Overview

- Conventional wisdom holds that expansionary monetary policy shocks generate a *persistent* decrease in nominal interest rates and a *persistent* increase in the levels of employment and output.
- However, existing quantitative general equilibrium business cycle models are inconsistent with this view: if money growth displays positive persistence, then unanticipated shocks to the growth rate of money drive interest rates up, not down.
- The explanation is that in these models, money shocks affect interest rates exclusively through an anticipated inflation effect.
- Furthermore, the mere existence of nominal rigidities is not enough to generate liquidity effects.

**Basic Frictions that generate Liquidity Effects – Limited Participation**
Basic Environment

- Monetary policy shocks are the only source of uncertainty.
- Three types of agents: households, firms and financial intermediaries.
- At the beginning of the period, households possess the entire stock of money, $M_t$.
- Households allocate $Q_t$ dollars toward consumption purchases $C_t$, and $M_t - Q_t$ to financial intermediaries.
- Consumption must be financed with $Q_t$ and wage earnings.
- The households chooses $Q_t$, $C_t$, and $L_t$ (labor) to maximize
  \[
  \sum_{t=0}^{\infty} \beta^t (1 - \gamma) \ln(C_t) + \gamma \ln(1 - L_t)
  \]
- The contingency plan for $Q_t$ is not a function of the time $t$ realization of $M_t$.
- For comparison, consider a CIA model that allows $Q_t$ to be a function of the period $t$ innovation in monetary policy.
• In both models, $P_t C_t \leq Q_t + W_t L_t$ and
  \[ M_{t+1} = R_t (M_t - Q_t) + D_t + F_t + (Q_t + W_t L_t + P_t C_t) \]
  where $R_t$ is the gross interest rate and $F_t$ and $D_t$ denote dividends received from firms and financial intermediaries, respectively.

• The financial intermediary has two sources of funds: $M_t - Q_t$ and lump-sum injections $X_t$ of cash by the monetary authority.

• Technology
  \[ f(K_t, z_t, L_t) = K_t^\alpha (z_t L_t)^{1-\alpha} + (1 - \delta) K_t \]
  where $K_t$ is the beginning of the period stock of capital, $\delta$ is the depreciation rate, $f(.,.)$ denoted new period-$t$ output plus the undepreciated part of capital, $z_t$ is the state of technology at time $t$, which grows at a constant geometric rate $\mu$.

• Firms must borrow working capital $W_t L_t$ from financial intermediaries so that total labor costs are $R_t W_t L_t$.

• $I_t = K_{t+1} - (1 - \delta) K_t$ but the firm is not required to borrow to invest.
• A perfectly competitive firm maximizes the expected present discounted value of dividends by choice of contingency plans for \( I_t \) and \( L_t \).

**Generating a Liquidity Effect**

• The rigidity in \( Q_t \) prevents that an increase in money supply be proportionally distributed among all agents.

• Assuming \( X_t/M_t \) is i.i.d., a money shock is neutral in the CIA model: it simply results in a proportional jump in future prices and wages, leaving all other variables unaffected.

• However, if \( Q_t \) does not respond to \( X_t \), a positive money shock increases the total percentage of money supply available to financial intermediaries.

• Financial intermediaries loan all available funds but in order for firms to absorb the additional funds, \( R_t \) must fall.
• Note that if money growth is positively correlated, then expected inflation effects exert a countervailing effect on $R_t$ upwards. The net effect is undetermined.

• If $R_t$ does decline, it shifts labor demand to the right without changing labor supply, so that aggregate hours increase, as well as output and the real wage rate.
Some Impulse Responses

Nominal Interest Rate, $R_t$

Inflation, $P_t/P_{t-1}$

- Basic Cash-in-Advance Model
- Basic Liquidity Model
- Adjustment-Cost Liquidity Model
Comments

• **The CIA response**: On impact, interest rates rise along with investment, while consumption falls. The rise in interest rates acts as a tax on the cash good (consumption) and a subsidy on the credit good (investment).

• Employment falls, a combination of a left-shift of labor demand and a right-shift in labor supply, the former induced by a rise in interest rates the latter by the fall in consumption.

• The stock of capital is unchanged, so output must fall. With output down and money stock up, prices increase by more than the percentage change in the money supply.

• Persistence in the money supply process implies inflation declines toward steady state, so do interest rates.
• The Liquidity Model: contemporaneous values of interest rates and investment fall, while consumption and labor increase.

• The contemporaneous increase in prices is muted by the increase in aggregate output and the initial increase in inflation is less than proportional to the increase in money.

• However, the basic model fails to generate a persistent liquidity effect since after one period, households get to adjust $Q_{t+1}$. 
Generating a Persistent Liquidity Effect

• **Basic Idea:** need to ensure financial sector remains liquid relative to the consumption sector for more than one period.

• **Mechanism:** have adjustment costs for $Q_t$. Substantial persistence can be generated with small adjustment costs.

• **Other shortcomings:**
  - Limited participation is not enough to generate business cycles.
  - Matching price, output, real wage and profits requires high labor supply elasticity.