Time-Consistent Fiscal Guarantee for Monetary Stability

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- Essential active **off-equilibrium** role
  - no fiscal surpluses along the equilibrium

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- Essential active **off-equilibrium** role
  - no fiscal surpluses along the equilibrium
- textbook Samuelson (1958)/Sims (2013) model of fiat money
- discretionary policy=f*(portfolio choice)

1. Model

OLG Model: consumption-saving problem

- Discrete time: $t \in \{0, 1, ...\}$
- Overlapping generations of agents living for two periods.
- Representative agent born at time t maximizes:

$$U_t \equiv \log C_{t,y} + \log C_{t+1,o}$$

- subject to:

$$\begin{aligned} \textit{young}: \quad & C_{t,y} + \frac{M_t}{P_t} + S_t + T_{t,y} = W \\ \textit{old}: \quad & C_{t,o} = \frac{M_{t-1}}{P_t} + \theta S_{t-1} + T_{t,o} \end{aligned}$$

where:

- individual endowment W, lump sum taxes/transfers $T_{t,y}$, $T_{t,o}$;
- agents choose consumption C and composition of savings:
- either in real cash holdings M/P
- or in freely available storage S with a return $\theta < 1$
- At date 0, $M_{-1} = \bar{M}$.

OLG Model: the authority

At date-t, the authority's objective is:

$$\log C_{y,t} + \log C_{o,t} + \lambda \log G_t,$$

G_t: government expenditures, and $\lambda > 0$. Its budget constraint is:

$$T_{t,y} + \frac{M_{g,t-1}}{P_t} = \frac{M_{g,t}}{P_t} + T_{t,o} + G_t.$$

with $M_{g,t} + M_t = \bar{M}$.

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- In the FTPL: price set indirectly by agents affected by tax decisions.
- Still, fixing a redemption price does not imply agent trading money
  - at the core of time-consistency

2. Benchmark: No Policy

Optimal choices of agents

No policy benchmark: $\mathcal{P}_t = (0, 0, 0, 0)$.

Savings

$$D_t \equiv S_t + \frac{M_t}{P_t} = \frac{W}{2}$$

for any expected return (property of log-utility)

$$\rho_t = \frac{\theta S_t + M_t / P_{t+1}}{D_t}$$

Portfolio allocation:

$$\begin{aligned} \frac{M_t}{P_t} = D_t \quad \text{and } S_t = 0 \qquad & \text{if} \qquad \Pi_{t+1} < \frac{1}{\theta}, \\ \frac{M_t}{P_t} + S_t = D_t \qquad & \text{if} \qquad \Pi_{t+1} = \frac{1}{\theta}, \\ S_t = D_t \quad \text{and } \frac{M_t}{P_t} = 0 \qquad & \text{if} \qquad \Pi_{t+1} > \frac{1}{\theta}, \end{aligned}$$

where $\Pi_{t+1} \equiv P_{t+1}/P_t$ is the inflation rate from time t to time $t+1$.

No policy leads to indeterminacy

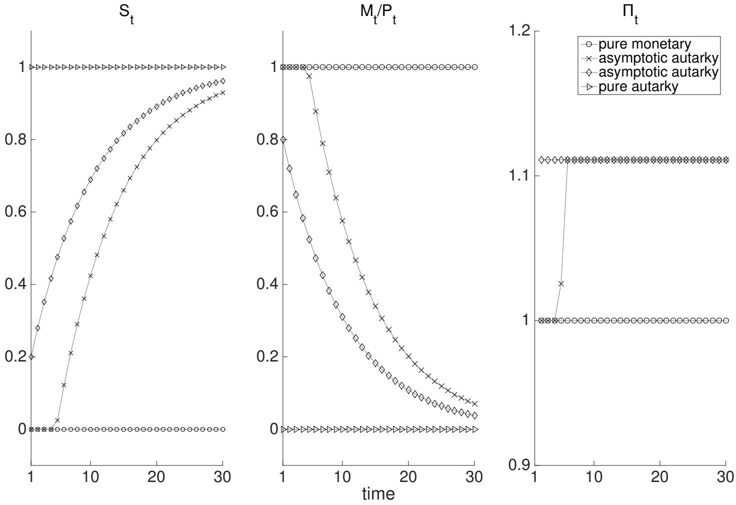

Figure : Equilibria without policy intervention for $\theta = 0.9$, $W = 2$ and $\bar{M} = 1$.

3. Optimal policy with fiscal power

Optimal policy with fiscal power

At any t, an optimal policy is a $\mathcal{P}_t^* = (T_{y,t}^*, M_{g,t}^*, G_t^*, 0)$ that solves:

$$\max_{\mathcal{P}_t, G_t} \{\log C_{y,t} + \log C_{o,t} + \lambda \log G_t\},$$

subject to

$$T_{y,t} + \frac{M_{g,t-1}}{P_t} = \frac{M_{g,t}}{P_t} + G_t$$

taking into account agents' decision process on consumption:

$$\begin{aligned} C_{y,t} &= \frac{M_t}{P_t} + S_t = \frac{W - T_{y,t}}{2} \\ C_{o,t} &= \frac{M_{t-1}}{P_t} + \theta S_{t-1} \end{aligned}$$

and market clearing conditions, with $S_0 = 0$ and $M_0 \leq \bar{M}$.

- WLoG: no transfers to old.

Optimal policy with fiscal power

We can rewrite the problem of the authority as

$$\max_{\mathcal{P}_t, G_t} \left\{ \log \underbrace{\left(W - G_t - \frac{M_{t-1}}{P_t} - S_t \right)}_{=C_{y,t}} + \log \underbrace{\left(\frac{M_{t-1}}{P_t} + \theta S_{t-1} \right)}_{=C_{o,t}} + \lambda \log G_t \right\}$$

whose solution is

$$\begin{cases} G_t = \lambda C_{y,t}, \; P_t = \frac{(2+\lambda)M_{t-1}}{W-(1+\lambda)\theta S_{t-1} - S_t} & \text{with} \quad C_{y,t} \geq C_{o,t} \\ G_t = \lambda C_{y,t}, \; P_t \to \infty & \text{otherwise.} \end{cases}$$

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If no private money demand $\rightarrow$ incentive to infinite deflation $\rightarrow$ autarky is not an equilibrium

Optimal policy with fiscal power

compare

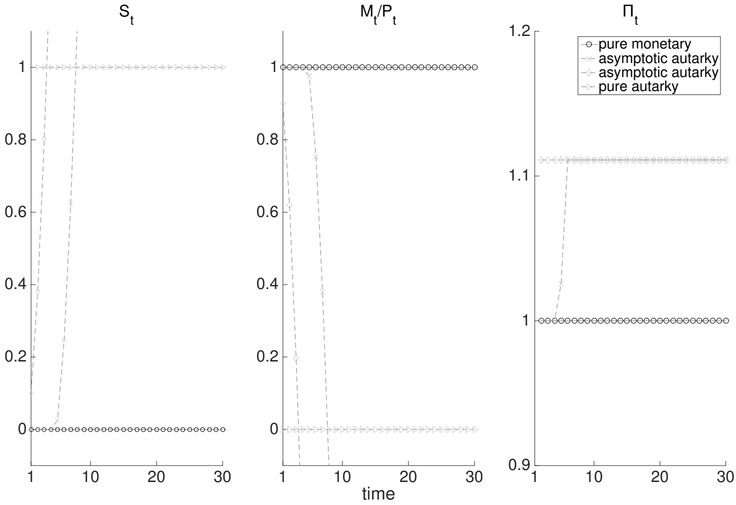

Figure : Uniqueness with optimal policy for $\theta = 0.9$, $W = 2$, $\bar{M} = 1$ and $\lambda \to 0$.

Monetary equilibrium

A single equilibrium:

(i) no inflation $\Pi_t = 1$,

(ii) real value of money:

$$\frac{\bar{M}}{P_t} = \frac{M_t}{P_t} = \frac{W}{2+\lambda} \quad \text{and} \quad S_t = 0,$$

(iii) no public open market interventions:

$$T_{y,t} = G_t = \frac{\lambda}{2+\lambda} W,$$

for each $t \geq 1$.

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- $\neq$ Fiscal theory of the price level:
  - *No surplus in equilibrium:* $T_{y,t} = G_t$
  - No money purchase in equilibrium: $M_{g,t} = M_{g,t-1}$
  - Money = bubble $\rightarrow$ no-fundamental dividend

4. Optimal policy without fiscal power

Optimal policy without fiscal power

At any t, an optimal policy is a $\mathcal{P}_t^* = (\bar{T}, M_{g,t}^*, G_t^*, 0)$ that solves:

$$\max_{M_{g,t}, G_t} \left\{ \log C_{y,t} + \log C_{o,t} + \lambda \log G_t \right\},$$

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and market clearing conditions, with $S_0 = 0$ and $M_0 \leq \bar{M}$.

- The authority has real endowment, but cannot raise taxes in response to a change in private savings!

Optimal policy without fiscal power

We can then rewrite the problem of the authority as

$$\max_{P_t} \left\{ \log \frac{W - \bar{T}}{2} + \log \underbrace{\left(\frac{M_{t-1}}{P_t} + \theta S_{t-1} \right)}_{=C_{o,t}} + \lambda \log \underbrace{\left(\frac{W + \bar{T}}{2} - \frac{M_{t-1}}{P_t} - S_t \right)}_{=G_t} \right\}$$

whose solution is

$$\begin{cases} P_t = \frac{2(1+\lambda)M_{t-1}}{W+\bar{T}-2\lambda\theta S_{t-1}-2S_t} & \text{with} \quad \lambda C_{o,t} \leq G_t \\ P_t \to \infty & \text{otherwise.} \end{cases}$$

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The authority trades-off public and old's cons. $\rightarrow$ **it produces** inflation!

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But inflation fixed by arbitrage $\rightarrow$ less storage is needed for the same inflation rate $\rightarrow$ at same money and storage can steadily coexist

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If no private money demand $\rightarrow$ infinite inflation could be possible $\rightarrow$ autarky can be an equilibrium

Optimal policy without fiscal power compare

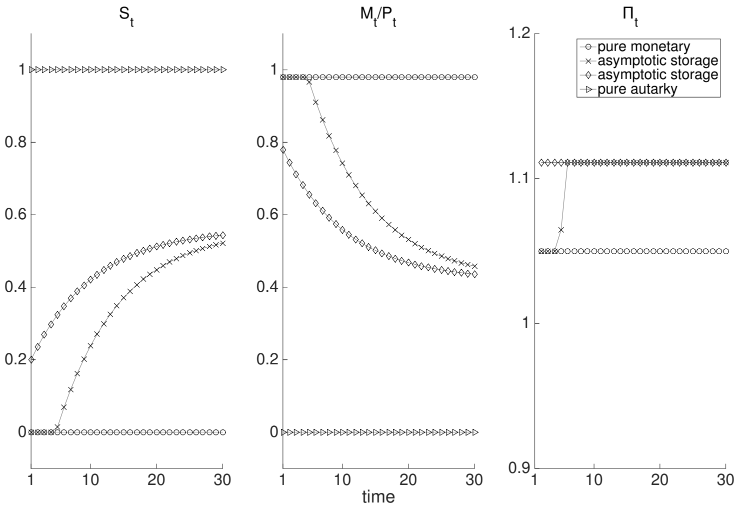


Figure : Uniqueness with fixed taxes for $\theta = 0.9$, $W = 2$, $\bar{M} = 1$ and $\lambda = 0.05$.

The monetary equilibrium?

- In this equilibrium:

$$\begin{aligned} \frac{M_t}{P_t} &= \frac{M_0}{P^*} = \frac{W-\bar{T}}{2}, \text{ for any } t \geq 1, \\ \Pi_t &= 1+\lambda, \text{ for any } t > 1, \\ S_t &= 0, \text{ for any } t > 1. \end{aligned}$$

- $\neq$ previous monetary equilibrium:
  - Consumption not equalized across generation.
  - Seigniorage in equilibrium.

- Exist only when $1+\lambda \leq \theta^{-1}$.

  Otherwise: storage strictly preferred to money.

Multiplicity without fiscal power

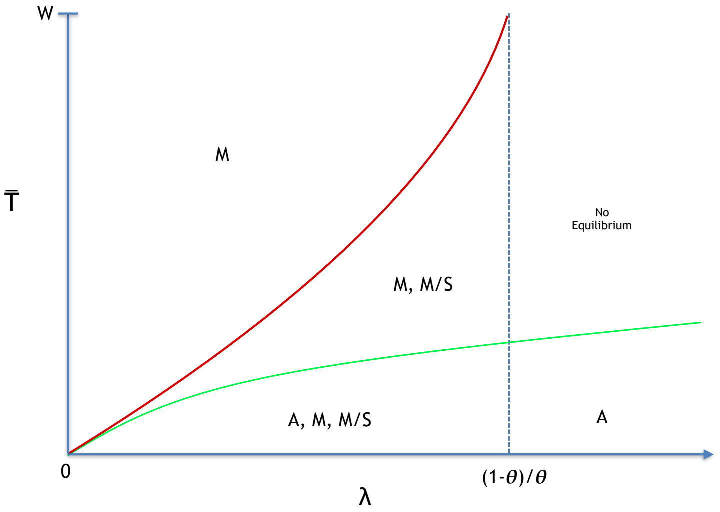


Figure : Multiplicity: A=autarky, M/S=asymptotic storage, M=pure monetary

5. Conclusion

Conclusion

A new way to think about the uniqueness of the monetary equilibrium.

Monetary stability relies on the **active but off-equilibrium** role of an authority with fiscal power.

Fiscal power is needed to let agents trust that money will not be used to implicitly tax instead!

Thanks

No policy leads to indeterminacy back

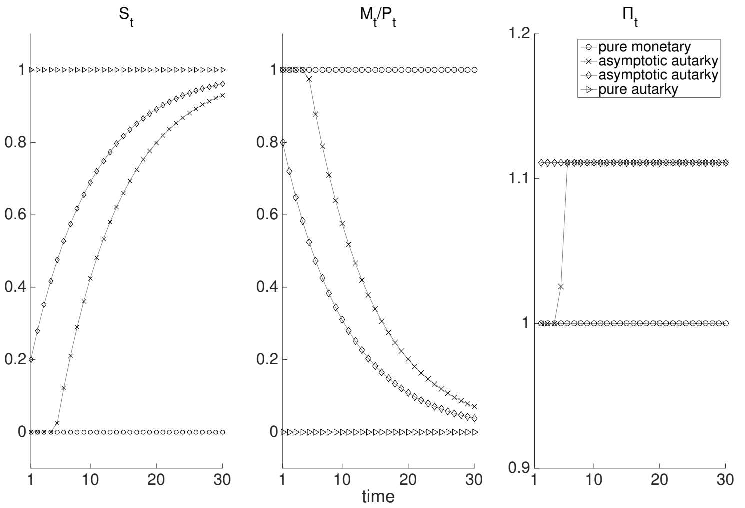


Figure : Equilibria without policy intervention for $\theta = 0.9$, $W = 2$ and $\bar{M} = 1$.

Appendix: Fluctuations in Endowment

Optimal policy reaction

- What happens when stochstic increases in endowment makes $\Pi_t = W_t / W_{t+1} > \theta^{-1}$?
- We build our solution on two elements:
  - First, in a solution where $S_t > 0$ we have that

$$\Pi_t = \frac{W_t + \theta S_{t-1} - 3S_t}{W_{t+1} - \theta S_t - S_{t+1}} = \theta^{-1}$$

  - Second, whenever $S_t = 0$ instead imposes

$$\Pi_t = \frac{W_t + \theta S_{t-1}}{W_{t+1} - S_{t+1}} < \theta^{-1},$$

- **Backward Implication:** Suppose $S_t > 0$, $S_{t+1} = 0$ and $S_{t+2} = 0$. Having $W_t = W$ at all times implies $S_{t-1} > 0$ which in turn implies $S_{t-2} > 0$ and so on.

Optimal policy reaction

Consider $W_1 = W + \epsilon$. The solution is a number n of periods of use of storage such that

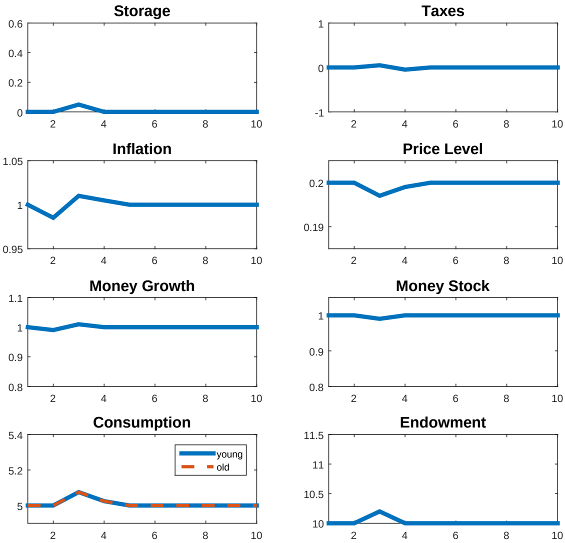
$$S_{T-n} = \frac{n\theta^n \varepsilon + \left(n\theta^n - \frac{1-\theta^n}{1-\theta}\right) W}{(1+n)\,\theta^n} \geq 0 \qquad \text{for } n = T-1$$

$$S_{T-n} = \frac{n\theta^n \theta S_{T-n-1} + \left(n\theta^n - \frac{1-\theta^n}{1-\theta}\right) W}{(1+n)\,\theta^n} \geq 0 \qquad \text{for } 0 \leq n \leq T-2$$

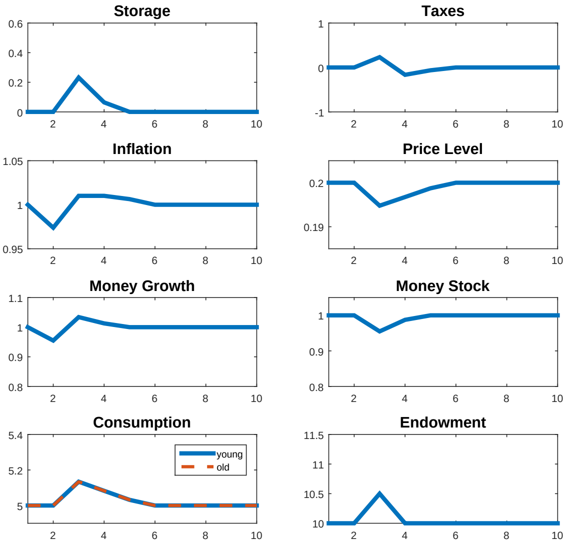
and

$$\theta S_{T-1} < \frac{1-\theta}{\theta} W \quad \text{and} \quad S_T = 0$$

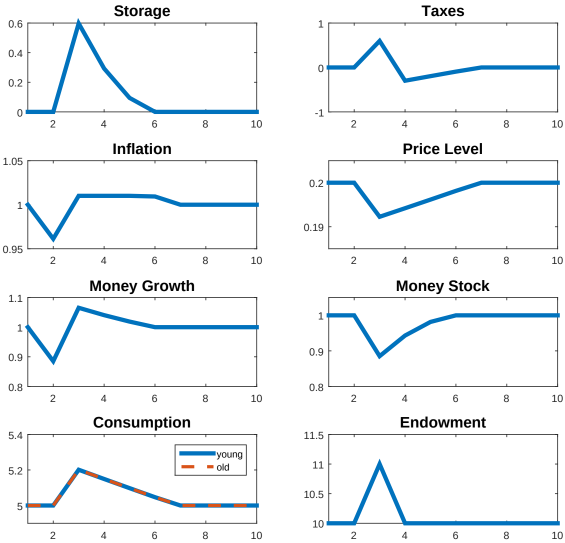
Optimal policy reaction: $w_3 = 0.2$, $\theta = 0.99$



Optimal policy reaction: $w_3 = 0.5$, $\theta = 0.99$



Optimal policy reaction: $w_3 = 1$, $\theta = 0.99$



Optimal policy reaction: $w_3 = 1$, $\theta = 0.98$