FGV EPGE
ESCOLA BRASILEIRA DE ECONOMIA E FINANÇAS

Macroeconomia e Mercados Financeiros

André C. Silva

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Monetary Policy and Fiscal Policy

Inflation and Debt Crises

Financing Needs

Governments are created to do certain activities. To pay for these activities, governments need to obtain revenues

The most direct way to obtain revenues is through taxes

Another way is to borrow from the public. From domestic or international lenders

A final way is by printing money

As an increase in money generates inflation, there is a connection between government deficits, monetary policy and inflation

Government Budget Constraint

Government Expenditures + Payments on Bonds = Tax Revenues + New Bond Sales

Government obligations

Financing through taxes and bonds

Government Budget Constraint

Write

$$\underbrace{G_t + B_{t-1} + rB_{t-1}}_{\text{Government obligations}} = \underbrace{T_t + B_t}_{\text{Financing through taxes and bonds}}$$

So far, excluding financing by printing money

Government Budget Constraint

Notation

G_t: government expenditures,

T_t: taxes,

B_t: outstanding bonds at the end of period t, the public debt

All in real terms

$B_t > 0$ means that the government is a borrower in period t

Primary and Total Deficit

Primary deficit:

$$G_t - T_t$$

Total deficit:

$$G_t - T_t + rB_{t-1}$$

Primary deficit: government expenditures minus tax revenues

Total deficit: includes payments of interest of the public debt

Deficits and Bonds

The government needs to issue new bonds if it incurs a deficit in period t

$$G_t - T_t + rB_{t-1} = B_t - B_{t-1}$$

Expenditures and Taxes

All expenditures must be paid by taxes, sooner or later

In other words, the present value of expenditures is equal to the present value of taxes

To see this, use the government budget constraint

$$G_t + B_{t-1} + rB_{t-1} = T_t + B_t$$

and substitute successively the value of the debt

Expenditures and Taxes

Government budget constraint:

$$G_t + B_{t-1} + rB_{t-1} = T_t + B_t$$

For time zero, we have

$$G_0 = T_0 + B_0$$

with $B_{-1} = 0$

Expenditures and Taxes

For $t = 1$,

$$G_1 + (1 + r)B_0 = T_1 + B_1$$

which implies

$$B_0 = \frac{1}{1 + r}(T_1 + B_1 - G_1)$$

Expenditures and Taxes

Substituting the expression of B_0 on the constraint for time zero,

$$G_0 + \frac{1}{1+r} G_1 = T_0 + \frac{1}{1+r} T_1 + \frac{1}{1+r} B_1$$

Expenditures and Taxes

For $t = 2$, working in the same way, we obtain

$$G_2 + (1 + r)B_1 = T_2 + B_2$$

This implies the following value for B_1:

$$B_1 = \frac{1}{1 + r}(T_2 + B_2 - G_2)$$

Expenditures and Taxes

Substitute the value for B_1 to obtain

$$G_0 + \frac{1}{1+r} G_1 + \left(\frac{1}{1+r}\right)^2 G_2$$
$$= T_0 + \frac{1}{1+r} T_1 + \left(\frac{1}{1+r}\right)^2 T_2 + \left(\frac{1}{1+r}\right)^2 B_2$$

Working like this successively implies that

Expenditures and Taxes

$$\sum_{t=0}^{T}\left(\frac{1}{1+r}\right)^{t} G_t = \sum_{t=0}^{T}\left(\frac{1}{1+r}\right)^{t} T_t + \left(\frac{1}{1+r}\right)^{T} B_T$$

The term $\left(\frac{1}{1+r}\right)^{T} B_T$ converges to zero as T increases

This is so because no investor would accept to keep B_t indefinitely without being paid

Expenditures and Taxes

Therefore, the government budget constraint in present value is

$$\sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^{t} G_t = \sum_{t=0}^{\infty}\left(\frac{1}{1+r}\right)^{t} T_t$$

This constraint states that all expenditures must sooner or later be paid through taxes

Inflation and Government Deficits

If the government cannot finance itself by taxes and bonds, the last resort is to print money

Usually it happens in extreme conditions: strong political crises, wars

In situations in which it is not possible to build a tax system

Or in which investors do not trust the ability of the government to repay its bonds

Inflation and Government Deficits

Printing money in excess of the natural increase of the demand for money implies inflation

Therefore, we have a connection between fiscal policy and inflation

Seigniorage

The amount of real resources obtained by printing money is called seigniorage

$$Seigniorage = \frac{M_t - M_{t-1}}{P_t}$$

Government Budget Constraint

With seigniorage,

$$\underbrace{G_t + B_{t-1} + rB_{t-1}}_{\text{Government obligations}} = \underbrace{T_t + B_t + \frac{M_t - M_{t-1}}{P_t}}_{\text{Financing through taxes, bonds, and money}}$$

Government Budget Constraint

Denote the primary deficit by $D_t = G_t - T_t$

The government budget constraint is then

$$\underbrace{D_t + (1+r)B_{t-1}}_{\text{Borrowing needs}} = \underbrace{B_t + \frac{M_t - M_{t-1}}{P_t}}_{\text{Financed through bonds and money}}$$

Unpleasant Monetarist Arithmetic

Idea: persistent government budget deficits bring inflation

This is so because there is a maximum level of debt that investors are willing to accept

Inflation may be low for extended periods

But if the deficits do not decrease, the government will have to rely on inflation to finance its deficit

How It Works

Fiscal Policy

We defined $D_t = G_t - T_t$

Denote the Fiscal Policy by deficits D_t

The government has decided the values of G_t and T_t over time

We take these decisions as given

How It Works

Monetary Policy

In the same way, denote the Monetary Policy by values for the money supply, M_t

Let us say that the government increases money supply at a constant growth rate θ:

$$\frac{M_t}{M_{t-1}} = 1 + \theta$$

Prices

Let real GDP be given by Y_t

Consumers use money to buy the goods produced

Given the money supply, we have

$$P_t Y_t = M_t$$

GDP

The rate of GDP growth is given by n

So,

$$\frac{Y_t}{Y_{t-1}} = 1 + n$$

With GDP growth, money supply growth, and the equation $P_t Y_t = M_t$, we can find the inflation rate

Inflation

$P_t Y_t = M_t$ implies

$$P_t = \frac{M_t}{Y_t}$$

We are looking for $1 + \pi \equiv \frac{P_t}{P_{t-1}}$

We have

$$\frac{P_t}{P_{t-1}} = \frac{{M_t}/{Y_t}}{{M_{t-1}}/{Y_{t-1}}} = \frac{M_t}{M_{t-1}} \frac{Y_{t-1}}{Y_t} \Rightarrow \frac{P_t}{P_{t-1}} = \frac{1+\theta}{1+n}$$

Inflation

The rate of inflation is, therefore,

$$1 + \pi \equiv \frac{P_t}{P_{t-1}} = \frac{1 + \theta}{1 + n}$$

The rate of inflation is smaller than the rate of money supply growth because GDP increases over time

We have, $\pi \approx \theta - n$

If the growth rate of money increases one percentage point, the rate of inflation increases one percentage point

Debt-to-GDP Ratio

B_t : public debt

b_t : debt-to-GDP ratio, $b_t = \frac{B_t}{Y_t}$

Let us say that investors are not willing to buy additional government bonds if b_t is higher than $\bar{b}$

$\bar{b}$ is an upper level for the debt-to-GDP ratio

For example, $\bar{b}$ may be equal to 200%

Crisis Date T

Let us say that the deficit is consistently greater than zero

Then, the debt-to-GDP will be increasing over time

b_t will sooner or later reach its upper level $\bar{b}$

At this date, it will be no longer possible to finance the deficit by borrowing

The government will have to rely on seigniorage, inflation will have to increase sharply

This is the crisis date, T (or catastrophe date)

Making the Calculations

Take the government budget constraint,

$$D_t = B_t - (1+r)B_{t-1} + \frac{M_t - M_{t-1}}{P_t}$$

$\div Y_t$, with $P_t = \frac{M_t}{Y_t}$

$$\Rightarrow \frac{D_t}{Y_t} = \frac{B_t}{Y_t} - (1+r)\frac{B_{t-1}}{Y_{t-1}}\frac{Y_{t-1}}{Y_t} + \frac{Y_t}{Y_t}\frac{M_t - M_{t-1}}{M_t}$$

Making the Calculations

So,

$$d_t = b_t - \frac{1+r}{1+n} b_{t-1} + \frac{M_t - M_{t-1}}{M_t}$$

where d_t is the deficit-to-GDP ratio and the last term is the seigniorage-to-GDP ratio

$$\frac{M_t - M_{t-1}}{M_t} = 1 - \frac{M_{t-1}}{M_t} = 1 - \frac{1}{1+\theta}$$

$$\Rightarrow \frac{Seigniorage}{GDP} = \frac{\theta}{1+\theta}$$

Debt-to-GDP Over Time

From the government budget constraint, with $d_t = d$,

$$b_t = \frac{1+r}{1+n} b_{t-1} + d - \frac{\theta}{1+\theta}$$

If $d - \frac{\theta}{1+\theta} > 0$ and $r > n$, then b_t increases without bound

Sooner or later, b_t will reach its upper limit

Debt-to-GDP Over Time

As an example, let $b_{-1} = 0$. Then

$$b_1 = d - \frac{\theta}{1+\theta}$$

$$b_2 = \left(d - \frac{\theta}{1+\theta}\right)\left(1 + \frac{1+r}{1+n}\right)$$

$$b_3 = \left(d - \frac{\theta}{1+\theta}\right)\left(1 + \frac{1+r}{1+n} + \left(\frac{1+r}{1+n}\right)^2\right)$$

Debt-to-GDP Over Time

Therefore,

$$b_t = \left(d - \frac{\theta}{1+\theta}\right) \sum_{s=1}^{t} \left(\frac{1+r}{1+n}\right)^{s-1}$$

If $d > \theta/(1+\theta)$ and $r > n$ then b_t increases over time

It will sooner or later reach its upper limit

If GDP grows faster (n is higher) then it will take longer for b_t to reach its upper limit

But b_t will eventually reach its upper limit, unless d decreases

Inflation Before and After the Crisis

Before the crisis, we have

$$1 + \pi = \frac{1 + \theta}{1 + n}$$

Before the crisis, inflation can be very low

All we need is to set the monetary policy in a way that θ is small

Money supply in this case increases at a small rate

Inflation Before and After the Crisis

For after the crisis, we need to find the level of seigniorage to finance the deficit

We need to find the value of the growth rate of money that closes the government budget constraint after T

Inflation Before and After the Crisis

From the budget constraint

$$b_t = \frac{1+r}{1+n} b_{t-1} + d - \left(1 - \frac{M_{t-1}}{M_t}\right)$$

Substituting the upper limit for the debt, $\bar{b}$, we obtain

$$\bar{b} = \frac{1+r}{1+n} \bar{b} + d - \left(1 - \frac{M_{t-1}}{M_t}\right)$$

Inflation Before and After the Crisis

Then,

$$\frac{M_t}{M_{t-1}} = \left(1 - d - \left(\frac{1+r}{1+n} - 1\right)\bar{b}\right)^{-1}$$

The inflation rate is given by $\frac{M_t}{M_{t-1}} \frac{1}{1+n}$

The inflation rate is independent of the time to reach T

If θ is small before T, the inflation rate will increase sharply

Inflation Before and After the Crisis

If $n = 0$, in particular, we have

$$1 + \pi_H = \frac{1}{1 - d - r\bar{b}}$$

If the deficit plus the service of the debt is large ($d + r\bar{b}$ close to 1), then the inflation rate will be large

Example

GDP growth rate, n : 2% p.a.

Real interest rate, r : 5% p.a.

Deficit-to-GDP ratio, d : 10%

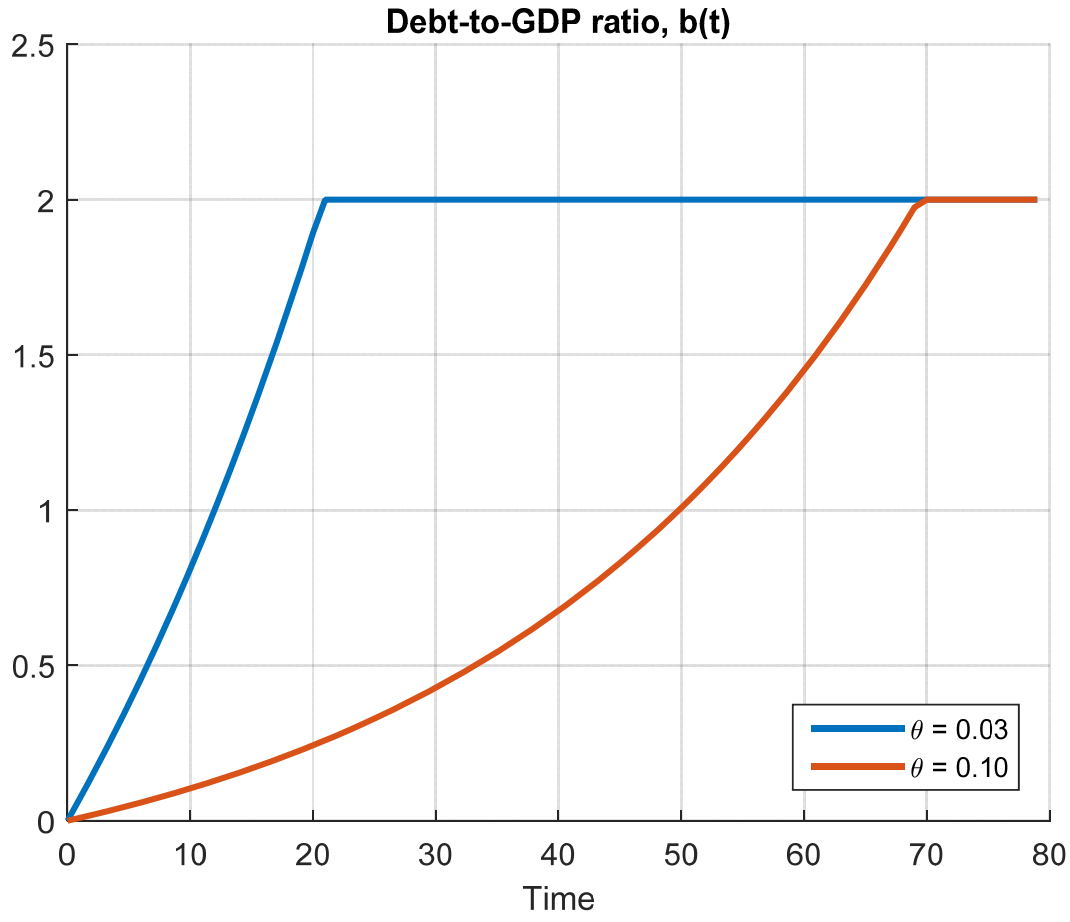
Maximum level of Debt-to-GDP ratio, $\bar{b}$: 200%

Monetary policies

Policy 1 (low inflation before T): $\theta = 0.03$

Policy 2 (high inflation before T): $\theta = 0.10$

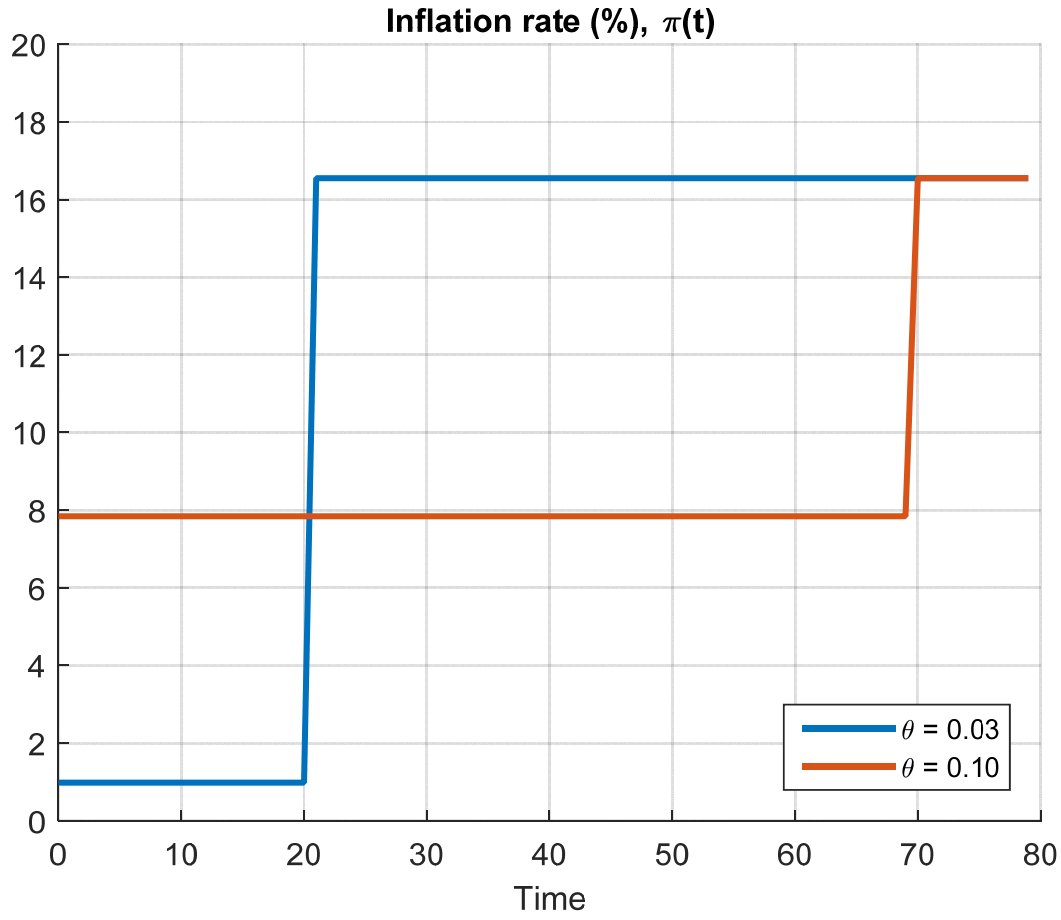
Debt-to-GDP Ratio over Time



Inflation may be low for extended periods.

However, if the deficits are persistent, the debt-to-GDP ratio will sooner or later reach its limit.

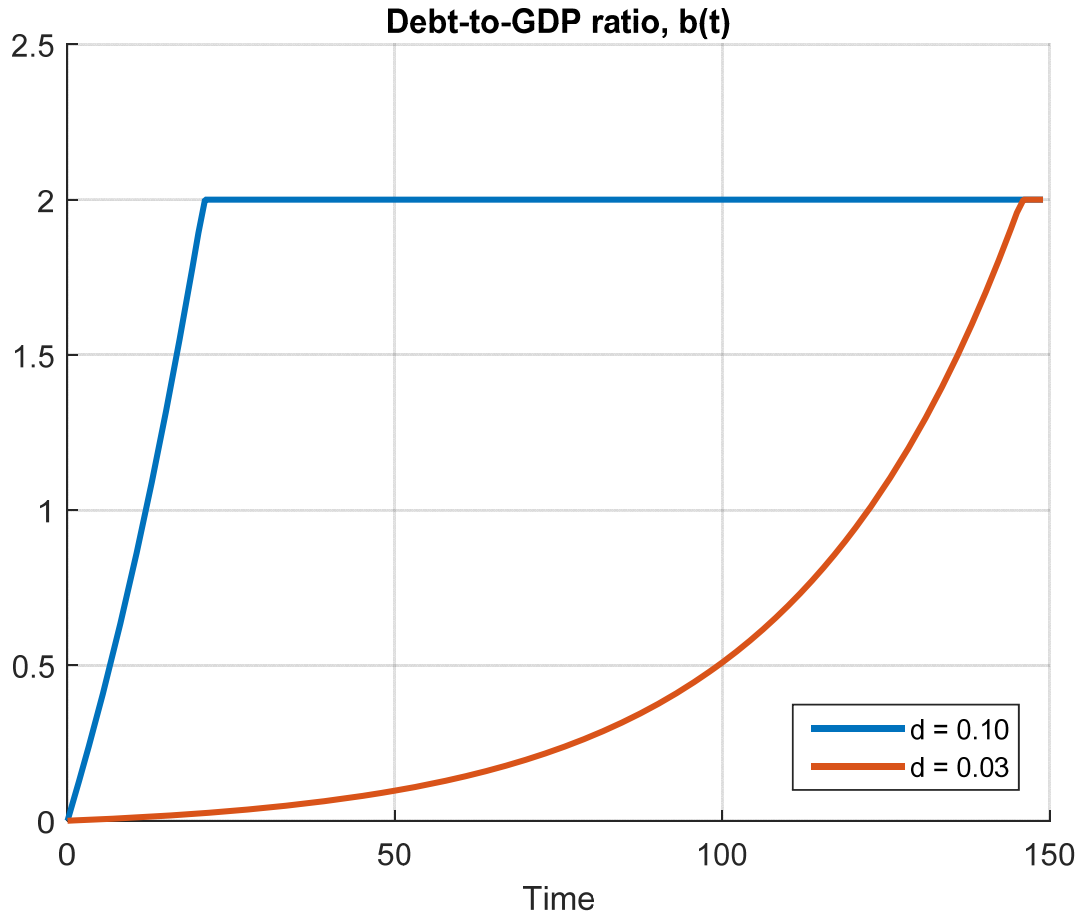
Inflation Rate over Time



At a certain time, the government will not be able to finance itself with bonds anymore.

At this time, the inflation rate increases sharply.

High and Low Deficit-to-GDP



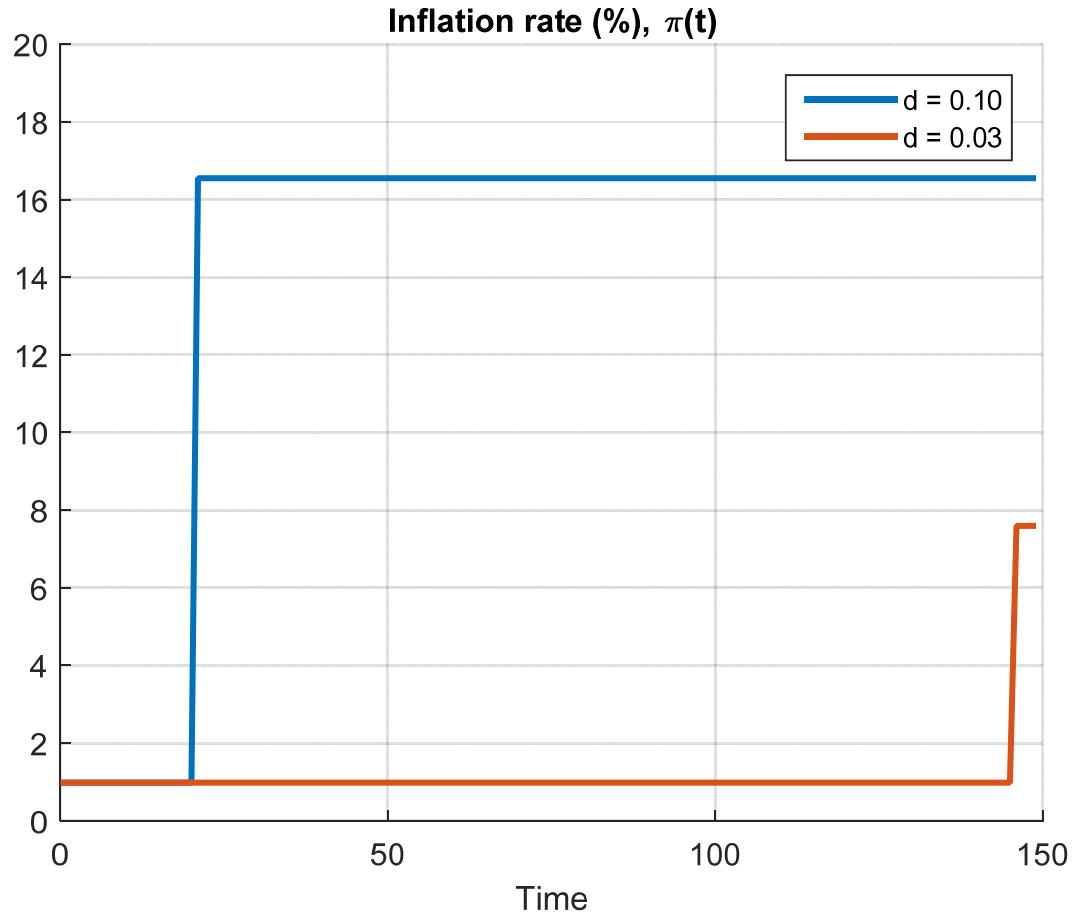
A smaller deficit-to-GDP ratio, d, makes the crisis occurs later.

If b continues to increase, the crisis will occur anyway.

A later date can give time for additional decreases in d.

$\theta = 0.03$

High and Low Deficit-to-GDP



Higher deficits imply that the crisis occurs earlier.

Moreover, the inflation rate after the crisis is higher.

$\theta = 0.03$

Conclusions

If the deficit, $G - T$, is large, the government will have to rely on seigniorage to finance its deficit sooner or later

The government may be able finance its deficit with new bond issues

In this way, inflation can be low

But if the deficit is chronic, this solution is temporary

Inflation would be low temporarily and later high

To mantain inflation low, it is necessary to maintain $G - T$ small