Monetary Macroeconomics

Lecture 10:
Government Debt

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Chapter 15: Government Debt

Some questions we will try to answer today are:

- How can the rates of return on fiat money and government bonds be different from each other although they both are issued by the same institution?

- Can a government roll over its debt forever?

- How are the current and future fiscal and monetary policies linked to each other? Do the current policies have an impact on future available policies?

Assets Issued by Governments

Governments often issue two types of assets held by the public: fiat money and government bonds (e.g. treasury bills).

They have different rates of return: Treasury bills dominate currency in rate of return.

However, treasury bills are issued only in large denominations.

How can we model these two assets together in an economy?

Separated Asset Markets

Suppose there are two types of people:

The rich have Y units of endowment when young. The poor have y units of endowment when young, where

$$Y >> y$$

Nobody is endowed when old. Populations of rich and poor grow over time at the same rate n.

There is a stock of fiat money growing at rate $z > 1$:

$$M_t = zM_{t-1}$$

Capital investment k today, yields xk units of consumption good tomorrow. But there is a minimum size of capital investment in order to produce, denoted by k^*.

$$Y >> k^* \quad \text{and} \quad k^* >> y$$

Hence the poor cannot individually invest in capital. Only the rich can use this technology.

Case 1: There is a Financial Intermediary

There is a financial intermediary that pools the endowments of the poor so that they can invest in capital.

Assume that it operates costlessly and makes zero profits: the rate of return on deposits must be then x.

Recall that the rate of return on fiat money will be $\frac{n}{z}$.

For a monetary equilibrium, it must be true that

$$x \leq \frac{n}{z}$$

so that people are willing to hold money.

So $z \leq \frac{n}{x}$. This is an upper bound on the rate of fiat money creation in order to have fiat money valued.

Case 2: There are Laws Banning Financial Intermediation

When there is no financial intermediation, the poor have only one option to save for tomorrow: fiat money.

Fiat money will be always valued independent of the value z.

The rich, on the other hand, can invest in capital or fiat money whichever has higher rate of return.

If $z > n/x$, only the poor hold fiat money, and the rich invest in capital.

So the government can collect seigniorage revenue only from the poor.

Government Bonds

Suppose that the government issues bonds intended to substitute for capital in the portfolios of the rich. These bonds have one-period maturity.

Here the rate of return on government bonds must be at least x, so that the rich are willing to hold bonds and not capital only.

But the government does not want to give up seigniorage revenue from the poor, hence the government issues bonds with a minimum price of k^* goods while banning all intermediation.

So the poor still have only one option to save for tomorrow: fiat money.

Two sources of government revenue: printing money and borrowing from the rich.

But the government has to pay with interest what it borrowed last period.

Can the government defer the payment of the debt forever?

Let $x < n$, and B_1 be the real bond issue in the first period.

Period	Real Bond Issue	Real Bond Payment	Real Net Revenue
1	B_1	-	B_1
2	nB_1	xB_1	$(n-x)B_1$
3	n^2B_1	xnB_1	$n(n-x)B_1$
4	n^3B_1	xn^2B_1	$n^2(n-x)B_1$
$\vdots$	$\vdots$	$\vdots$	$\vdots$

When $x < n$, i.e. the rate of return on government bond is less than the economy's growth rate, the government **can** permanently obtain revenue from the issuance of bonds.

Rolling Over Debt

When the government wants to roll over its debt, it merely issues enough bonds in each period to make the repayments (including interest) on the previous period's bond issue.

Denote the total real amount of the government bond issue in period t as B_t.

So

$$B_2 = xB_1 = x^2 B_0$$

$$B_3 = xB_2 = x^3 B_0$$

$$B_4 = xB_3 = x^4 B_0$$

Thus

$$B_t = x^t B_0$$

Take natural logarithm on both sides:

$$\ln B_t = t \ln x + \ln B_0$$

This is linear in t, and hence easier to graph. It gives the time path of the government bond issuance.

Now consider the time path of the economy's endowment.

Denote the total amount of rich people's endowment in period t as E_t. So

$$E_1 = N_1 Y = n N_0 Y$$

$$E_2 = N_2 Y = n N_1 Y = n^2 N_0 Y$$

$$E_3 = N_3 Y = n N_2 Y = n^3 N_0 Y$$

Thus

$$E_t = n^t N_0 Y$$

Take natural logarithm on both sides

$$\ln E_t = t \ln n + \ln(N_0 Y)$$

This is linear in t and gives the time path of the ability of the government to borrow.

Case 1: $x < n$

Graph the time paths of the government's bond issue and the economy's endowment when $x < n$ (and hence $\ln x < \ln n$).

$$\ln B_t = t \ln x + \ln B_0$$

$$\ln E_t = t \ln n + \ln(N_0 Y)$$

What is the economic interpretation of the assumption that $x < n$?

What happens to the Debt-GDP ratio over time?

$x < n$ means that the economy grows at a faster rate than the real interest rate the government has to pay on bonds.

In this case, we observe that $\ln E_t$ and $\ln B_t$ never intersect. Thus perpetual bond financing is possible. The growing economy has enough resources to absorb the bonds.

Debt-GDP ratio falls over time.

Case 2: $x > n$

Graph the time paths of the government bonds and the economy's endowment when $x > n$ (and hence $\ln x > \ln n$).

$$\ln B_t = t \ln x + \ln B_0$$

$$\ln E_t = t \ln n + \ln(N_0 Y)$$

What is the economic interpretation of the assumption that $x > n$?

What happens to the Debt-GDP ratio over time?

ln E_t and ln B_t intersect eventually. So it is *impossible* for the government to roll over its debt forever.

Debt-GDP ratio would increase over time and reach 1 at some point.

That is because the government debt grows at a faster rate than the economy.

Afterwards the government debt would *exceed* total endowment in the economy.

Note: Debt-GDP ratio is an important determinant of how large a burden that debt is for the economy.

Depending on the relative size of x and n, the government can or cannot roll over its debt forever.

Now the question remains: *Is* $x > n$ *or* $n > x$ *in the data?*

Is $x > n$ or $n > x$?

“Some Unpleasant Monetarist Arithmetic” by Neil Wallace and Thomas J. Sargent

The paper shows that tighter monetary policy today will lead to higher government debt today which in turn will lead to looser monetary policy in the future which will result in higher inflation today.

https://www.minneapolisfed.org/research/qr/qr531.pdf

“Some Pleasant Monetarist Arithmetic” by Michael R. Darby

Darby claims that the average real yield on government securities was not as high as the growth rate of real income from 1926 to 1981 in the US.

https://www.minneapolisfed.org/research/qr/qr822.pdf

Government's Budget Constraint

Government Revenue = Government Expenditures

First we will write down a general government budget constraint.

Then we will analyze the effects of government borrowing on the future available government policies using its budget constraint.

Revenue sources:

- new fiat money printing
- taxing people in the economy
- new bond issuance

Expenditures:

- government spending
- paying back principal and interest to bonds issued last period

Suppose $N_t = nN_{t-1}$, and $M_t = zM_{t-1}$. Suppose that everybody is alike. The government taxes each young person, a lump-sum amount of τ_t.

Let b_t be the bond issuance in period t per young person.

r is the gross real interest rate paid on bonds.

g is the government consumption per young person in the economy.

p_t is the price level in the economy.

Hence the government budget constraint is:

$$\frac{M_t - M_{t-1}}{p_t} + N_t\tau_t + N_t b_t = N_t g + rN_{t-1}b_{t-1}$$

Divide both sides by N_t

$$\frac{M_t - \frac{1}{z}M_t}{N_t p_t} + \tau_t + b_t = g + r\frac{N_{t-1}}{N_t}b_{t-1}$$

$$\frac{M_t}{N_t p_t}\Big(1 - \frac{1}{z}\Big) + \tau_t + b_t = g + \frac{r}{n}b_{t-1}$$

Denote the real value of money balances per young person as $q_t = \frac{M_t}{N_t p_t}$.

So the government's budget constraint in period t is

$$q_t\Big(1 - \frac{1}{z}\Big) + \tau_t + b_t = g + \frac{r}{n} b_{t-1}$$

So in period 1, the government faces the budget constraint:

$$q_1\Big(1 - \frac{1}{z}\Big) + \tau_1 + b_1 = g + \frac{r}{n}b_0 \quad (*)$$

where b_0 is the initial debt and b_1 is the debt to be passed on to future governments.

Next, consider the budget constraint in a stationary economy:

$$q\Big(1 - \frac{1}{z}\Big) + \tau + b = g + \frac{r}{n}b$$

$$q\Big(1 - \frac{1}{z}\Big) + \tau + b\Big(1 - \frac{r}{n}\Big) = g \quad (**)$$

If from period 2 on the economy is stationary, then $b = b_1$. Hence (*) and (**) are linked!

What is the Effect of Increasing Government Spending in Period 1 on Future Taxes and/or Inflation?

Suppose in period 1 the government has a higher spending and prefers not to print more money or to increase taxes in period 1.

Consider (*):

$$q_1\Big(1 - \frac{1}{z}\Big) + \tau_1 + b_1 = g + \frac{r}{n} b_0 \quad (*)$$

To finance the higher g, the government has only one option left — increase b_1, that is borrow more.

Then next period assume the economy is stationary. Look at (**).

$$q\Big(1 - \frac{1}{z}\Big) + \tau + b\Big(1 - \frac{r}{n}\Big) = g \quad (**)$$

Assume that $r > n$, that is the real interest rate is greater than the economy's growth rate. Hence $1 - \frac{r}{n} < 0$.

So if b has increased, then in order to finance g the government has to increase taxes or print more fiat money in period 2.

Thus if $r > n$, then lower taxes or seigniorage today imply higher taxes or seigniorage in the future.

So the government cannot always run deficits!

Lesson 1: There are strong links between fiscal and monetary policies.

Lesson 2: Policies implemented today affect tomorrow's state and available policies.