequence of consumption (and saving) so as to maximize the present value of the utility of consumption.

- Note in particular that the present value of tax revenue, $\sum_T \beta^t T_t$, is pinned down by the present value of government spending, $\hat{G} \equiv \sum_t \beta^t g_t$ (which is here treated as exogenous). In this regard, the “average” deficit has to be zero over time: if the government borrows at some period, it has to pay back its debt at some other periods. However, the government is free to choose the timing of taxes and debt: it is free to run deficits in some periods and surpluses in other periods.
- The question of interest then is to understand what is the optimal strategy in terms of when to run deficits and when to run surpluses. To do this, we first ask what is the optimal path of taxes over time. Once we figure out the optimal taxes, the optimal primary deficit/surplus of period t is given simply by the residual between the (exogenous) spending g_t of that period and the (optimally chosen) tax revenue T_t of that period.

- To determine the optimal taxes, take the FOC of the government's optimization problem to get the following:

$$\Lambda'(T_t) = \lambda \quad \forall t$$

where λ is the Lagrange multiplier on the government's intertemporal budget. And since Λ' is strictly increasing (the distortionary costs of taxation are convex in the level of taxation), we conclude that the optimal policy is to equalize the tax rate across periods:

$$T_t = T^* \quad \forall t$$

- The level of T^* is then pinned down by the intertemporal budget: using $\sum_t \beta^t T_t = \hat{G} \equiv \sum_t \beta^t g_t$ from the intertemporal budget along with $T_t = T^* \quad \forall t$ from the aforementioned optimality condition, we get

$$T^* = \frac{\sum_t \beta^t g_t}{1 - \beta} \tag{1}$$

which means that T^* is equated to the annuity value of government spending.

- Clearly, this is similar to how a consumer equates his optimal level of consumption with the annuity value of his income, when the interest rate equals the discount rate and consumption is perfectly smoothed.

- Now, suppose that

$$g_t = \bar{g}$$

for all t . In this case, (1) reduces to

$$T^* = \bar{g}$$

and therefore the government runs a balanced budget in each period.

- Starting from the above situation, suppose that suddenly (and for reasons exogenous to our analysis here) government spending increases permanently to a new higher level:

$$g_t = \bar{g} + \Delta,$$

$\Delta > 0$. Then, (??) gives

$$T^{**} = \bar{g} + \Delta$$

which means that taxes shift up permanently and by the same amount as government spending, so that the government runs a balanced budget once again.

- Permanent increases in government spending therefore lead to equal permanent increases in taxes and no change in surpluses/deficits.

- Now, suppose instead that there is a temporary increase in government spending. Think, e.g., of a temporary fiscal stimulus lasting X years:

$$g_t = \bar{g} + \Delta \text{ for } t = 0, \dots, X - 1 \text{ but } g_t = \bar{g} \forall t > X.$$

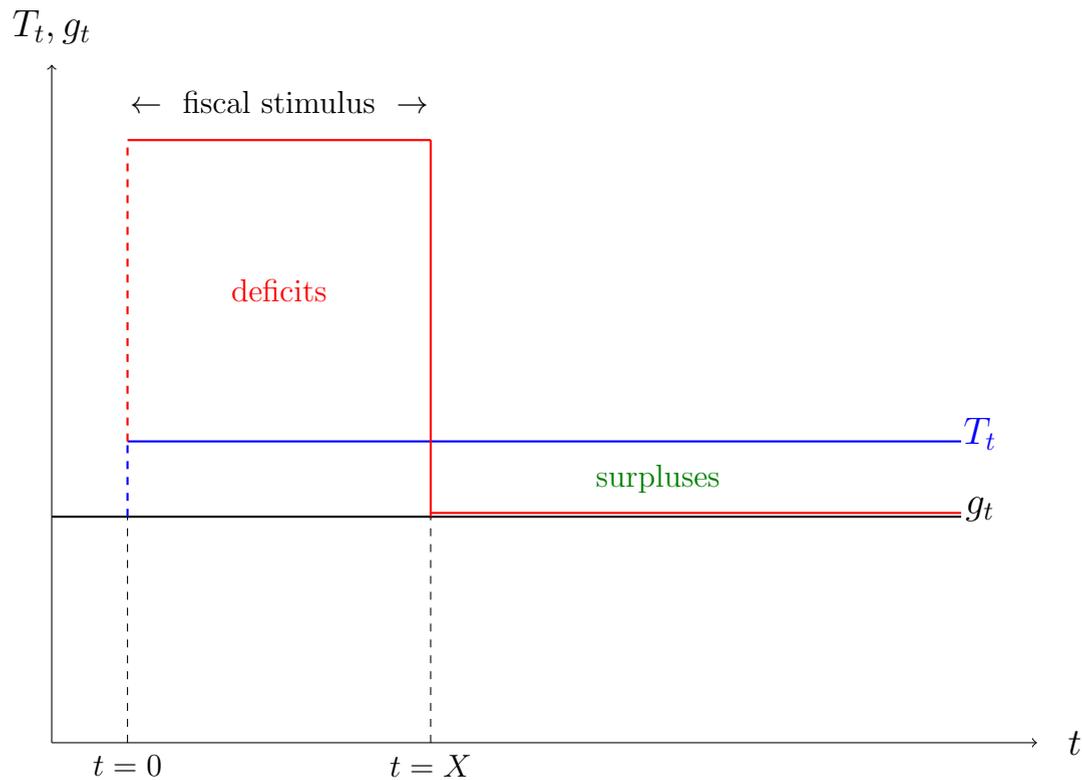
In this case, (1) reduces to

$$T^{***} = \bar{g} + \frac{1 + \beta + \dots + \beta^X}{1 - \beta} \Delta$$

- If the interest rate is a small number R (say, R is a couple percentage points) and the length X is also small (say, X is a couple of years), the above gives

$$T^{***} = \bar{g} + RX \cdot \Delta$$

where $RX \ll 1$. For example, with $R = 0.025$ and $X = 2$, we get that, during the two years of the fiscal stimulus, the increase in taxes should be about only $RX = 5\%$ of the contemporaneous increase Δ in government spending. That is, almost all the fiscal stimulus must be financed with deficits. But after g returns to its normal level, taxes must remain higher for ever, in order to run primary surpluses that will pay for the interest on the debt that it got accumulate during the fiscal stimulus.



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