

Economic Modelling

Ricardian Equivalence: Example of Two Period
General Equilibrium with Taxes with Representative
Agents

Dr. Keshab Bahttarai,
Business School University of Hull

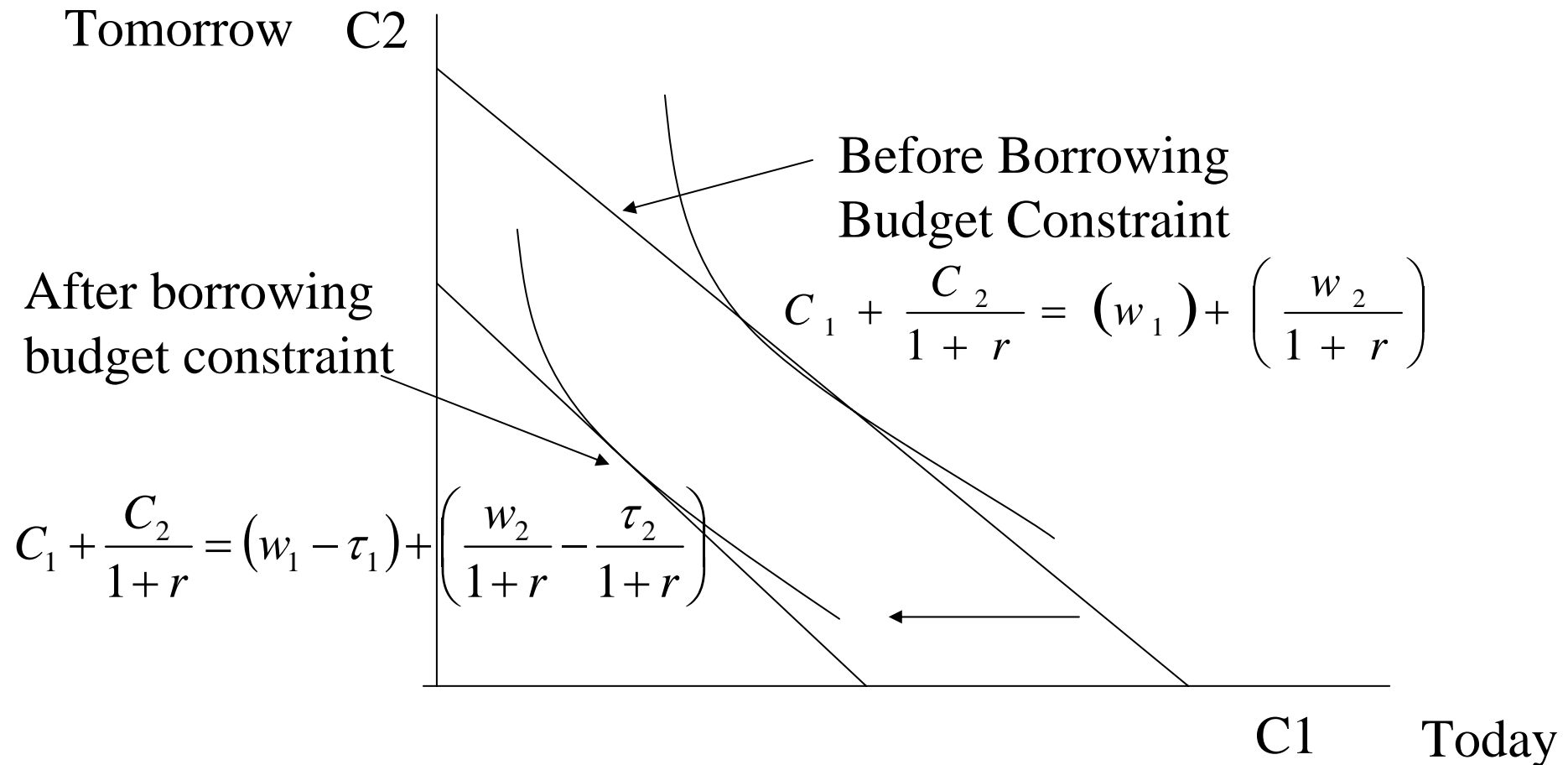
Ricardian Equivalence: Main Proposition

- How important is a tax cut?
- Should government finance deficit by borrowing or by raising taxes?
- Ricardian Equivalence Theorem is after David Ricardo.
- British economist, who wrote about 180 years ago that it does not matter whether government finances its deficit by
 - borrowing or
 - taxes.

Ricardian Equivalence: Main Proposition

- If it borrows now it raises tax in future for repayment of its debt.
- With more current debt private households save more in anticipation of higher taxes in the future that government will impose on them to repay the debt.
- Private households optimise intertemporally and completely internalise public policy.
- Borrowing only or tax only strategy does not matter if both the government and household honour their own inter temporal budget constraints.

Basic Proposition of the Ricardian Equivalence Tax or Borrowing Does not Make Any Difference



Model Economy for Ricardian Equivalence Theorem

Preference of households:

$$U(C_1, C_2) = \ln C_1 + \beta \ln C_2$$

Endowments:

$$\{w_1, w_2\}$$

Government policy:

$$\{G_1, G_2, \tau_1, \tau_2, B\}$$

Budget constraint for N identical households (in real terms)

Period 1:

$$C_1 + b \leq w_1 - \tau_1$$

Period 2:

$$C_2 \leq b(1+r) - \tau_2$$

Budget constraint for the Government:

Period 1:

$$G_1 + B \leq N \tau_1$$

Period 2:

$$G_2 \leq B(1+r) + N \tau_2$$

Tax Spending and Borrowing Strategies

Inter-temporal budget constraint for the government:

$$G_1 + \frac{G_2}{1+r} = N\tau_1 + \frac{N\tau_2}{1+r}$$

Two strategies of financing fixed amount of G_1 and G_2

(i) Taxes only strategy: $\{G_1, G_2, \tau_1, \tau_2, B = 0\}$

(ii) Borrowing strategy $\{G_1, G_2, \tau_1 = 0, \tau_2, B\}$

Market clearing for goods in period 1 and 2:

$$NC_1 + G_1 = Nw_1$$

$$NC_2 + G_2 = Nw_2$$

Optimisation for Ricardian Equivalence Theorem

Inter temporal budget constraint for individuals

$$C_1 + \frac{C_2}{1+r} = (w_1 - T_1) + \left(\frac{w_2}{1+r} - \frac{T_2}{1+r} \right) \quad (2)$$

where $T_1 = N\tau_1$ $T_2 = N\tau_2$

$$L = \ln C_1 + \beta \ln C_2 + \lambda \left[C_1 + \frac{C_2}{1+r} - (w_1 - T_1) - \left(\frac{w_2}{1+r} - \frac{T_2}{1+r} \right) \right]$$

First order condition for optimisation:

$$\frac{C_2}{\beta C_1} = 1+r \Rightarrow C_2 = \beta(1+r)C_1$$

Using it in the intertemporal budget constraint:

$$C_1 = \frac{1}{1+\beta} \left[(w_1 - T_1) + \left(\frac{w_2}{1+r} - \frac{T_2}{1+r} \right) \right]$$

Conclusion of the Ricardian Equivalence Theorem

Given that number of households remains N

The strategy 1 gives solution to consumption as above.

There is no borrowing but only taxes in both periods.

Per Capita Consumption $c_1^* = w_1 - g_1$; $c_2^* = w_2 - g_2$.

In strategy 2 government cuts taxes to 0 in the first period and borrows to finance services and pays back by paying higher taxes in period 2.

These two financing scheme are equivalent. Because if government borrows 1 now, it has to pay back $(1+r)$ in period 2. Tax also has to increase by $(1+r)$ in period 2.

People anticipate higher taxes in future and save more in period 1 to be able to pay in period 2.

These two effects offset each other. Both strategies of financing public deficit yields the same result.

Numerical Proof of Ricardian Equivalence Theorem -1

Tax only Strategy

Endowments: $\{w_1, w_2\} = \{100, 100\}$

Interest rate 5%

Lump Sum Taxes in periods 1 and 2

$$\tau_1 = 20 ; \tau_2 = 20$$

Thus the government is committed to provide services

$$R = 0.2(100) + 0.2\left(\frac{100}{1.05}\right) = 39.04$$

Using these information in consumption function for period

$$C_1 = \frac{1}{1 + \beta} \left[(w_1 - \tau_1) + \left(\frac{w_2}{1+r} - \frac{\tau_2}{1+r} \right) \right] = \frac{1}{1.9} \left[80 + \frac{80}{1.05} \right] = 82.2$$

Consumption in period 2

$$C_2 = \beta(1+r)C_1 = 0.9(1.05)(82.2) = 77.8$$

Borrowing strategy: period 1 borrowing of 30

$T_2 = ?$ if $T_1 = 0$ (it will certainly be higher)

Fix the consumption level as before at $C_1 = 82.2$

$$C_1 = \frac{1}{1 + 0.9} \left[100 + \left(\frac{100}{1 + 0.05} - \frac{T_2}{1 + 0.05} \right) \right]$$

$$82.2 = \frac{1}{1 + 0.9} \left[100 + \left(\frac{100}{1 + 0.05} - \frac{T_2}{1 + 0.05} \right) \right]$$

$$T_2 = \left[1.05 \left\{ (82.2 \times 1.9) - 100 - \frac{100}{1.05} \right\} \right] = 41.1$$

Thus taxes in period 2 has risen to 41.1.

Loan repayment $B(1 + r) = 30(1.05) = 31.5$;

$$c_2 = \beta(1 + r)c_1 = 0.9(1.05)82.2 = 77.68$$

Since households know that they have to pay so much of taxes in period 2, they increase their saving in period 1 in anticipation of higher taxes in period 2.

Limitations of Ricardian Equivalence Theorem

Why was there a big concern on accumulation of public debt in 1970 and early 1980s? Also to debt accumulation in many developing economies?

By Ricardian Equivalence private saving rises against an increase in the public sector deficit.

If private sector saving compensates for public sector deficit then there is no alteration in national saving in response to public debt.

There is no crowding out between public and private sector.

This does not hold when private agents face inter generational borrowing-lending constraint or if it takes long time for government to increase taxes to repay debt.

By choosing deficit financing by borrowing government is promoting inter generational transfers because current debts may be paid by taxing people in the far distant future generation.

Main issue in this intergenerational transfer is that how many people save for their children, grand children or grand-grand children?

How Big the Debt Problem Around the World?

Debt Outstanding and Debt Services (in Billion of US \$)

| | 2002 | | 1990 | |
|--|--------|--------------|--------|--------------|
| | Debt | Debt Service | Debt | Debt Service |
| DEVELOPING COUNTRIES | 2186.4 | 315.2 | 1259.8 | 140.6 |
| AFRICA | 268 | 26.9 | 244.3 | 16.9 |
| SUB-SAHARA AFRICA | 221.3 | 18.4 | 187.6 | 13.5 |
| DEVELOPING ASIA | 711.1 | 89.9 | 335.5 | 36 |
| MIDDLE EAST | 426 | 44.3 | 234.7 | 24.1 |
| WESTERN HEMISPHERE | 781.3 | 154.2 | 445.2 | 63.5 |
| COUNTRIES IN TRANSITION | 374.7 | 51.6 | 203.2 | 44.1 |
| CENTRAL AND EASTERN EUROPE | 195.6 | 31.8 | 113.6 | 25.7 |
| COMMONWEALTH OF INDEPENDENT STATES AND MONGOLIA | 179.1 | 19.9 | 89.6 | 18.4 |
| COMMONWEALTH OF INDEPENDENT STATES AND MONGOLIA, EXCL RUSSIA | 46.2 | 5.2 | 0.1 | 0.1 |

References

- Barro, R. J. (1974), "Are Government Bonds Net Wealth?," Journal of Political Economy pp. 1095-1117.
- Clark Tom , M Elsby and S Love (2001) Twenty Five Years of Falling Investment? Trends in Capital Spending on Public Services, Institute of Fiscal Studies.
- HM Treasury (2002) Reforming Britain's Economic and Financial Policy, Palgrave, Institute for Fiscal Studies (2002), The IFS Green Budget, January.
- Ricardo David, Principles of Political Economy