# Advanced Modern Macroeconomics

## Public Finance

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6 December 2010

- Focus on government budget constraint.
  - Initial start-up, each period, over complete time.
  - Budget constraint built period by period;
  - taken to limit: notion of government wealth constraint.
  - Includes limiting condition on government borrowing.
- Ricardian equivalence:
  - means government wealth constraint is binding;
  - solvent government must repay value of spending, debt,
  - with value of tax revenue, other funding sources.
  - Debt: discounted flow of revenue net of spending;
  - no net wealth residual from government borrowing.
- Examples:
  - seigniorage from printing money, and money-output ratio;
  - EU Maastricht Treaty mathematical link between deficits, debt;
  - optimal taxes with implied deficit, debt totals.

# Building on the Last Chapters

- Chapter 3 introduces government budget constraint, taxes.
    - also found in Chapters 6, 9.
    - Last chapter: government borrowing through bonds.
    - Taxes on goods, labor income, capital income, plus issuing bonds,
    - now also supplemented by printing money for spending.
- Main difference: implications over time developed.
    - to form government wealth constraint,
    - like consumer wealth constraint construction
    - from each period budget constraint.
- The infinite stream of revenue, spending, with discounting
    - related to stock valuation of last chapter.
    - Discounting key element of finance theory,
    - both for private markets and government finance.

# Learning Objective

- Derive wealth constraint
  - adding up government time constraints at each period,
  - as discounted by interest rate.
- Concept of Ricardian equivalence;
  - how simple concept can be applied,
  - to a variety of financial elements,
  - including deficit and debt limits
  - of the European Union.
- See role of printing money in financing government:
  - an implicit tax that like other taxes
  - adds to government revenue.

# Who Made It Happen

- David Ricardo: *The Principles of Political Economy and Taxation*,
    - with last (3rd) edition of 1821; anything spent now paid for later.
    - Respect for government intertemporal budget constraint:
    - borrowing, spending today paid off by taxes in future.
    - Called "Ricardian equivalence".
- Non-Ricardian theories in contrast:
    - government spending financed by borrowing
    - with positive net effect on economy.
- Keynes 1936: increase government spending
    - as way out of 1930s Great Depression,
    - also proposed in 2007-2010 world recession.
    - "Keynesian" economics policy prescription, Hansen 1953, 1960,
    - questioned by nature of Ricardian equivalence.
- Barro 1979 revived Ricardian equivalence.
    - Woodford 2003 revives non-Ricardian ideas,
    - of new Keynesian policy agenda to run up debt, spending.
    - Ricardian theory: short term solutions burden future generations.

# Government Budget and Wealth Constraints

- Infinite sequence of current period budget constraints,
  - rather than just two periods, combined into wealth constraint.
- Initial period revenue and spending
  - Let time period $-1$ start-up period
  - when government raises capital by issuing debt, $B_0$,
  - and by issuing money, denoted by $M_0$.
  - Collect capital from representative agent:
  - equal to initial capital investment $k_0$ by consumer.
- Government spends initial capital on time $-1$
  - government infrastructure, in law, property rights,
  - with spending denoted by $G_{-1}$ :

$$k_0 = B_0 + M_0 = G_{-1}.$$

- Government also sets up tax collection process at time $-1$.
  - with proportional labor income, capital income, consumption taxes,
  - denoted by $\tau_l$, $\tau_k$, $\tau_c$.

# Subsequent Period Budget Constraints

- Time $t = 0$, government spends $G_0$,
  - pays interest on initial debt: $R_0 B_0$,
  - collects tax revenue $\tau_l w_0 l_0 h_0 + \tau_k r_0 k_0 + \tau_c c_0$.
  - Can issue new debt, money stock, $(B_1 - B_0) + (M_1 - M_0)$ :

$$G_0 + R_0 B_0 = (\tau_l w_0 l_0 h_0 + \tau_k r_0 k_0 + \tau_c c_0) + (B_1 - B_0) + (M_1 - M_0) .$$

- Discounted spending, revenue over two periods at time $-1$ :

$$G_{-1} + \frac{G_0 + R_0 B_0}{1 + R_0} = B_0 + M_0 + \frac{(\tau_l w_0 l_0 h_0 + \tau_k r_0 k_0 + \tau_c c_0) + (B_1 - B_0) + (M_1 - M_0)}{1 + R_0} .$$

- Any subsequent period $t$ : period budget constraint is

$$G_t + R_t B_t = (\tau_l w_t l_t h_t + \tau_k r_t k_t + \tau_c c_t) + (B_{t+1} - B_t) + (M_{t+1} - M_t) .$$

# Wealth Constraint with Discount after Initial Period

- Add all period budget constraints, with discounting for future

$$
\begin{aligned}
& G_{-1} + \frac{G_0 + R_0 B_0}{1 + R_0} + \frac{G_1 + R_1 B_1}{(1 + R_0)(1 + R_1)} \\
& + \frac{G_2 + R_2 B_2}{(1 + R_0)(1 + R_1)(1 + R_2)} + \ldots \\
= \quad & B_0 + M_0 + \frac{(\tau_l w_0 l_0 h_0 + \tau_k r_0 k_0 + \tau_c c_0) + B_1 - B_0 + M_1 - M_0}{1 + R_0} \\
& + \frac{(\tau_l w_1 l_1 h_1 + \tau_k r_1 k_1 + \tau_c c_1) + (B_2 - B_1) + (M_2 - M_1)}{(1 + R_0)(1 + R_1)} \\
& + \frac{(\tau_l w_2 l_2 h_2 + \tau_k r_2 k_2 + \tau_c c_2) + (B_3 - B_2) + (M_3 - M_2)}{(1 + R_0)(1 + R_1)(1 + R_2)} + \ldots
\end{aligned}
$$

- Wealth constraint gives future discounted stream of spending
  - as equal to initial debt, money issue,
  - plus discounted stream of taxes.

# Wealth Constraint with Different Terms Accumulated

- Government expenditure, tax , bond , money terms:

$$
\begin{aligned}
& G_{-1} + \frac{G_0}{1+R_0} + \frac{G_1}{(1+R_0)(1+R_1)} \\
& + \frac{G_2}{(1+R_0)(1+R_1)(1+R_2)} + \ldots \\
= \quad & \frac{\tau_l w_0 l_0 h_0 + \tau_k r_0 k_0 + \tau_c c_0}{1+R_0} + \frac{\tau_l w_1 l_1 h_1 + \tau_k r_1 k_1 + \tau_c c_1}{(1+R_0)(1+R_1)} + \\
& \frac{\tau_l w_2 l_2 h_2 + \tau_k r_2 k_2 + \tau_c c_2}{(1+R_0)(1+R_1)(1+R_2)} + \ldots \\
& B_0 - \frac{B_0}{1+R_0} - \frac{R_0 B_0}{1+R_0} + \frac{B_1}{1+R_0} + \frac{B_2 - B_1 - B_1 R_1}{(1+R_0)(1+R_1)} \\
& + \frac{B_3 - B_2 - B_2 R_2}{(1+R_0)(1+R_1)(1+R_2)} + \ldots + M_0 + \frac{M_1 - M_0}{1+R_0} \\
& + \frac{M_2 - M_1}{(1+R_0)(1+R_1)} + \frac{M_3 - M_2}{(1+R_0)(1+R_1)(1+R_2)} + \ldots
\end{aligned}
$$

# Bond Transversality and Wealth Constraint

- First focus on bond terms $B_0$ of wealth constraint:

$$B_0 - \frac{B_0}{1+R_0} - \frac{R_0 B_0}{1+R_0} = B_0 - \frac{B_0 (1+R_0)}{1+R_0} = B_0 - B_0 = 0.$$

  - They cancel out; sum to zero. Same for time $B_1$, $B_2$ terms:

$$\begin{aligned} & \frac{B_1}{1+R_0} - \frac{B_1 + B_1 R_1}{(1+R_0)(1+R_1)} \\ = \; & \frac{B_1}{1+R_0} - \frac{B_1 (1+R_1)}{(1+R_0)(1+R_1)} = \frac{B_1}{1+R_0} - \frac{B_1}{1+R_0} = 0. \end{aligned}$$

$$\begin{aligned} & \frac{B_2}{(1+R_0)(1+R_1)} - \frac{B_2 + B_2 R_2}{(1+R_0)(1+R_1)(1+R_2)} \\ = \; & \frac{B_2}{(1+R_0)(1+R_1)} - \frac{B_2 (1+R_2)}{(1+R_0)(1+R_1)(1+R_2)} = 0. \end{aligned}$$

- Continues forever, for all $t$, all finite time bonds term cancel out.

# Bond Term as Time Approaches Infinity

- At last only term left is one as $t$ goes to infinity; bond terms:

$$
\begin{aligned}
& B_0 - B_0 + \frac{B_1}{1+R_0} + \frac{B_2 - B_1\left(1+R_1\right)}{\left(1+R_0\right)\left(1+R_1\right)} \\
& + \frac{B_3 - B_2\left(1+R_2\right)}{\left(1+R_0\right)\left(1+R_1\right)\left(1+R_2\right)} + \ldots \\
= \; & 0 + 0 + 0 + \ldots + \lim_{j \to \infty}\left[\frac{B_{t+j}}{\left(1+R_{t+1}\right)\left(1+R_{t+2}\right)\cdots\left(1+R_{t+j}\right)}\right].
\end{aligned}
$$

- "Transversality" assumption is that last term is zero.
  - Present discounted value of stock of bonds at time $t \to \infty$, is 0.

$$
\lim_{j \to \infty}\left[\frac{B_{t+j}}{\left(1+R_{t+1}\right)\left(1+R_{t+2}\right)\cdots\left(1+R_{t+j}\right)}\right] = 0.
$$

  - Means discounted value of government debt in limit is zero.
  - Bonds completely drop out of government wealth constraint.

# Ricardian Equivalence

- Ricardian equivalence: all spending eventually paid for by taxes.
  - Spending not paid for only by increasing borrowing
  - forever without raising taxes, since debt value in limit positive,
  - vioilating transversality condition.
- If transversality condition expected to be violated,
  - harder for government borrow through issuing bonds:
  - market would view bonds as obligation not intended to be kept.
- With transversality condition: wealth constraint is
  - discounted stream of government expenditure
  - equals discounted stream of taxes and money supply increases;
  - no residual debt.

# Impossibility Theorem of Non-Ricardian Equivalence

- Suppose transversality condition does not hold, and

$$\lim_{j\to\infty}\left[\frac{B_{t+j}}{(1+R_{t+1})(1+R_{t+2})\cdots(1+R_{t+j})}\right] > 0,$$

  - then Ricardian equivalence does not hold.
  - Similar to asset price bubble permanently existing.
  - Government wealth constraint not binding.
  - This is idea of "Non-Ricardian" world.
- Kocherlakota, Phelan 1999: non-Ricardian world
  - impossible to prove as existing, or not existing.
  - Implies "impossibility theorem" of showing non-Ricardian equilibria.
- Transversality condition not binding: government debt held?
- Often non-Ricardian world taken to mean
  - taxes do not have to be increased for higher government expenditure.
  - Might be called "irresponsible guide to government finance",
  - as opposed to the much less glamorous Ricardian world:
  - of having to pay for expenditure with taxes.

# Bonds as Net Wealth?

- Bond acts as "wealth" to consumer,
  - as in non-Ricardian models. "Overlapping generations" models:
  - only two time periods; government debt increases wealth to current consumer;
  - imposes tax burden to future generations; output still rises now.
- Others argue that economies can be in non-Ricardian world
  - for a limited period of time, but not permanently.
  - Type of concept in-between an infinite horizon, 2-period models.
  - More a descriptive concept of government issuing a lot of debt.
  - Not a mathematical description of equilibrium.
- Governments lose credibility if do not pay off debt,
  - pay high risk premia on debt: implies even informally
  - how Ricardian equivalence, transversality condition of bonds,
  - are realistic parts of macroeconomics.

# Balanced Growth Path Government Tax Revenue

- Assume on balanced growth path equilibrium,
  - with endogenous growth rate $g$, at time 0 and every period after.
  - Assume inflation is zero, nominal price of goods $P_t = 1$.
  - Constant: nominal interest rate $R_t$, real interest $r_t$, wage $w_t$.
  - Growing variables: capitals $k_t$, $h_t$, consumption $c_t$, spending $G_t$,
  - real money supply $\frac{M_t}{P_t}$.
  - Same results hold for exogenous growth.
- Tax Component

$$\frac{\tau_l w_0 l_0 h_0 + \tau_k r_0 k_0 + \tau_c c_0}{1 + R_0} + \frac{\tau_l w_1 l_1 h_0 + \tau_k r_1 k_1 + \tau_c c_1}{(1 + R_0)(1 + R_1)} + \frac{\tau_l w_2 l_2 h_0 + \tau_k r_2 k_2 + \tau_c c_2}{(1 + R_0)(1 + R_1)(1 + R_2)} + \ldots$$

$$\begin{aligned} r_0 &= r_1 = \ldots = r_t = \ldots;\ w_0 = w_1 = \ldots = w_t = \ldots \\ R_0 &= R_1 = \ldots = R_t = \ldots;\ l_0 = l_1 = \ldots = l_t = \ldots \end{aligned}$$

# Simplified Discounted Tax Revenue Stream

$$
\begin{aligned}
& \frac{\tau_l w_0 l_0 h_0 + \tau_k r_0 k_0 + \tau_c c_0}{1+R_0} \\
& + \frac{\tau_l w_0 l_0 h_0 (1+g) + \tau_k r_0 k_0 (1+g) + \tau_c c_0 (1+g)}{(1+R_0)(1+R_0)} + \\
& + \frac{\tau_l w_0 l_0 h_0 (1+g)^2 + \tau_k r_0 k_0 (1+g)^2 + \tau_c c_0 (1+g)^2}{(1+R_0)(1+R_0)(1+R_0)} + \ldots \\
= \; & \frac{\tau_l w_0 l_0 h_0 + \tau_k r_0 k_0 + \tau_c c_0}{1+R_0} \left( 1 + \frac{1+g}{1+R_0} + \left( \frac{1+g}{1+R_0} \right)^2 + \ldots \right) \\
= \; & \frac{(\tau_l w_0 l_0 h_0 + \tau_k r_0 k_0 + \tau_c c_0)}{R_0 - g} = \frac{\tau_l w_0 l_0 h_0 + \tau_k r_0 k_0 + \tau_c c_0}{\rho (1+g)}.
\end{aligned}
$$

# Government Spending Component

$$
\begin{aligned}
& G_{-1} + \frac{G_0}{1+R_0} + \frac{G_1}{(1+R_0)(1+R_1)} \\
& + \frac{G_2}{(1+R_0)(1+R_1)(1+R_2)} + \ldots \\
= \quad & G_{-1} + \frac{G_0}{1+R_0}\left(1 + \frac{1+g}{1+R_0} + \left(\frac{1+g}{1+R_0}\right)^2 + ..\right) \\
= \quad & G_{-1} + \frac{G_0}{1+R_0}\left(\frac{1}{1-\frac{1+g}{1+R_0}}\right) \\
= \quad & G_{-1} + \frac{G_0}{R_0 - g} \\
= \quad & G_{-1} + \frac{G_0}{\rho(1+g)}.
\end{aligned}
$$

When zero inflation, BGP growth rate $g$ : $M_t$ grows at rate $g$.

$$
\begin{aligned}
& M_0 + \frac{M_1 - M_0}{1+R_0} + \frac{M_2 - M_1}{(1+R_0)(1+R_1)} \\
& + \frac{M_3 - M_2}{(1+R_0)(1+R_1)(1+R_2)} + \ldots \\
= \quad & M_0 + \frac{M_0(1+g) - M_0}{1+R_0} + \frac{M_0(1+g)^2 - M_0(1+g)}{(1+R_0)(1+R_0)} \\
& + \frac{M_0(1+g)^3 - M_0(1+g)^2}{(1+R_0)(1+R_0)(1+R_0)} + \ldots \\
= \quad & \left(M_0 - \frac{M_0}{1+R_0}\right)\left(1 + \frac{1+g}{1+R_0} + \left(\frac{1+g}{1+R_0}\right)^2 + \ldots\right) \\
= \quad & \frac{R_0 M_0}{R_0 - g} = M_0\left(\frac{\rho(1+g)+g}{\rho(1+g)}\right) = M_0\left(1 + \frac{g}{\rho(1+g)}\right).
\end{aligned}
$$

# Wealth Constraint with Balanced Growth

$$
\begin{aligned}
G_{-1} + \frac{G_0}{\rho(1+g)} &= \frac{\tau_l w_0 l_0 h_0 + \tau_k r_0 k_0 + \tau_c c_0}{\rho(1+g)} \\
&\quad + M_0 \left(1 + \frac{g}{\rho(1+g)}\right); \\
G_{-1} &= M_0 + B_0; \\
M_0 + B_0 + \frac{G_0}{\rho(1+g)} &= \frac{\tau_l w_0 l_0 h_0 + \tau_k r_0 k_0 + \tau_c c_0}{\rho(1+g)} \\
&\quad + M_0 \left(1 + \frac{g}{\rho(1+g)}\right); \\
\frac{G_0}{\rho(1+g)} &= \frac{\tau_l w_0 l_0 h_0 + \tau_k r_0 k_0 + \tau_c c_0}{\rho(1+g)} + \frac{gM_0}{\rho(1+g)} - B_0. \\
B_0 &= \frac{\tau_l w_0 l_0 h_0 + \tau_k r_0 k_0 + \tau_c c_0 + gM_0 - G_0}{\rho(1+g)}.
\end{aligned}
$$

# With Inflation

- Inflation rate denoted by $\pi_t$; with $P_t$ price of goods,

$$1+\pi_t \equiv \frac{P_{t+1}}{P_t}.$$

- "Fisher equation" of nominal interest rate $R_t$, derived Chapter 20 :

$$1+R_t = (1+\pi_t)(1+r_t-\delta_k).$$

  - When $\pi_t = 0$, the nominal equals real: $R_t = r_t - \delta_k$.

- Assume constant money supply growth rate $\sigma$ :

$$M_{t+1} = M_t (1+\sigma),$$

  - if $\sigma = g$, then $\pi_t = 0$,
  - since money supply growth equals money demand growth.

- Money revenue: $\frac{R_0 M_0}{R_0-\sigma} = M_0 + \frac{M_0(1+\sigma)-M_0}{1+R_0} + \frac{M_0(1+\sigma)^2-M_0(1+\sigma)}{(1+R_0)(1+R_0)} + ....$
  - Instead of $\frac{R_0 M_0}{R_0-g}$, but same if if $\sigma = g$, $\pi_t = 0$.

# Revenue from Inflation

- When money supply growth rate $\sigma$ rises,
  - can get more direct revenue from inflation tax,
  - which is "collected" as government prints the money.
  - Quantitative easing: new name for printing money,
  - by having central bank buy government bonds,
  - and giving money to government Treasury.
- Second, higher inflation can lower real value of nominal debt,
  - by reducing real value of debt interest payments.
  - When inflation raises nominal interest rate above expected rate,
  - reduces value of debt liabilities.
- Third: inflation can reduce stream of direct tax revenues,
  - by causing a lower endogenous growth rate.
  - Partly offsets gains in revenue from collecting inflation tax,
  - and lowering value of debt obligations.

# Example 18.1 Seigniorage Wealth

- Considering only additions to money supply as revenue,
  - subtract intial money stock as revenue,

$$\frac{R_0 M_0}{R_0 - \sigma} - M_0 = M_0 \left( \frac{R_0 - R_0 + \sigma}{R_0 - \sigma} \right) = \frac{\sigma M_0}{R_0 - \sigma}.$$

  - Written as a fraction of nominal output $P_0 y_0$, with $m \equiv \frac{M}{P}$ :

$$\frac{\frac{\sigma M_0}{R_0 - \sigma}}{P_0 y_0} = \frac{m_0}{y_0} \frac{\sigma}{R_0 - \sigma}.$$

- Assume $\sigma = 0.03$, $R_0 = 0.06$, as fraction of output

$$Seignoirage\ Wealth : \frac{m_0}{y_0} \frac{\sigma}{R_0 - \sigma} = \frac{m_0}{y_0} \frac{0.03}{0.03} = \frac{m_0}{y_0}.$$

  - Equals money supply to output ratio:
  - inverse of "income velocity" of money $\frac{y}{m}$.
- Velocity of money varies by country, across time
  - can be $15 - 20$ after high inflation, as low as 2 historically in US.
  - Seigniorage wealth as ratio to output: between 5% and 50%.

# Government Debt from Deficits

- While running a deficit, government runs up a liability.
  - Define debt build-up from continuous deficits as $D_0$ :

$$D_0 = \frac{G_0 - (\tau_l w_t l_0 h_0 + \tau_k r_0 k_0 + \tau_c c_0 + gM_0)}{\rho (1+g)}.$$

  - Amount of debt liability incurred by perpetual deficits.
- Debt to $y$ ratio: divide by output:

$$\frac{D_0}{y_0} = \frac{G_0 - (\tau_l w_0 l_0 h_0 + \tau_k r_0 k_0 + \tau_c c_0 + gM_0)}{y_0 \rho (1+g)}.$$

- Deficit to $y$ ratio:

$$\frac{Deficit}{y_0} = \frac{G_0 - (\tau_l w_0 l_0 h_0 + \tau_k r_0 k_0 + \tau_c c_0 + gM_0)}{y_0}.$$

# Example 18.2 Maastricht Treaty Debt, Deficit Limits

- Deficit to $y$ ratio:

$$\frac{Deficit}{y_0} = \frac{G_0 - (\tau_l w_0 l_0 h_0 + \tau_k r_0 k_0 + \tau_c c_0 + gM_0)}{y_0} = 0.03..$$

- Debt to $GDP$ limit of 60% consistent $\frac{Deficit}{y_0} = 0.03$?

$$\frac{D_0}{y_0} = \frac{G_0 - (\tau_l w_0 l_0 h_0 + \tau_k r_0 k_0 + \tau_c c_0 + gM_0)}{y_0 \rho (1+g)} = \frac{0.03}{\rho (1+g)}.$$

  - Use baseline endogenous growth economy calibration,
  - assume $\rho = 0.0526$, $g = 0.02$ :

$$\frac{D_0}{y_0} = \frac{0.03}{\rho (1+g)} = \frac{0.03}{0.0526 (1+0.02)} = 0.559.$$

- 56% debt to GDP from 3% deficit to output ratio
  - within limit of 60% of Treaty guidelines, in this example.
  - Higher deficits, lower growth: debt ratio could be above 60%.

# Optimal Public Finance

- Ramsey solution to optimal public finance:
  - equalize value of marginal distortion across different taxes.
  - Focuses on how to raise taxes efficiently.
  - On margin, distortionary effect should be same.
  - Otherwise, one tax used too much while another too little.
- Assuming exogenous government expenditure $G_t$:
  - central result is zero capital income tax,
  - since intertemporally substitutable goods like capital can be avoided,
  - while goods like current period labor cannot be avoided:
  - tax only labor and/or goods, not capital.
- Result does not hold
  - if government spending a constant share of output.
  - Then can get equal labor, capital tax rates.

# Spending as a Constant Share of Output

- Assume government spending a constant fraction of output
  - $\eta$ a constant fraction, financed with labor, capital taxes $\tau_l, \tau_k$ :
$$\eta = \frac{G_t}{y_t}.$$
  - Empirical evidence: $\eta$ fairly constant over time; 20% for US.
- Within endogenous growth economy:
  - equalize human, physical capital returns on BGP;
  - implies optimum of "equal flat tax regime",
$$\tau_l = \tau_k.$$
- Given $\eta$, Azacis, Gillman 2010 show tax rates should equal $\eta$ :
$$\tau_l = \tau_k = \eta,$$
  - Adding goods tax $\tau_c$, set "composite labor tax rate" to $\eta$ :
$$\frac{\tau_c + \tau_l}{1 + \tau_c} = \tau_k = \eta.$$

# Example 18.3 Optimal Taxes, Debt and Deficit

- Assume on BGP $\eta = 30\%$, $\tau_c = 0$, and

$$
\begin{aligned}
\tau_l &= \tau_k = \eta = 0.30, \\
&\Longrightarrow \frac{Deficit}{y_0} = \frac{G_0 - (\tau_l w_0 l_0 h_0 + \tau_k r_0 k_0)}{y_0}, \\
\gamma &= \frac{wlh}{y},\ (1-\gamma) = \frac{rk}{y}, \\
\frac{Deficit}{y_0} &= \frac{G_0}{y_0} - \tau_l \left( \frac{w_0 l_0 h_0}{y_0} \right) - \tau_k \left( \frac{r_0 k_0}{y_0} \right), \\
\frac{Deficit}{y_0} &= 0.30 - 0.30\gamma - 0.30\,(1-\gamma) = 0.
\end{aligned}
$$

  - No deficit in equilibrium; carries over to zero debt to output ratio:

$$
\frac{D_0}{y_0} = \frac{G_0 - (\tau_l w_0 l_0 h_0 + \tau_k r_0 k_0)}{y_0 \rho\,(1+g)} = 0.
$$

- A responsible guide to government finance in long run.

# Greek Debt Crisis and Ricardian Equivalence

- 2009 Greek deficit-output ratio 12.5%, debt to output 113%;
  - "sustainable" long run BGP debt-output ratio implies

$$DY_{2009} \equiv \frac{\frac{Deficit}{y_{2009}}}{\rho\left(1+g\right)} = \frac{0.125}{\rho\left(1+g\right)} = 1.13.$$

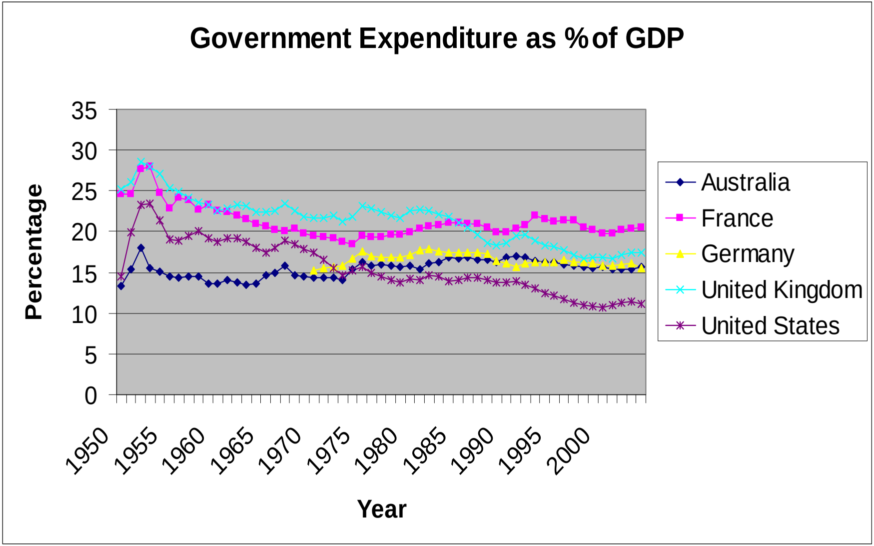
  - With $\rho = 0.0526$, growth rate would need to be

$$g = \frac{0.125}{\rho\left(1.13\right)} - 1 = \frac{0.125}{\left(0.0526\right)\left(1.13\right)} - 1 = 1.103,$$

  - or 110% : 50 times higher than historical average growth rates.
- Implied growth rates implausible.
  - Greece requires lower deficit through higher taxes, less spending.
  - May resort to trying to print money.
  - But in Euro, and cannot print money; only can if leave Euro.
- Stark choices: fundamentals of Ricardian Equivalence in action.
  - Greece could leave Euro and inflate economy.
  - Or ECB could itself print money to buy Greek debt:
  - causing higher inflation rate across Euro zone; depreciated Euro.

# Taxes and Government Size

- Government builds public capital, adds to wealth of nation.
  - as infrastructure, a public good, as in Samuelson 1954.
  - Infrastructure lowers operating costs of free markets.
  - Government role allowed in law, economics tradition:
  - Coase's 1960 theorem: exchange of property rights
  - can decrease transaction costs of exchange.
- Useful public capital includes legal system of laws.
- M. Friedman has argued efficient government
  - can provide such public capital, but grow slower than output,
  - so shrinking share of government expenditure in output;
  - this means that $\eta$ should go down, rather than being constant,
  - thereby decreasing tax burden.
- Spending to GDP as trended down post-WWII US, UK


Government Expenditure as %of GDP
Percentage
35
30
25
20
15
10
5
0
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
Year
Australia
France
Germany
United Kingdom
United States

# Flat Tax Policy Around the World

- International trend: towards lower capital, labor tax rates.
  - In many cases, taxes have become more “balanced”
  - between capital, labor, and consumption tax.
  - And have become more "flat", with fewer "brackets".
- US: 92% 1952 tax rate for top-bracket personal income;
  - 52% top-bracket corporate income tax was.
  - US: 35% 2010 top rates for corporate, personal income tax.
  - Shows trend down, with balancing, and flattening.
- Called “The Global Flat Tax Revolution” by Mitchell, 2007.
  - Equal flat tax rates on both personal, corporate income
  - Romania- 16%; Serbia- 14%;
  - equal rates on personal, corporate, VAT: Slovakia- 19%.
  - Baltic tax reforms started in 1994 in Estonia,
  - by 2007, average Baltic personal tax rate of 25%,
  - average corporate tax rates of 10%.
  - Russia, Ukraine, Georgia: flat corporate tax 24%, personal income 13%.
- Motivation: low balanced flat taxes; less tax evasion, higher growth.