Monetary Policy with Endogenous Money Supply

S. Cem Karaman
St. Louis
Adjunct Faculty at Maryville University
Contact: skaraman@maryville.edu

Abstract

We develop a modified cash-in-advance model where we add asset market to goods and money market. In our model, money supply changes with households' borrowing decisions. Moreover, the model has two separate price systems; asset and general price systems. As a result, in our steady state analysis, while an expansionary monetary policy can tame asset prices, its effect on general price level is the same regardless of asset demand.

Motivation:

- Asset prices, borrowing and debt stock are closely related in an economy.
- We observe that asset prices are correlated to money supply.
- Asset prices and general price level do not follow the same path which requires a dual price system, general price level and asset prices.

Model

- A representative agent model
- A modified Cash-in Advance (CIA) model.
- In a CIA model, "money" is in the form of cash only, where in our model bank deposits are money as well.
- Consequently, more borrowing (loans) implies more money in the economy. D_t^s is the debt stock of an agent at time t, D_t is period borrowing (or saving if negative) at period t. $D_t^s = D_{t-1}^s + D_{t-1}$. In real terms:
- $d_t^s = \frac{1}{1+\pi_t}(d_{t-1}^s + d_{t-1})$

Assets

- Households have the opportunity to build up wealth in the form of assets which have no returns other than their nominal appreciation, or depreciation. A_t^s is the nominal value of an agent's asset stock at period t, A_t is how much assets is purchased at period t.
- The nominal value of assets is determined from the quantity of assets purchased by multiplying the quantity of assets (q_t) by the general price level (P_t) and the asset price level ($\tilde{P}_t$), $A_t = P_t\tilde{P}_t q_t$ & $A_t^s = P_t\tilde{P}_t q_t^s$
- In quantity, $q_t^s = \phi q_{t-1}^s + q_{t-1}$ where ϕ is period asset depreciation and in real terms $a_t^s = (1+\tilde{\pi}_t)(\phi a_{t-1}^s + a_{t-1})$ where $\tilde{P}_t/\tilde{P}_{t-1} = 1+\tilde{\pi}_t$, $a_t = A_t/P_t$, $a_t^s = A_t^s/P_t$
- Asset supply is constant at "s" every period. Therefore, asset market equilibrium condition is $a_t = s$, demand equals supply

The Budget Constraint

- $P_t c_t + E_t\{P_{t+1}\}E_t\{\tilde{P}_{t+1}\}q_{t+1}^s + i_{t-1}D_t^s \le P_t y_t + P_t\tau_t + P_t\tilde{P}_t\phi q_t^s + D_t$
- Households have a constant stream of real income, y_t. They can borrow funds, D_t (saving if $D_t < 0$). They receive an extra income of τ_t from production of new assets every period.
- Households pay the interest cost on their debt stock but they carry the balance to the next period, unless they are saving (a negative D_t)
- Households decide how many assets to purchase that determines their asset stock. The choice variable, a_t, is in real terms.
- For solving our model we will assume naive expectations, $E_t\{P_{t+1}\} = P_t$ and $E_t\{\tilde{P}_{t+1}\} = \tilde{P}_t$

Constraint on Purchases

- Similar to a CIA model, money is required to purchase consumption goods and assets. But the definition of money is extended to include money created by bank loans. We use the following "money-in-advance" constraint:
- $P_t(c_t + a_t) \le D_t^s$
- As people borrow more, D_t^s increases which allows for more purchases. As people save more, D_t^s decreases which restricts people's purchases.
- For the sake of simplicity we ignored government printed money

Market Clearing

- To close the money market, we have a borrowing limit: $d_t = a_t^s - d_t^s$
- The borrowing limit is the net worth of households, the difference between their asset stock and debt stock. We assume that banks lend, as long as net worth is positive. More debt than assets imply a negative d_t, savings!
- Asset market eq-m condition: $a_t = s_t$ where a_t is asset demand, s_t is asset supply. s_t is exogenous, a_t is determined in the model. Asset prices make sure that demand equals supply

Results

- $a = (\frac{1}{1+\tilde{\pi}} - \phi)a^s > 0$ as long as real value of asset stock is decreasing, $\phi(1+\tilde{\pi}) < 1$
- We assumed asset stock, a^s, has a steady state too. This requires buying assets to keep asset stock steady when assets are losing value.
- $\frac{\partial\tilde{\pi}}{\partial i} > 0$ when $\phi(1+\tilde{\pi}) < 1$, as long as there is a demand for assets, $a > 0$, an expansionary monetary policy lowers steady state asset price inflation.
- $\frac{\partial\pi}{\partial i} > 0$, regardless of asset demand, an expansionary monetary policy lowers steady state general price inflation too.
- $\frac{\partial d^s}{\partial i} = \frac{-y(1-\frac{\partial\pi}{\partial i})}{(1+i-\pi)^2} < 0$ which is an expected result, an expansionary monetary policy will increase money stock in the economy.

Conclusion

- Adding a second price system to a model where money is needed to purchase not only goods, but assets too is necessary to analyze the effects of monetary policy on inflation, and asset price inflation.
- A sudden drop in asset prices induces households to save rather than borrow.
- A low interest rate policy is intended to increase asset prices. But as long as the real value of asset stock is steady, this will lead to negative inflation rates and household saving instead of borrowing, as it is the case for Japan.
- Further Research: This model assumes debt stock and asset stock are steady, $d_t^s = d^s\ \forall t$ and $a_t^s = a^s\ \forall t$, which is a significant restriction on the model. Analyzing the dynamics of the model rather than the steady state of the model is necessary.

References

- Eggertsson, G. B. and P. Krugman, 2012. Debt, deleveraging, and the liquidity trap: A fisher-minsky-koo approach. The Quarterly Journal of Economics, 127(3):1469–1513.
- Gambacorta, L. and D. Marques-Ibanez, 2011. The bank lending channel: lessons from the crisis. Economic Policy, 26(66):135–182.
- Kapeller, J. and B. Schütz, 2014. Debt, boom, bust: a theory of minsky-veblen cycles. Journal of Post Keynesian Economics, 36(4):781–814.
- Keen, S., 2009. Household debt: the final stage in an artificially extended ponzi bubble. Australian Economic Review, 42(3):347–357
- Koo, R. C. et al., 2015. Escape from Balance Sheet Recession and the QE Trap. Wiley Online Library
- Lucas Jr, R. E., 982. Interest rates and currency prices in a two-country world. Journal of Monetary Economics, 10(3):335–359.
- Palivos, T., Wang, P. and Zhang, J., 1995. Velocity of money in a modified cash-in-advance economy: theory and evidence. Journal of Macroeconomics, 17(2), pp.225-248
- Salyer, K. D., 1991. The timing of markets and monetary transfers in cash-in-advance economies. Economic Inquiry, 29(4):762–773.
- Svensson, L. E., 1985. Money and asset prices in a cash-in-advance economy. Journal of Political Economy, 93(5):919–944.