Notes on Fiscal Policy - 14.02

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The intertemporal dimension of Fiscal Policy

- When discussing Fiscal Policy we must start by recognizing that countries (and governments) are in for the long term
- They don't need to balance their books year-by-year:
  - they can spend in excess of tax revenue today (running up debt)
  - provided they will be able to pay back their debt in the future thanks to tax revenues in excess of spending (otherwise households will not buy government bonds)
- That's why – in order to understand Fiscal Policy – we need to be able to value streams of income that will come at some time in the future
- The Present Value of a stream of income is the value today (time t_0) of a stream of income that will flow between t_0 and some future date, say $t_0 + T$

Valuing today goods that will be received tomorrow

- Assume the economy has a technology to transfer goods from today (period t) to tomorrow (period $t+1$). For instance one unit of corn used as seed and planted today yields $(1+r)$ units of corn tomorrow

$$y_{t+1} = (1+r)\, y_t$$

- Then the price of a unit of good at time $t+1$ relative to a unit of good at time t (*i.e.* the number of units of t good required to obtain 1 unit of $t+1$ good)

$$\frac{[\text{units of goods at time } t]}{[\text{units of goods at time } t+1]} = \frac{1}{(1+r)}$$

- Thus if one wants to add up the two goods at time t, the way to do it is

$$y_t + \frac{y_{t+1}}{(1+r)}$$

A more realistic consumption function

Consumption also depends on wealth

- To start thinking about Fiscal Policy it is useful to move a step beyond the consumption function we used so far and realize that consumption also depends on a household's wealth

$$C = C\left(Y^{disp}, Wealth\right)$$

$$Wealth = W^{financial} + W^{housing} + PDV\left(Y^{disp}\right)$$

- The first term is financial wealth (stocks and bonds), the second is the value of the family's house (because they can use it as "collateral" to borrow from a bank), the third is human wealth, the value of expected income (net of taxes) over a lifetime: if you attend an MBA you can go to the bank and ask for a loan anticpating you will land a job on Wall Street (we shall see in a minute what are the consequences if the bank refuses to lend you the money)

$$PDV\left(Y^{disp}\right) = \sum_{i=0}^{T} \frac{Y_{t+i} - T_{t+i}}{(1+r)^{i}}$$

How can Fiscal Policy affect consumption ?

- The dependency of consumption on wealth is useful to understand how Fiscal Policy affects consumption and thus output
- To see why this is the case, we begin by considering intertemporal budget constraints

Does it matter how a government finances G ?

- Assume thre are only two periods. The government's *intertemporal budget constraint*, i.e. its budget constraint over the two periods is

$$T_1 + \frac{T_2}{(1+r)} = G_1 + \frac{G_2}{(1+r)}$$

- The households' *intertemporal budget constraint*—assume for the moment that financial and housing wealth are zero, so that the only form of wealth is $PDV(Y^{disp})$—is

$$C_1 + \frac{C_2}{(1+r)} = (Y_1 - T_1) + \frac{(Y_2 - T_2)}{(1+r)}$$

The irrelevance of the government's financial policy

Assume now that households realize that the government is subject to an intertemporal budget constraint and consider two cases

1. The government budget is balanced in each period

$$T_1 = G_1, \quad T_2 = G_2$$

then

$$\begin{aligned} C_1 + \frac{C_2}{(1+r)} &= (Y_1 - T_1) + \frac{(Y_2 - T_2)}{(1+r)} \\ &= (Y_1 - G_1) + \frac{(Y_2 - G_2)}{(1+r)} \end{aligned}$$

2.

$$T_1 = 0, \quad G_1 = B, \quad T_2 = G_2 + B(1+r)$$

substituting we still get

$$C_1 + \frac{C_2}{(1+r)} = (Y_1 - G_1) + \frac{(Y_2 - G_2)}{(1+r)}$$

Ricardian Equivalence

- From 1. and 2. we see that they way the government finances a given level of spending makes no difference. All that matters is $PDV(G) = G_1 + \frac{G_2}{(1+r)}$
- This result is known as *Ricardian Equivalence* from David Ricardo the British economist who first noted this
  - in his *Essay on the Funding System* (1820) Ricardo studied whether it makes a difference to finance a war with the £20 million in current taxes or to issue government bonds with infinite maturity (consols) and annual interest payment of £1 million in all following years financed by future taxes
  - at the assumed interest rate of 5%, Ricardo concluded that there is no difference between the two modes: 20 millions in one payment, 1 million per annum for ever, or £1,2 million for 45 years are all precisely of the same value

Private Consumption and Government Spending

- Assume G_1 increases to $G_1^{'} > G_1$, while G_2 does not change
  - $\left(Y_1 - G_1^{'}\right) + \frac{(Y_2 - G_2)}{(1+r)} = \left(C_1 + \frac{C_2}{(1+r)}\right)_{|G_1^{'}} < \left(C_1 + \frac{C_2}{(1+r)}\right)_{|G_1} = (Y_1 - G_1) + \frac{(Y_2 - G_2)}{(1+r)}$
  - $\frac{d\left(C_1 + \frac{C_2}{(1+r)}\right)}{dG_1} < 0$
  - the *opposite sign* compared with what we have learned so far

Expansionary fiscal contractions: Denmark, 1983-86

(numbers are average yearly growth rates over the period indicated)

	$1979-82$	$1983-86$
G	**+ 4.0**	**0.0**
T	- 0.03	+ 1.3
$(G-T)$	+ 1.8	- 1.8
Δ *debt*	+10.2	0.0
$\Delta\ Y^{disposable}$	+ 2.6	- 0.3
C	**- 0.8**	**+ 3.7**
I	- 2.9	+12.7
GDP	+ 1.3	+ 3.2

Sourse: Giavazzi, F. and M. Pagano 1990 "Can Severe Fiscal Contractions Be Expansionary?"

- This means that a fiscal contraction can be expansionary: if consumption increases enough to more than compensate the reduction in G
- Fiscal contractions can be good news for the economy

Expansionary contractions: How can this be possible ?

- if Ricardian Equivalence holds
- $\frac{d\left(C_1+\frac{C_2}{(1+r)}\right)}{dG_1} < 0$
- since $Y = C + G$ (forgetting I)
- $\frac{dY_1}{dG_1}$?
- but you could make the argument also for I: $\frac{dI}{dG} < 0$
- then $\frac{dY}{dG_1}$? is even more likely

The limits of Ricardian Equivalence

- We will now show that the result that the government's financial policy is irrelevant (or Ricardian Equivalence) depends on a few strong assumptions
- Ricardo himself had doubts. In the same essay he went towrite: "But the people who paid the taxes never so estimate them, and therefore do not manage their private affairs accordingly. We are too apt to think that the war is burdensome only in proportion to what we are at the moment called to pay for it in taxes, without reflecting on the probable duration of such taxes. It would be difficult to convince a man possessed of £20,000, or any other sum, that a perpetual payment of £50 per annum was equally burdensome with a single tax of £1000."
- In other words, only if people had rational expectations they would be indifferent as to when they pay taxes

The limits of Ricardian Equivalence (cont.)

- The assumptions needed to obtain the Ricardian Equivalence result are two
  1. The horizon of households corresponds to that of the government. In other words, people think they will pay all the taxes the government will eventually have to levy, *i.e.* they will not leave debts (future taxes to pay) to their children to pay
  2. People can freely borrow

The limits of Ricardian Equivalence (cont.)

- We now consider what happens if these conditions fail, namely if
  1. Households' horizon is shorter than that of the government
  2. Households cannot freely borrow against their expected future income

1. Households' horizon is shorter than that of the government

- if people plan to be around in period 2
  - $\left\{ \begin{array}{l} T_1 = 0 \\ G_1 = B \\ G_2 = 0 \end{array} \right. , \; T_2 = B\left(1+r\right) \Bigg\}$
  - $C_1 + \frac{C_2}{(1+r)} = (Y_1 - G_1) + \frac{(Y_2 - G_2)}{(1+r)}$
- if people anticipate that the government will wait period 3 to balance its books ($T_2 = 0, \; T_3 = B\left(1+r\right)^2$) and think they will not be around in period 3, then
  - $C_1 + \frac{C_2}{(1+r)} = Y_1 + \frac{Y_2}{(1+r)}$
- In this case

$$\frac{d\left(C_1 + \frac{C_2}{(1+r)}\right)}{dG_1} = 0 \quad \text{not} \quad < 0 \; !$$

2. Liquidity constraints (people cannot borrow on the expectation of higher future income)

- to keep the algebra simple let

$$\left\{ \begin{array}{cc} G_1 = G_2 = G & C_1 = C_2 = C \\ r = 0 & Y_1 = Y_2 = Y \end{array} \right\}$$

- then the max achievable level of consumption is

$$C_1 + \frac{C_2}{(1+r)} = 2C = 2Y - 2G$$

- and the optimal path of consumption is

$$C_1 = C_2 = C = Y - G$$

Liquidity Constraints (cont.)

- Assume all taxes are levied in $t = 1$ $\left\{ \begin{array}{c} T_2 = 0 \\ T_1 = 2G \end{array} \right\}$
  - along the optimal path $C_1 = C_2 = C = Y - G$
    - thus in $t = 1$ $Y_1^{disp} = Y - 2G$ and $C = Y - G$ so that $\mathbf{C} > \mathbf{Y}_1^{disp}$
    - and in $t = 2$ $Y_2^{disp} = Y =$ and $C = Y - G$ so that $\mathbf{C} < \mathbf{Y}_2^{Disp}$
- but if households cannot borrow in $t = 1$ the optimal path of consumption cannot be achieved

Discussion

- So far we have assumed Y_1 and Y_2 exogenous. In particular we have assumed that the level of output does not respond to G.
- We have thus considered what are the effects of G in the medium run where y_n is fixed and independent of M, G, and T
- If $y = y_n$ it is obvious that private sector demand must fall as G rises. But the channel through which this happens is different in this model, compared to the AS-AD model
  - in the AS-AD model, as G rises, P rises, M/P falls, i rises and investment falls to make room for G
  - here it is C that falls, but the fall in C has nothing to do with i: it depends on the expectation of higher T in the future
- In the case the crowding out happens mostly via interest rates, G affects Y while prices are fixed and the effect vanishes as prices adjust
- If the crowding out happens mostly through C and the anticipation of future taxes, the effects of G can be zero, even with fixed prices

Discussion (cont.)

- Can an increase in G raise y_n ?
- Remember what determines y_n: the level of mark-ups and the generodisty of unemployment benefits. Nothing G can do about this
- But y_n also depends on the production function: $Y = AN$. If G is spent, for instance, on public infrastructure, it could improve the efficiency of private sector firms and thus raise Y for any level of labor input N. In this case higher G would raise y_n

The nominal and the real interest rate

- We now study the government budget constraint and the dynamics of the ratio of public debt to GDP
- Remember our assumption that the economy has a technology to transfer goods from period t to period $t+1$

$$y_{t+1} = (1+r)\, y_t$$

- Now think that instead of goods, we wish to transfer *dollars* from t to $t+1$. Since the price of a unit of good in period t is P_t, with 1 Dollar you buy $1/P_t$ goods which at time $t+1$ translate into $(1+r)/P_t$ goods and $\left[(1+r)/P_t\right] P_{t+1}$ dollars
  - $(1+r)$: real interest rate
  - $(1+i) = (1+r)\, P_{t+1}/P_t$: nominal interest rate
  - $(1+i) = (1+r)\left(1+\frac{P_{t+1}-P_t}{P_t}\right) = (1+r)\,(1+\text{inflation})$

The government's budget: definitions

- real budget deficit (real because measured in units of goods)

$$\left(\text{real deficit}\right)_t = rB_{t-1} + G_t - T_t = B_t - B_{t-1}$$

$$\begin{aligned} B &= \text{real government debt} \\ rB_{t-1} &: \text{real interest payments} \end{aligned}$$

$G_t - T_t$: real primary deficit

- nominal deficit (measured in current Dollars. "$" denotes variables measured in current Dollars). Remember

$$(1+i) = (1+r)\,(1+\text{inflation})$$

$$\left(\text{nominal deficit}\right)_t = i\$B_{t-1} + \$G_t - \$T_t = \$B_t - \$B_{t-1}$$

$$\left(\text{nominal deficit}\right)_t - inflation * B_{t-1} = \left(\text{real deficit}\right)_t$$

The dynamics of the debt-GDP ratio

$$\frac{B_t}{Y_t} = (1+r)\frac{B_{t-1}}{Y_t} + \frac{G_t - T_t}{Y_t}$$

$$\frac{Y_t}{Y_{t-1}} \equiv (1+g)$$

$$\frac{(1+r)}{(1+g)} \simeq 1 + r - g$$

$$\frac{B_t}{Y_t} = (1+r-g)\frac{B_{t-1}}{Y_{t-1}} + \frac{G_t - T_t}{Y_t}$$

$$\underbrace{\left(\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}}\right)}_{debt-GDP\ growth} = \underbrace{(r-g)\frac{B_{t-1}}{Y_{t-1}}}_{real\ rate\ minus\ growth\ rate\ times\ debt\ stock} + \underbrace{\frac{G_t - T_t}{Y_t}}_{primary\ deficit}$$

The debt-GDP ratio with money financing (Seigniorage)

$$\frac{B_t}{Y_t} = (1+r)\frac{B_{t-1}}{Y_t} + \frac{G_t - T_t}{Y_t} - \frac{\Delta M_t / P_t}{Y_t}$$

$$\frac{\Delta M_t / P_t}{Y_t} = \frac{\Delta M_t}{M_t}\frac{M_t / P_t}{Y_t} = \frac{\Delta M_t}{M_t} L(r + \text{inf}^{\text{exp}})$$

in the Medium Run (inf=$\text{inf}^{\text{exp}} = \frac{\Delta M}{M}$, Y=$Y_n$,)

$$\frac{\Delta M_t}{M_t} L(r + \text{inf}^{\text{exp}}) = \text{inf}\, L(r + \text{inf})$$

$$\frac{B_t}{Y_n} = (1+r)\frac{B_{t-1}}{Y_n} + \frac{G_t - T_t}{Y_n} + \text{inf}\, L(r + \text{inf})$$

$$\frac{d\left(\text{inf}\, L(r + \text{inf})\right)}{d\,\text{inf}} : \quad > 0 \text{ for } \text{inf} < \text{inf}^{*}, \quad < 0 \text{ for } \text{inf} > \text{inf}^{*}$$

The cost of delaying paying for G

- delaying one period

$$\begin{aligned} T_1 &= 0, \quad G_1 = B \\ T_2 &= G_1 (1 + r) \end{aligned}$$

- dealying t periods

$$\begin{aligned} T_1 &= T_2 = ... \; T_{t-1} = 0, \quad G_1 = B \\ T_t &= G_1 (1 + r)^{t-1} \end{aligned}$$

Debt sustainability

$$\left(\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}}\right) = (r-g)\frac{B_{t-1}}{Y_{t-1}} + \frac{G_t - T_t}{Y_t}$$

$$\left(\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}}\right) = 0, \quad i.e. \quad \frac{B_t}{Y_t} = b \ \text{ for all } t$$

$\rightarrow$

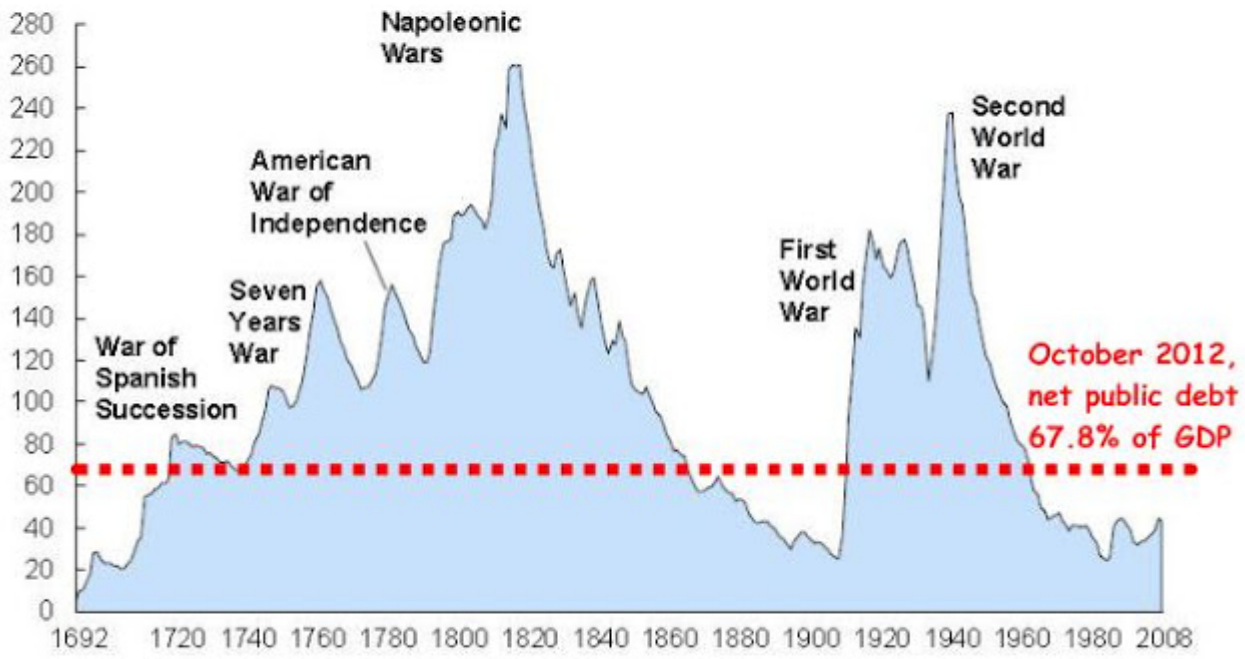
$$\left(\frac{B_t}{Y_t} - \frac{B_{t-1}}{Y_{t-1}}\right) = 0 \quad \Rightarrow \quad \underbrace{\frac{T_t - G_t}{Y_t}}_{primary\ surplus} = (r-g)\frac{B_{t-1}}{Y_{t-1}} > 0$$

United States: Public debt, percent of GDP, 1790 – 2014

Figure is in the public domain.

Exhibit 34

The UK government has experienced several large expansions in public debt since 1692



SOURCE: HM Treasury; Gregory Clark (2008), ukpublicspending.co.uk; Office of National Statistics; McKinsey Global Institute

Why financing a war with debt might the right thing to do

- Assume taxes introduce distortions in the economy and that these distortions are non linear
- For instance: as the marginal tax rate τ increases, people work less and thus output falls
- Assume the following

$$L^s = \bar{L}\,(1-\tau)^{1/2}$$

- Assume government spending is $G_1 > 0, \quad G_2 = 0.$
- Which of these two financing options is less costly?
  - $T_1 = \tau_1 L_1 = G_1, \quad T_2 = 0$
  - $T_1 = T_2 = 1/2\ G$

14.02 Principles of Macroeconomics

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