Conventional and Unconventional Monetary Policy and FTPL

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Ideas

- Explore fiscal/monetary interaction in two simple monetary models:
  - Simple cash-in-advance endowment economy with Fisherian properties.
  - Model with production and secured credit.
- Consider some unconventional monetary policies:
  - Balance sheet expansion.
  - Helicopter drops.
- Just examples – no general results here.

Fisherian Cash-in-Advance Economy

- Deterministic world, continuum of identical households with unit mass:

$$\sum_{t=0}^{\infty} \beta^t u(x_t)$$

- Fixed endowment y forever. Cannot consume own output – purchase goods from other households. Consumption goods must be purchased with currency.

Minimal Government

- Government grants monopoly note issue powers to a central bank. Assume costless enforcement of the monopoly.
- Central bank constrained to issuing currency and reserves backed by loans to the private sector.
- Reserves are interest-bearing liabilities of the central bank, which are not acceptable in retail exchange, but are convertible one-for-one into currency and vice-versa.
- Government issues shares in the central bank to the private sector – share dividends are the central bank's profits.
- reserves + currency = loans at the beginning of each period – no central bank capital.
- Looks like role envisioned for the Federal Reserve System in 1913 (or current ECB, roughly), absent commodity standard and collateral for central bank loans.

Central Bank's Constraints

$$m_0 = l_0$$

$$m_t - m_{t-1}\frac{R_t}{\pi_t} + c_{t-1}\left(\frac{R_t - 1}{\pi_t}\right) - l_t + \frac{R_t}{\pi_t} l_{t-1} = \tau_t^b, \;\; t = 1, 2, ...$$

$$c_t \leq m_t$$

$$m_t = l_t$$

- $\pi_t = \frac{P_t}{P_{t-1}}$ is the gross inflation rate, and P_t is the price level.
- m_t, c_t, l_t are total central bank liabilities, currency, and loans outsanding, in real terms.
- R_t = gross nominal interest rate.
- τ_t^b = central bank dividend.

Equilibrium

- Optimization by households:

$$u'(x_t) = \beta \frac{R_{t+1}}{\pi_{t+1}} u'(x_{t+1})$$

- Markets in currency and reserves clear.
- Cash-in-advance constraint binds.

Stationary Equilibrium

- Central bank sets R, $M_t = M_0 \mu^t$, and nominal dividend payments $T_t^b = T_0 \mu^t$.
- Implies equilibrium inflation rate is constant

$$\pi = \beta R$$

- And central bank must choose μ consistent with its interest rate policy

$$\mu = \beta R$$

- So, the central bank's dividend each period is

$$\tau^b = \frac{y}{\beta R}(R-1),$$

- Then, T_0 determines the initial price level

$$P_0 = \frac{T_0 \beta R}{y(R-1)}$$

Stationary Equilibrium, II

- The size of the central bank's balance sheet in real terms is $\frac{M_0}{P_0} \geq y$, and the quantity of reserves is then

$$z = y \left[\frac{M_0(R-1) - T_0 \beta R}{T_0 \beta R} \right]$$

- Finally, the price of shares in the central bank is a constant

$$q = \frac{y}{R} \frac{(R-1)}{(1-\beta)}$$

Key Properties of the Equilibrium

- Economy is purely Fisherian – nominal interest rate set by the central bank determines the inflation rate.
- With reserves outstanding, an expansion in the central bank's balance sheet, holding constant R and nominal dividend payments by the central bank, is irrelevant – M_0 does not matter for quantities or prices.
- Central bank determines price level and inflation without any fiscal support, other than that it was granted a monopoly, and must distribute its profits to the public.

Government Debt and Taxation

- Consolidated government budget constraints

$$m_0 + b_0 = \tau_0^f$$

$$m_t - m_{t-1}\frac{R_t}{\pi_t} + c_{t-1}\left(\frac{R_t - 1}{\pi_t}\right) + b_t - \frac{R_t}{\pi_t}b_{t-1} = \tau_t^f + \tau_t^b, \;\; t = 1, 2, ...$$

$$\tau_t^b = c_{t-1}\left(\frac{R_t - 1}{\pi_t}\right)$$

$$\tau_t^f = m_t + b_t - \frac{R_t}{\pi_t}\left(m_{t-1} + b_{t-1}\right)$$

- Here, central bank holds government debt as assets, and remits profits period-by-period to the fiscal authority.
- Assume the fiscal authority never issues so little government debt that it constrains the central bank – though if it did, central bank could revert to making loans to support its currency issues.

Equilibrium

- Looks the same as in the world with minimal government, except we have to say what the fiscal authority does.
- Suppose fiscal authority chooses τ_0^f and $\tau_t^f = \tau^f$, for $t = 1, 2, \ldots$. Then,

$$\tau_0^f = -\frac{\beta \tau^f}{1-\beta}$$

- In a stationary equilibrium, τ_0^f determines the real stock of consolidated government liabilities outstanding forever.
- As in other case, increasing M_0 is irrelevant – no effect on prices or quantities, only expands the central bank's balance sheet, and reduces government debt outstanding.
- Suppose a helicopter drop:
  - constant R and nominal remittances by the central bank to fiscal authority held constant.
  - increase τ_0^f, and "monetize" it – equal increase in $\frac{M_0}{P_0}$.
  - has no effect on prices or quantities, just like the increase in reserve balances.

Production and Secured Credit

- Household now has preferences

$$\sum_{t=0}^{\infty} \beta^t \left[\theta u(x_t^m) + (1-\theta) u(x_t^b) - n_t \right],$$

- x_t^m denotes goods purchased with currency, x_t^b goods purchased with secured credit, n_t is labor input.
- Household's constraints

$$b_{t+1} + z_{t+1} + \theta x_t^m \leq \frac{(b_t + z_t) R_t + c_t}{\pi_t} + \tau_t^f + \tau_t^b$$

$$(1-\theta) x_t^b \leq R_{t+1} (b_{t+1} + z_{t+1})$$

$$\begin{aligned} & b_{t+1} + z_{t+1} + c_{t+1} + \theta x_t^m + (1-\theta) x_t^b \\ = \quad & n_t + \frac{(b_t + z_t) R_t + c_t}{\pi_t} + \tau_t^f + \tau_t^b \end{aligned}$$

First Order Condition and Asset Pricing

- Marginal intratemporal rate of substitution = gross nominal interest rate

$$\frac{u'(x_t^m)}{u'(x_t^b)} = R_{t+1}$$

- Asset pricing: currency

$$1 = \underbrace{\frac{u'(x_t^m) - 1}{u'(x_t^m)}}_{\text{liquidity premium}} + \underbrace{\beta \frac{u'(x_{t+1}^m)}{\pi_{t+1} u'(x_t^m)}}_{\text{fundamental}}$$

- Asset pricing: government debt and reserves

$$\frac{1}{R_{t+1}} = \underbrace{\frac{u'(x_t^b) - 1}{u'(x_t^m)}}_{\text{liquidity premium}} + \underbrace{\beta \frac{u'(x_{t+1}^m)}{\pi_{t+1} u'(x_t^m)}}_{\text{fundamental}}$$

Stationary Equilibrium with Binding Collateral Constraint

$$v = m + b \text{ [value of consolidated government debt constant]}$$

- Solve for consumption $\left(x^m, x^b\right)$:

$$\theta x^m u'(x^m) + (1-\theta) x^b u'(x^b) = v u'(x^m)$$

$$u'(x^m) = R u'(x^b)$$

- Results:
  - Higher v : x^m, x^b increase, welfare goes up, real interest rate rises, liquidity premia fall, inflation falls.
  - Higher R : x^m falls, x^b rises, real interest rate rises, liquidity premium falls, inflation rises.
  - $R = 1$ is suboptimal, given v.

More on Stationary Equilibrium with Binding Collateral Constraint

- Transfers in each period $t = 1, 2, ...,$

$$\tau^b = \frac{\theta x^m}{\beta}\left(\frac{1}{u'(x^b)} - \frac{1}{u'(x^m)}\right)$$

$$\tau^f = v\left(1 - \frac{1}{\beta u'(x^b)}\right)$$

- Real interest rate:

$$\frac{R}{\pi} = \frac{1}{\beta u'(x^b)}$$

$$\text{present value of fiscal transfers} = \frac{v}{(1-\beta)}\left[1 - \frac{1}{u'(x^b)}\right]$$

$$\text{present value of central bank's remittances} = \frac{\theta x^m}{(1-\beta)}\left(\frac{1}{u'(x^b)} - \frac{1}{u'(x^m)}\right)$$

Unconventional Monetary Policies with a Binding Collateral Constraint

- Increase in the balance sheet, everything else held constant, is still neutral – no effects on quantities or prices.
- Helicopter drop – increase in v – not neutral. Has the effects above.
  - monetization of the debt increase irrelevant – will just be held as reserves.
  - welfare goes up, real interest rate rises, inflation rate falls.

Suppose Reserves Inferior Collateral

- Rewrite collateral constraint:

$$(1-\theta)x_t^b \leq R_{t+1}\left(b_{t+1}+\gamma z_{t+1}\right),\ 0<\gamma<1$$

- Why? For example, include banks and "balance sheet costs," i.e. what causes the fed funds rate to be lower than the interest rate on reserves.
- Implies that an increase in central bank balance sheet size is not neutral – reduces real interest rate and increases inflation.
- Why? Tightens collateral constraint and reduces welfare. QE is bad.

Key Conclusions

- In a world with with no inefficiencies, can conveniently separate central bank determination of inflation and the price level from fiscal policy.
- With all assets playing some role as liquid assets, things are not so simple.
- In a model with binding collateral constraints, where government debt serves as collateral:
  - Central bank balance sheet expansion is at best neutral, at worst welfare-reducing.
  - Increasing government debt increases welfare, but irrelevant (or reduces welfare) to monetize the debt increase (helicopter drop).