Part II
Money and Public Finance
Lecture 7
Selected Issues from a Positive Perspective

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Monetary and Fiscal Policy Issues in General Equilibrium
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Motivation

- Exercises in jointly optimal monetary and fiscal policies lead to interesting benchmark results...
- ...but they ignore that in advanced economies MP and FP are carried out by different agents (ie central bank vs. government), subject to distinct mandates, time horizons, and decision-making procedures and typically with not (fully) harmonized objectives

→ **How to account for monetary and fiscal interactions from a positive perspective?**

Motivation

Positive analysis of MP and FP interactions - Starting points:

$\longrightarrow$ Both MP and FP contribute to the public sector budget constraint

$\longrightarrow$ Ability of policymakers to pursue their respective goals depends on budgetary arrangement

$\longrightarrow$ More generally speaking, on how MP and FP are coordinated

Motivation

→ Ability of central banks to control inflation not to be taken for granted, but to be backed by appropriate regime

This insight follows from contributions which challenge ‘conventional’ monetarist reasoning and take the idea that MP and FP share a common budget constraint seriously:

1) Some unpleasant monetarist arithmetic
(Sargent and Wallace, 1981)
→ critical channel for budgetary adjustment: **seigniorage**

2) The fiscal theory of the price level
(Woodford, 1994, Sims, 1994, Leeper, 1991)
→ critical channel for budgetary adjustment: **revaluation of nominal government debt**

Unpleasant monetarist arithmetic

M. Friedman (1968) in his famous presidential address to the AEA warned not to expect too much from MP:
→ MP cannot permanently influence the levels of real activity, unemployment and of real return rates,
→ *but:* MP *does* have control over inflation in the long run

T. Sargent/N. Wallace (1981):
→ Friedman's dictum needs a certain qualification if one discusses explicitly interactions between monetary and fiscal policy
→ To illustrate this SW describe a famous constellation in a seemingly monetarist economy in which long-run inflation is not under the control of the central bank ("unpleasant monetarist arithmetic")
→ The paper has been crucial for the debate about appropriate monetary and fiscal arrangements and institutional designs of central banks

Unpleasant monetarist arithmetic

Consider a monetarist economy in which
- the price level is closely related to the monetary base and
- the central bank has the ability to collect revenues from money creation (seigniorage)

Specific assumptions:
(A 1) The growth rate n of real income and of the population is constant and independent of MP
(A 2) The real return rate r on government bonds is independent of MP. Moreover, $r > n$.
(A 3) The behaviour of the price level satisfies a strong version of the quantity theory of money with *constant* velocity (ie $1/m$):

$$M_t = m \cdot p_t \cdot N_t$$

Unpleasant monetarist arithmetic

Comment on assumptions (A 1) - (A 3):

"A model with these features has the limitations on monetary policy stressed by Milton Friedman in his AEA presidential address: a natural, or equilibrium, growth rate of real income that monetary policy is powerless to affect and a real rate of interest on government bonds beyond the influence of monetary policy. We choose this model...to show that our argument about the limitations of monetary policy is not based on abandoning any of the key assumptions made by monetarists who stress the potency of monetary policy for controlling inflation.
Instead, the argument hinges entirely on taking into account the future budgetary consequences of alternative current monetary policies when the real rate of return on government bonds exceeds n, the growth rate of the economy."

(Sargent and Wallace, 1981, p. 3)

Unpleasant monetarist arithmetic

Comment on velocity:

In the second part of the analysis done below, **(A 3)** will be relaxed and m_t will be variable, leading to the alternative assumption:

(A 3') The behaviour of the price level satisfies a weaker version of the quantity theory of money with *variable* velocity (ie $1/m_t$):

$$M_t = m_t(\underbrace{\frac{p_{t+1}}{p_t}}_{-}) \cdot p_t \cdot N_t$$

Unpleasant monetarist arithmetic

Public sector budget constraint in period t in real terms:

$$B_t^r = (1 + r_{t-1})B_{t-1}^r + D_t^r - \frac{M_t - M_{t-1}}{p_t} \tag{1}$$

B_{t-1}^r : real value of one-period gov't bonds maturing in period t, measured in units of time $t-1$ goods
r_{t-1} : real interest rate on bonds prevailing between period $t-1$ and t
B_t^r : real value of newly emitted bonds in period t, measured in units of time t goods
D_t^r : Real primary fiscal deficit in period t (i.e. expenditures net of interest payments − revenues)
M_t : nominal stock of (base) money in period t
p_t : price level in period t
$\frac{M_t - M_{t-1}}{p_t}$: seigniorage income resulting from increased stock of money

Unpleasant monetarist arithmetic

Fiscal policy is a sequence : $D_1^r, D_2^r, D_3^r, \ldots$

Monetary policy is a sequence: $M_1, M_2, M_3, \ldots$

Assumption: Current date: $t = 1$. Policies are announced in $t = 1$ and are perceived to be credible

Coordination between monetary and fiscal policy?

Fiscal dominance: D^r-sequence announced first and M-sequence reacts to this, consistent with (1)

Monetary dominance: M-sequence announced first and D^r-sequence reacts to this, consistent with (1)

Unpleasant monetarist arithmetic

Law of motion of population:

$$N_{t+1} = (1+n)N_t \tag{2}$$

N_t : population at time t, n : constant population growth rate

Budget constraint (1) in per capita terms:

$$\frac{B_t^r}{N_t} = \underbrace{\frac{1+r_{t-1}}{1+n}}_{>1!}\frac{B_{t-1}^r}{N_{t-1}} + \frac{D_t^r}{N_t} - \frac{M_t - M_{t-1}}{N_t \cdot p_t}$$

Use the definitions $b_t = \frac{B_t^r}{N_t}$, $d_t = \frac{D_t^r}{N_t}$ to rewrite this as:

$$b_t = \underbrace{\frac{1+r_{t-1}}{1+n}}_{>1!} b_{t-1} + d_t - m \cdot (1 - \frac{1}{(1+n)\frac{p_t}{p_{t-1}}}), \tag{3}$$

where $\frac{M_t - M_{t-1}}{N_t \cdot p_t} = m \cdot (1 - \frac{1}{(1+n)\frac{p_t}{p_{t-1}}})$ describes the real seigniorage per capita

Unpleasant monetarist arithmetic

Claim 1: Consider assumptions (A 1), (A 2), (A 3) and assume *fiscal dominance*. Then: '**tighter money now can mean higher inflation eventually**'

Why?

1) Real per capita debt $\frac{B_t^r}{N_t} = b_t$ in (3) has an unstable root, since $\frac{1+r_{t-1}}{1+n} > 1$

2) Private sector is aware of 1) and places an upper limit on growing government debt holdings. To make this operational assume that b_t is forced to be constant from period T onwards at some level b_T

3) Until T is reached, this capital market constraint is not binding and monetary policy follows the ('constant money growth') rule

$$M_t = (1+\theta)M_{t-1}, \quad \text{for } t = 2, 3, \dots, T; \text{ with } M_1 \text{ given} \tag{4}$$

while the price level, in line with (A 3), is determined according to

$$p_t = \frac{1}{m}\frac{M_t}{N_t} \tag{5}$$

Unpleasant monetarist arithmetic

$\Rightarrow$ for $t = 2, 3, .., T$: for a given money growth rate θ, inflation is determined by

$$\frac{p_t}{p_{t-1}} = \frac{1+\theta}{1+n}$$

(and θ may be chosen in line with the inflation objective of the central bank)

4) How does inflation after period T depend on the tightness of monetary policy before period T?
Definition: $\theta_1 < \theta_2$ means policy 1 is tighter than policy 2

Step I: $\longrightarrow$ show that inflation after T increases in b_T
Step II: $\longrightarrow$ show that b_T decreases in θ

Unpleasant monetarist arithmetic

Step I): $\longrightarrow$ show that inflation after T increases in b_T

for $t > T$, use $b_t = b_T =$ constant in eqn (3):

$$m \cdot \left(1 - \frac{1}{(1+n)\frac{p_t}{p_{t-1}}}\right) = d_t + \frac{r_{t-1} - n}{1+n} \cdot b_T \tag{6}$$

From eqn (6), one infers that inflation p_t / p_{t-1} after period T increases in b_T

Intuition: Under fiscal dominance (ie for a given sequence $d_t = \frac{D_t^r}{N_t}$), a higher b_T raises the required contribution of MP to the budget in terms of real seigniorage per capita. Given (A 3) this in turn requires a higher inflation rate

Unpleasant monetarist arithmetic

Remark ad eqn (6):

$$1 - \frac{1}{(1+n)\frac{p_t}{p_{t-1}}} = \frac{1}{m} \cdot [d_t + \frac{r_{t-1} - n}{1+n} \cdot b_T]$$

makes only sense if the RHS is less than 1, i.e. there exists some upper bound of b_T to be financed via seigniorage

Unpleasant monetarist arithmetic

Step II): $\rightarrow$ show that b_T decreases in θ

Let us derive the sequence $b_1, b_2, ..., b_T$ starting in period 1
Budget constraint (3) in period 1 :

$$b_1 = \widetilde{b}_0 + d_1 - \frac{M_1 - M_0}{N_1 \cdot p_1} \tag{7}$$

$\widetilde{b}_0$: Real per capita value of principal and interest of debt issued at $t = 0$, measured in units of time $t = 1$ - goods

Remark: we use $\widetilde{b}_0$ rather than $\frac{1+r_0}{1+n} b_0$ since the reasoning starts, by assumption, in $t = 1$ and we don't want to take a view whether expectations between period 0 and 1 have been correct or not

Unpleasant monetarist arithmetic

General expression for $b_t : t > 2$ and $t \leq T$:

$$b_t = \frac{1 + r_{t-1}}{1+n} b_{t-1} + d_t - \frac{\theta}{1+\theta} m, \tag{8}$$

where we have used that under the constant money growth rule the seigniorage term simplifies to:

$$\frac{M_t - M_{t-1}}{N_t \cdot p_t} = m \cdot (1 - \frac{1}{(1+n)\frac{p_t}{p_{t-1}}}) = \frac{\theta}{1+\theta} m.$$

Equation (8) has a recursive structure...

$$\begin{aligned} b_t &= \frac{1+r_{t-1}}{1+n} \cdot [\frac{1+r_{t-2}}{1+n} b_{t-2} + d_{t-1} - \frac{\theta}{1+\theta} m] + d_t - \frac{\theta}{1+\theta} m \\ &= \frac{(1+r_{t-1})(1+r_{t-2})}{(1+n)^2} b_{t-2} + \frac{1+r_{t-1}}{1+n} d_{t-1} + d_t \\ &\quad - \frac{1+r_{t-1}}{1+n} \frac{\theta}{1+\theta} m - \frac{\theta}{1+\theta} m \end{aligned}$$

Unpleasant monetarist arithmetic

...and repeated substitution leads to

$$b_t = \phi(t,1)b_1 + \sum_{s=2}^{t} \phi(t,s) \cdot d_s - \frac{\theta}{1+\theta} m \cdot \sum_{s=2}^{t} \phi(t,s) \qquad (9)$$

$$\text{with:} \quad \phi(t,t) = 1 \quad \text{and for } t > s: \quad \phi(t,s) = \frac{\prod_{j=s}^{t-1}(1+r_j)}{(1+n)^{t-s}},$$

In equation (9), set $t = T$ and recognize that $b_T(\theta)$ **decreases in** θ

Intuition:
$\rightarrow$ The seigniorage term $\frac{\theta}{1+\theta} m$ increases in θ
$\rightarrow$ A tighter monetary policy ('θ small') generates ceteris paribus period by period less seigniorage. For a given d_t - sequence this increases the rate of bond creation, i.e. $b_T(\theta)$ will be 'large'.

Steps I and II: $\rightarrow$ '**tighter money now can mean higher inflation eventually**'

Unpleasant monetarist arithmetic

Claim 2: Consider assumptions (A 1),(A 2), (A 3') and assume *fiscal dominance.* Then: **'tighter money now can mean higher inflation now'**

Assume instead of (A 3) that the demand for real balances depends negatively on expected inflation, in line with (A 3'):

$$\frac{M_t}{p_t} = m_t(\underbrace{\frac{p_{t+1}}{p_t}}_{-}) \cdot N_t \tag{10}$$

Technical implication of (10): path of price level before T depends not only on θ, but on what happens at and after T
($\rightarrow$ *Appendix B of Sargent/Wallace-paper*)

Unpleasant monetarist arithmetic

Economic implication of (10): **'tighter money now can mean higher inflation now'**

Intuition: for $t = 2, 3, \ldots T$, there are two effects at work
i) Tight money by itself reduces inflation
ii) Tight money implies high expected inflation beyond T (see *claim 1*). This is anticipated via (10) and by backward-induction this tends to increase inflation already today.

→ Net effect of i) and ii) is ambiguous
→ SW offer examples where the second effect dominates

Unpleasant monetarist arithmetic

Conclusions:

- Intertemporal budget constraint of the public sector combines contributions from monetary and fiscal policies
- This is illustrated in the arithmetic of Sargent and Wallace (1981) in a spectacular way:
  $\longrightarrow$ under *fiscal dominance*, long-run inflation not necessarily in line with objectives of central bank
  $\longrightarrow$ *monetary dominance* ('independence of the central bank') is indispensable in order to give monetary policy control over long-run inflation

Fiscal theory of the price level

- A more controversial challenge of monetarist reasoning is offered by the so-called **'Fiscal theory of the price level',** in the spirit of Woodford (1994), Sims (1994) and Leeper (1991)
- This theory argues that monetary policy may not be able to control the price level no matter how tough and independent the central bank is, unless fiscal policies are conducted in an appropriate way
- Inappropriate fiscal policies (which endanger the sustainability of government debt at the going price level) trigger revaluations of the outstanding nominal amount of debt via adjustments in the price level
- This revaluation channel of nominal debt is effective even if monetary policy is fully independent

Fiscal theory of the price level

To highlight the logic underlying the FTPL, consider a simplified version of the basic MIU model:

- Endowment economy, ie output is a constant endowment y in each period
- Constant population (normalized to $N = 1$)
- Assumption on **initial values**: The economy starts to operate in $t = 0$, taken as given the **nominal** values M_{-1}, B_{-1}, i_{-1}, while the price level p_0 is determined in $t = 0$

Fiscal theory of the price level

Preferences of representative household:

$$\max \sum_{t=0}^{\infty} \beta^t u(c_t, m_t) \qquad \beta \in (0,1)$$

Private sector flow budget constraint in nominal terms:

$$P_t y - P_t \tau_t^{tax} + (1 + i_{t-1}) B_{t-1} + M_{t-1} = P_t c_t + B_t + M_t$$

τ_t^{tax} : Per capita lump-sum *tax*

Private sector flow budget constraint in real terms:

$$y - \tau_t^{tax} + (1 + r_{t-1}) b_{t-1} + \frac{1}{1+\pi_t} m_{t-1} = c_t + b_t + m_t$$

Fiscal theory of the price level

Public sector flow budget constraint in real terms:

$$(1+r_{t-1})b_{t-1} = \underbrace{\tau_t^{tax} - g_t}_{s_t^f} + \underbrace{m_t - \frac{1}{1+\pi_t}m_{t-1}}_{s_t^m} + b_t$$

s_t^f: primary surplus (surplus generated by fiscal policy)
s_t^m: seigniorage (surplus generated by monetary policy)
$s_t = s_t^f + s_t^m$: combined surplus generated by monetary and fiscal policy

Resource constraint (follows from combining the private and public bc's):

$$y = c_t + g_t$$

Fiscal theory of the price level

Optimality conditions of private sector:

- Fisher equation:

$$1 + i_t = (1 + r_t) \cdot (1 + \pi_{t+1})$$

- Consumption Euler equation:

$$u_c(c_t, m_t) = \beta(1 + r_t) \cdot u_c(c_{t+1}, m_{t+1})$$

- Allocation between consumption and real balances:

$$\frac{u_m(c_t, m_t)}{u_c(c_t, m_t)} = \frac{i_t}{1 + i_t}$$

- Transversality condition:

$$\lim_{t \to \infty} \beta^t u_c(c_t, m_t) x_t = 0 \quad x = b, m$$

Fiscal theory of the price level

(Simplifying) **assumptions on policy**, conducive to a fiscally determined price level:

Fiscal policy: exogenous (or 'non-Ricardian') primary surplus

$$\tau_t^{tax} = \tau^{tax}, \ g_t = g$$

Monetary policy: interest rate peg

$$i_t = i$$

$\longrightarrow$ **Implications:**

$$c_t = y - g = c \quad r_t = 1/\beta - 1 = r \quad m_t = m \quad \forall t \geqslant 0$$

Hence, the surplus-terms are constant for $t \geqslant 0$:

$$\begin{aligned} s_t^f &= \tau^{tax} - g = s^f \\ s_t^m &= m \cdot (1 - \frac{1}{1+\pi}) = m \cdot \frac{i - r}{1 + i} = s^m \\ s_t &= s^f + s^m = s \end{aligned}$$

Fiscal theory of the price level

Implications for public sector budget constraint:

$$(1+r)b_{t-1} = s + b_t$$

Alternative representation via forward solution:

$$(1+r)b_{t-1} = \sum_{t=0}^{\infty} \frac{s}{(1+r)^t} + \lim_{t\to\infty} \frac{1}{(1+r)^t} b_t \tag{11}$$

Notice:

- TV-condition from HH optimality conditions implies

$$\lim_{t\to\infty} \beta^t b_t = \lim_{t\to\infty} \frac{1}{(1+r)^t} b_t = 0$$

- Use initial condition to write LHS of (11) as:

$$\frac{(1+i_{-1})B_{-1}}{p_0}$$

Hence, (11) turns into

$$\frac{(1+i_{-1})B_{-1}}{p_0} = \sum_{t=0}^{\infty} \frac{s}{(1+r)^t} \tag{12}$$

Fiscal theory of the price level

Interpretation of (12), ie

$$\frac{(1+i_{-1})B_{-1}}{p_0} = \sum_{t=0}^{\infty} \frac{s}{(1+r)^t}$$

- If monetary policy follows an interest rate peg $(i_t = i)$, or, more generally speaking, an exogenously specified path of $i_{t,}$ it does not determine the price level (only π)
- The price level p_0 is instead determined within the budget constraint of the public sector. Eqn (12) says that the real value of outstanding nominal government debt equals in equilibrium the value of the discounted stream of all future monetary and fiscal surpluses.
- Exogenous changes in the value of s lead to changes in p_0. Even if monetary policy does not vary s_t^m, fiscal policy changes in terms of exogenous variations in s_t^f change the price level p_0

Fiscal theory of the price level

Comments and controversial issues:

- Assume the primary surplus is subject to random shocks. Then, the above specification would be consistent with a world in which monetary policy controls the average inflation rate, while fiscal shocks cause random fluctuations of the inflation rate around the average
- Under non-Ricardian fiscal policies, when combined with alternative specifications of monetary policies, the price level may be overdetermined (such that no equilibrium exists) or the equilibrium may be explosive
- The revaluation channel via price level adjustments avoids open default if fiscal policies are perceived as being unsustainable. Sovereign defaults occur in reality, suggesting that the logic of the FTPL is a special one