Discussion: "Monetary Aggregates and Liquidity in a Neo-Wicksellian Framework" by Canzoneri, Cumby, Diba and Lopez-Salido

- This paper
- Takes the *neo-Wicksellian model* where
  - money does not matter.
- Considers the financial frictions:
  - Government bonds provide liquidity;
  - Banks issue deposits and make loans.
  - Modelled like you would model them in the NW model, where money does not matter.
- Concludes that:
  - those moetary and financial frictions do not matter.

Outline

- Simplest model. Bonds model. Flexible prices.
  - The financial friction does not matter.
  - New way of looking at monetary policy instruments.
- Banks and Bonds model. Flexible prices.
  - Monetary and financial frictions do not matter.
- Sticky prices. If inflation is low, the sticky price model behaves like the flexible price model and again monetary and financial frictions do not matter.

Model with liquid government debt

- Model with two types of money, one that does not pay interest and one that does.

- Preferences:

$$\sum_{t=0}^{\infty}\beta^t\left\{u\left(c_t,n_t\right)+v^m\left(\frac{M_t}{P_t}\right)+v^b\left(\frac{B_t}{P_t}\right)\right\}$$

- Budget constraint:

$$P_tc_t+M_t+B_t+A_t \leq$$

$$M_{t-1}+B_{t-1}I_{t-1}^g+A_{t-1}I_{t-1}^c+W_tn_t-T_t,\ t \geq 0$$

- Intertemporal budget constraint:

$$\sum_{t=0}^{\infty} q_t \left[c_t - w_t n_t + \tau_t\right] + \sum_{t=0}^{\infty} q_t \left[\frac{I_t^c - 1}{I_t^c} m_t + \frac{I_t^c - I_t^g}{I_t^c} b_t\right] \leq \frac{W_{-1}}{P_0}$$

where $q_t = \frac{\Pi_1}{I_0^c}\frac{\Pi_2}{I_1^c}\ldots\frac{\Pi_T}{I_{T-1}^c}$, $t \geq 1$ and $q_0 = 1$.

- The marginal conditions are:

$$-\frac{u_c(t)}{u_n(t)} = \frac{1}{w_t}$$

$$\frac{v_m^m(t)}{u_c(t)} = \frac{I_t^c - 1}{I_t^c}$$

$$\frac{v_b^b(t)}{u_c(t)} = \frac{I_t^c - I_t^g}{I_t^c}$$

$$\frac{u_c(t)}{\beta u_c(t+1)} = \frac{q_t}{q_{t+1}} = \frac{I_t^c}{\Pi_{t+1}}$$

- Firms:

$$y_t = Z_{y,t} n_t$$

$$w_t = Z_{y,t}$$

- Market clearing:

$$c_t + g_t = Z_{y,t} n_t$$

- Equilibrium conditions:

$$-\frac{u_c\left(t\right)}{u_n\left(t\right)} = \frac{1}{w_t}$$

$$\frac{v_m^m\left(t\right)}{u_c\left(t\right)} = \frac{I_t^c - 1}{I_t^c}$$

$$\frac{v_b^b\left(t\right)}{u_c\left(t\right)} = \frac{I_t^c - I_t^g}{I_t^c}$$

$$\frac{u_c\left(t\right)}{\beta u_c\left(t+1\right)} = \frac{q_t}{q_{t+1}} = \frac{I_t^c}{\Pi_{t+1}}$$

$$\sum_{t=0}^{\infty} q_t\left[c_t - w_t n_t + \tau_t\right] + \sum_{t=0}^{\infty} q_t\left[\frac{I_t^c - 1}{I_t^c} m_t + \frac{I_t^c - I_t^g}{I_t^c} b_t\right] \leq \frac{W_{-1}}{P_0}$$

$$w_t = Z_{y,t}$$

$$c_t + g_t = Z_{y,t} n_t$$

- Equilibria:

$$-\frac{u_c(c_t,n_t)}{u_n(c_t,n_t)}=\frac{1}{w_t}$$

$$w_t = Z_{y,t}$$

$$c_t + g_t = Z_{y,t} n_t$$

- Consumption and labor allocations are independent of inflation, interest rates, monetary aggregates.

- The monetary variables are residual variables.
- Suppose $I_t^c \geq 1$ and $I_t^g \leq I_t^c$ are given. Then

$$\frac{v_m^m(t)}{u_c(t)} = \frac{I_t^c - 1}{I_t^c}$$

determines m_t;

$$\frac{v_b^b(t)}{u_c(t)} = \frac{I_t^c - I_t^g}{I_t^c}$$

determines b_t;

$$\frac{u_c(t)}{\beta u_c(t+1)} = \frac{q_t}{q_{t+1}} = \frac{I_t^c}{\Pi_{t+1}}$$

determines Π_{t+1};

$$\sum_{t=0}^{\infty} q_t \left[c_t - w_t n_t + \tau_t\right] + \sum_{t=0}^{\infty} q_t \left[\frac{I_t^c - 1}{I_t^c} m_t + \frac{I_t^c - I_t^g}{I_t^c} b_t\right] \leq \frac{W_{-1}}{P_0}$$

restricts τ_t.

- Both I_t^c and I_t^g are monetary policy variables.

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- The price level is still not pinned down.
  - Need the money supply in the initial period.
  - Need an interest rate rule to pin it down, locally.

Steady state

- Allocations of consumption and labor:

$$-\frac{u_c}{u_n} = \frac{1}{Z_y}$$

$$c + g = Z_y n$$

- Other variables:

$$\frac{v_m^m}{u_c} = \frac{I^c - 1}{I^c}$$

$$\frac{v_m^m}{v_b^b} = \frac{I^c - 1}{I^c - I^g}$$

$$\frac{1}{\beta} = \frac{I^c}{\Pi}$$

$$\frac{M_{t+1}}{M_t} = \frac{B_{t+1}}{B_t} = \mu = \Pi$$

Need to determine I^c and I^g.

- Need to determine I^c and I^g
  - or I^g and μ;
  - or I^g and b;
  - or I^g and $m + b$.
- The price level is still not pinned down.
- Need to rethink the instruments of monetary policy.
  - Interest rates, I^c and I^g are both instruments.
  - Still doesn't solve the multiplicity of equilibria.

Model with banks

- Preferences:

$$\sum_{t=0}^{\infty} \beta^t \left\{ u\left(c_t, n_t\right) + v^m\left(\frac{M_t}{P_t}\right) + v^b\left(\frac{B_t}{P_t}\right) + v^d\left(\frac{D_t}{P_t}\right) \right\} \quad (1)$$

- Budget constraint:

$$P_t c_t + M_t + D_t + B_t + A_t - L_t \le$$

$$M_{t-1} + D_{t-1} I_{t-1}^d + B_{t-1} I_{t-1}^g + A_{t-1} I_{t-1}^c - L_{t-1} I_{t-1}^l + W_t n_t - T_t,\ t \ge 0$$

- Intertemporal budget constraint:

$$\sum_{t=0}^{\infty} q_t \left[c_t - w_t n_t + \tau_t\right] + \sum_{t=0}^{\infty} q_t \left[\frac{I_t^c - 1}{I_t^c} m_t + \frac{I_t^c - I_t^d}{I_t^c} d_t + \frac{I_t^c - I_t^g}{I_t^c} b_t + \frac{I_t^l - I_t^c}{I_t^c} l_t\right]$$
$$\leq \frac{W_{-1}}{P_0}$$

- Restriction on loans:

$$l_t \geq l$$

- The marginal conditions are:

$$-\frac{u_c(t)}{u_n(t)} = \frac{1}{w_t}$$

$$\frac{v_m^m(t)}{u_c(t)} = \frac{I_t^c - 1}{I_t^c}$$

$$\frac{v_d^d(t)}{u_c(t)} = \frac{I_t^c - I_t^d}{I_t^c}$$

$$\frac{v_b^b(t)}{u_c(t)} = \frac{I_t^c - I_t^g}{I_t^c}$$

$$\frac{u_c(t)}{\beta u_c(t+1)} = \frac{q_t}{q_{t+1}} = \frac{I_t^c}{\Pi_{t+1}}$$

- Since

$$I_t^l > I_t^c$$

then

$$l_t = l$$

Banks

- Banks are competitive.
- They need to hold money and bonds to issue deposits

$$d_{b,t} \leq Z_d m_{b,t}^{\delta} b_{b,t}^{1-\delta}$$

- They need to spend resources to make loans

$$l_{b,t} = Z_l n_{b,t}$$

- Deposits:
- The banks minimize

$$Cost = \frac{I_t^c - I_t^g}{I_t^c} b_{b,t} - \frac{I_t^c - 1}{I_t^c} m_{b,t}$$

s. t.

$$d_{b,t} \leq Z_d m_{b,t}^{\delta} b_{b,t}^{1-\delta}$$

- It follows that

$$\frac{\frac{I_t^c - I_t^g}{I_t^c} b_{b,t}}{\frac{I_t^c - 1}{I_t^c} m_{b,t}} = \frac{\delta}{1-\delta}$$

$$d_{b,t} = Z_d m_{b,t}^{\delta} b_{b,t}^{1-\delta}$$

$$Cost_t = \frac{\left(\frac{I_t^c - 1}{I_t^c}\right)^{\delta} \left(\frac{I_t^c - I_t^g}{I_t^c}\right)^{1-\delta}}{Z_d \delta^{\delta} (1-\delta)^{1-\delta}} d_{b,t}$$

- The price of deposits must equal marginal cost

$$\frac{I_t^c - I_t^d}{I_t^c} = MCost_t = \frac{\left(\frac{I_t^c - 1}{I_t^c}\right)^{\delta} \left(\frac{I_t^c - I_t^g}{I_t^c}\right)^{1-\delta}}{Z_d \delta^{\delta} (1-\delta)^{1-\delta}}$$

- Loans

$$\text{Max} \left[\frac{I_t^c - I_t^d}{I_t^c} d_{b,t} - w_t n_{b,t} \right]$$

s.t.

$$l_{b,t} = Z_l n_{b,t}$$

- Again, the price of loans must equal marginal cost

$$\frac{I_t^l - I_t^c}{I_t^c} = \frac{w_t}{Z_l}$$

- Firms:

$$y_t = Z_{y,t} n_{y,t}$$

$$w_t = Z_{y,t}$$

- Market clearing:

$$c_t + g_t = Z_{y,t} n_{y,t}$$

$$l_{b,t} = Z_l n_{b,t}$$

$$n_{b,t} + n_{y,t} = n_t$$

$$l_{b,t} = l$$

or

$$c_t + g_t = Z_{y,t} \left(n_t - \frac{l}{Z_l} \right) = Z_{y,t} n_t - \frac{Z_{y,t}}{Z_l} l$$

- Equilibria:

$$-\frac{u_c(t)}{u_n(t)} = \frac{1}{Z_{y,t}}$$

$$c_t + g_t = Z_{y,t} n_t - \frac{Z_{y,t}}{Z_l} l$$

- Again, consumption and labor allocations are independent of inflation, interest rates and monetary variables.

- Monetary variables are residual variables.

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- Suppose I_t^c and I_t^g are given. Then

$$\frac{I_t^l - I_t^c}{I_t^c} = \frac{w_t}{Z_l}$$

and

$$w_t = Z_{y,t}$$

determine I_t^l; and

$$I_t^c = I_t^d + \kappa_t$$

where

$$\kappa_t = \frac{\left(I_t^c - 1\right)^{\delta} \left(I_t^c - I_t^g\right)^{1-\delta}}{\delta^{\delta} \left(1 - \delta\right)^{1-\delta} Z_d}$$

determines I_t^d;

$$\frac{v_m^m(t)}{u_c(t)} = \frac{I_t^c - 1}{I_t^c}$$

determines m_t;

$$\frac{v_d^d(t)}{u_c(t)} = \frac{I_t^c - I_t^d}{I_t^c}$$

determines d_t; and

$$\frac{v_b^b(t)}{u_c(t)} = \frac{I_t^c - I_t^g}{I_t^c}$$

determines b_t;

$$d_t = Z_d m_{b,t}^{\delta} b_{b,t}^{1-\delta}$$

and

$$\frac{\delta}{1-\delta}\frac{b_{b,t}}{m_{b,t}} = \frac{I_t^c - 1}{I_t^c - I_t^g}$$

determines $b_{b,t}$ and $m_{b,t}$.

- The other equations determine the remaining variables:

$$\frac{u_c(t)}{\beta u_c(t+1)} = \frac{q_t}{q_{t+1}} = \frac{I_t^c}{\Pi_{t+1}}$$

determines inflation;

$$\sum_{t=0}^{\infty} q_t \left[c_t - w_t n_t + \tau_t\right] + \sum_{t=0}^{\infty} q_t \left[\frac{I_t^c - 1}{I_t^c} m_t + \frac{I_t^c - I_t^d}{I_t^c} d_t + \frac{I_t^c - I_t^g}{I_t^c} b_t - \frac{I_t^c - I_t^l}{I_t^c} l_t\right]$$
$$\leq \frac{W_{-1}}{P_0}$$

- determines taxes.

- Policy set I_t^c and I_t^g.
- Alternatively, could set policy with I_t^g and b_t, or in a few other ways.
- There is still multiplicity of the initial price level.

Sticky prices

- Inflation Π_t matters.
- Therefore I_t^c matters.
- I_t^g and monetary aggregates should not matter.
- For the same I_t^c policy should get the same allocations in the two models, NW or BB.

- If policy in BB uses I_t^g and the target of the real supply of bonds, then it is different policy.

- If the resulting inflation is close to zero, then the two models, NW and BB, are similar and similar to Flexible prices, where only technology and government consumption shocks matter.

$$-\frac{u_c(t)}{u_n(t)} = \frac{1}{Z_{y,t}}$$

$$c_t + g_t = Z_{y,t} n_t - \frac{Z_{y,t}}{Z_l}$$