

Macroeconomic Theory and Policy

Lecture 17

National Debt and Ricardian Equivalence

Reasons for Public Debt

- No debt if the budget is balanced every time:
 $G - T = 0$
- Debt (B) accumulates when $G > T$.
- Change in debt has two components

Primary deficit $(\Delta B = G - T)$

Debt servicing rB

$$\Delta B = (G - T) + r B \quad (1)$$

Debt and Primary Surplus

In terms of GDP

$$\frac{\Delta B}{Y} = \frac{(G - T)}{Y} + \frac{rB}{Y} \quad (2)$$

If the primary budget is balanced $G - T = 0$
Then the debt increases by the rate of interest:

$$\frac{\Delta B}{B} = r \quad (3)$$

A primary surplus is required to pay the interest if debt is to remain constant

$$\Delta B = 0 \Rightarrow (T - G) = rB \quad (4)$$

Budget Surplus Required Keep the Debt/GDP Ratio Constant

$$\Delta\left(\frac{B}{Y}\right) = \frac{\Delta B}{Y} - \frac{\Delta Y}{Y} \frac{B}{Y} \quad \Rightarrow \quad \Delta\left(\frac{B}{Y}\right) = \frac{\Delta B}{Y} - g \frac{B}{Y} \quad \Rightarrow \quad \frac{\Delta B}{Y} = \Delta\left(\frac{B}{Y}\right) + g \frac{B}{Y}$$

$$\frac{\Delta B}{Y} = \Delta\left(\frac{B}{Y}\right) + g \frac{B}{Y} = \frac{G - T}{Y} + \frac{rB}{Y}$$

$$\Delta\left(\frac{B}{Y}\right) = \frac{G - T}{Y} + (r - g) \frac{B}{Y} \quad (5)$$

$$\Delta\left(\frac{B}{Y}\right) = 0 \quad \Rightarrow \quad \left(\frac{T - G}{Y}\right) = (r - g) \frac{B}{Y}$$

Determinants of Debt/GDP Ratio

- Higher the interest higher is the B/Y
- Lower the growth rate of the economy higher the B/Y
- Higher the current deficit ($G - T$) higher will be the B/Y
- Higher the initial B/Y higher will be the B/Y in subsequent years

Example

Debt ratio = 100% $r = 3%$ $g = 2%$

$G - T = 1%$ is required to keep B/Y constant

Derivation of Inflation Tax from Nominal Balances (Seigniorage finance)

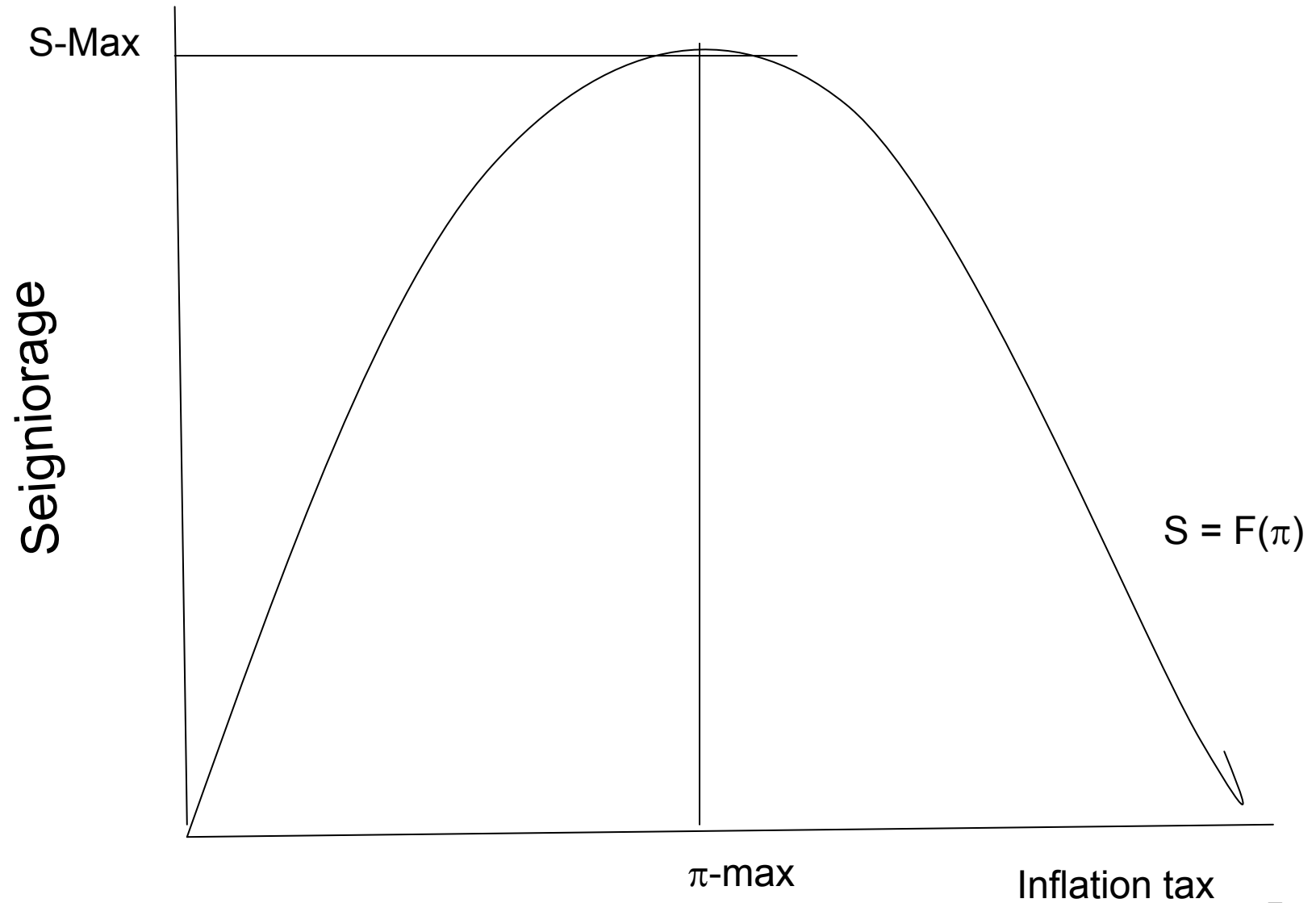
$$\frac{\Delta(PB)}{PY} + \frac{\Delta M}{PY} = \frac{PG}{PY} - \frac{PT}{PY} + i \frac{PB}{PY}$$

$$\Delta\left(\frac{B}{Y}\right) = \frac{G - T}{Y} + (i - \pi - g) \frac{B}{Y} - \frac{\Delta M}{PY}$$

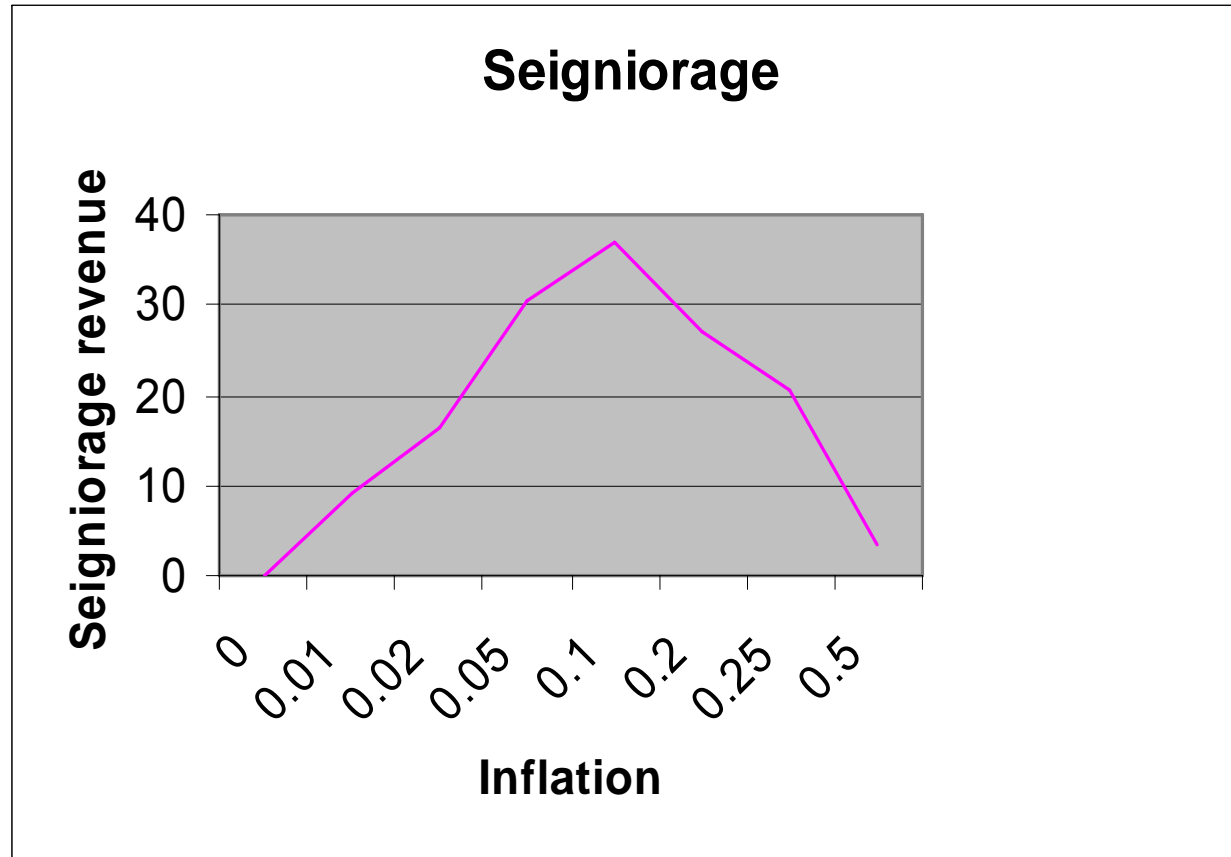
$$\Delta\left(\frac{B}{Y}\right) = 0 = \frac{G - T}{Y} + (i - \pi - g) \frac{B}{Y} - \frac{\Delta M}{PY}$$

$$\frac{T - G}{Y} + \frac{\Delta M}{PY} = (i - \pi - g) \frac{B}{Y}$$

Limitation of Inflation Tax



Seigniorage (Inflation Tax) : A Numerical Example



M/P	π	Si
1000	0	0
905	0.01	9.05
819	0.02	16.38
607	0.05	30.35
368	0.1	36.8
135	0.2	27
82	0.25	20.5
7	0.5	3.5

Macroeconomic Problem: High Inflation

Country	Beginning	End	P_T/P_O	Average Monthly Inflation rate (%)	Average Monthly Money Growth (%)
Austria	Oct. 1921	Aug. 1922	70	47	31
Germany	Aug. 1922	Nov. 1923	1.0×10^{10}	322	314
Greece	Nov. 1943	Nov. 1944	4.7×10^6	365	220
Hungary I	Mar. 1923	Feb. 1924	44	46	33
Hungary II	Aug. 1945	Jul. 1946	2.8×10^{27}	19,800	12,200
Poland	Jan. 1923	Jan. 1924	699	82	72
Russia	Dec. 1921	Jan. 1924	1.2×10^5	57	49

	Average Monthly Inflation Rate (%)				
	1976-1980	1981-1985	1986-1990	1991-1995	1996-1998
Argentina	9.3	12.7	20.0	2.3	0.1
Brazil	3.4	7.9	20.7	19.0	0.6
Nicaragua	1.4	3.6	35.6	8.5	--
Peru	3.4	6.0	23.7	4.8	0.8

Source: Blanchard (2000)

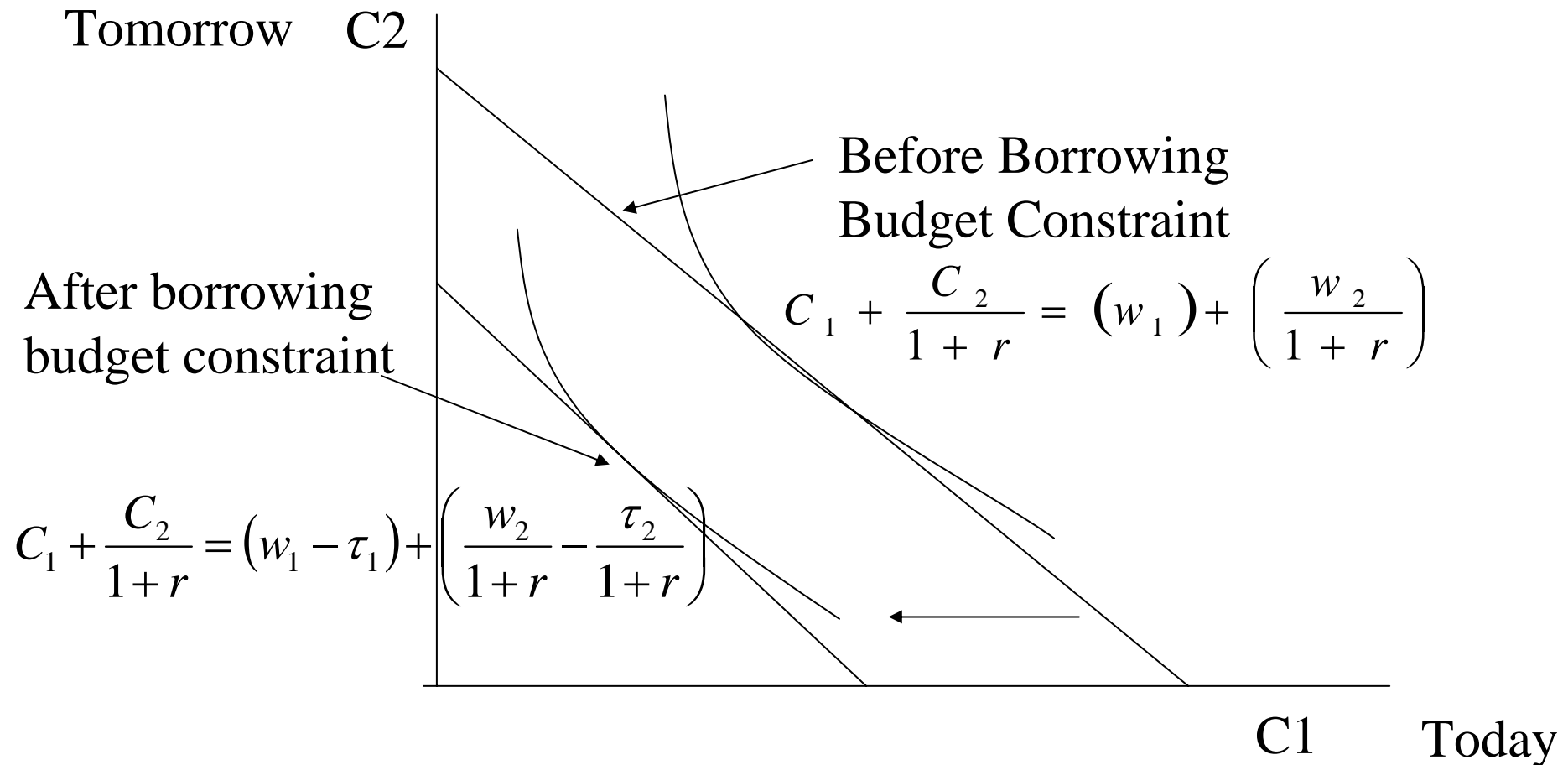
Ricardian Equivalence: Main Proposition

- 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

- Aghevli B B (1977), Inflationary Finance and Growth, Journal of Political Economy, vol. 85, no.6 pp. 1295-1307.
- Barro, R. J. (1974), "Are Government Bonds Net Wealth?," Journal of Political Economy pp. 1095-1117.
- Bhattarai K. (2002) Welfare Impacts of Equal-yield Tax Reforms in the UK Economy, mimeo, University of Hull.
- Bhattarai K. and J. Whalley (1999) "Role of labour demand elasticities in tax incidence analysis with heterogeneous labour" Empirical Economics, 24:4, pp.599-620.
- 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.
- Dilnot A, C.Emmerson and H.Simpson (2002) The IFS Green Budget: January 2002, Institute of Fiscal Studies, Commentary 87, 7 Ridgmount Street, London WC1E 7AE.
- <http://www.ifs.org.uk/budgetindex.shtml>; <http://www.ifs.org.uk/public/bn20.pdf>.
- HM Treasury (2002) Reforming Britain's Economic and Financial Policy, Palgrave.
- Institute for Fiscal Studies (2002), The IFS Green Budget, January.