Monetary Economics

Inventory Model

Seyed Ali Madanizadeh

Sharif University of Technology

November 20, 2016

Monetary Economics

- Money Neutrality
  - Short run
  - Long run
- Schools of thoughts
- Modeling
  - Money Demand
  - Money Supply
    - Money aggregates
    - Interest rate targets
  - Equilibrium
    - Frictionless economies
    - Frictional economies

Demnad for Money

- Why do people hold money?
- People hold money to facilitate transactions.
- There are costs to holding money: foregone interest, risk of theft, etc.
- What is the optimal level of money holdings? i.e. how is money demand determined?

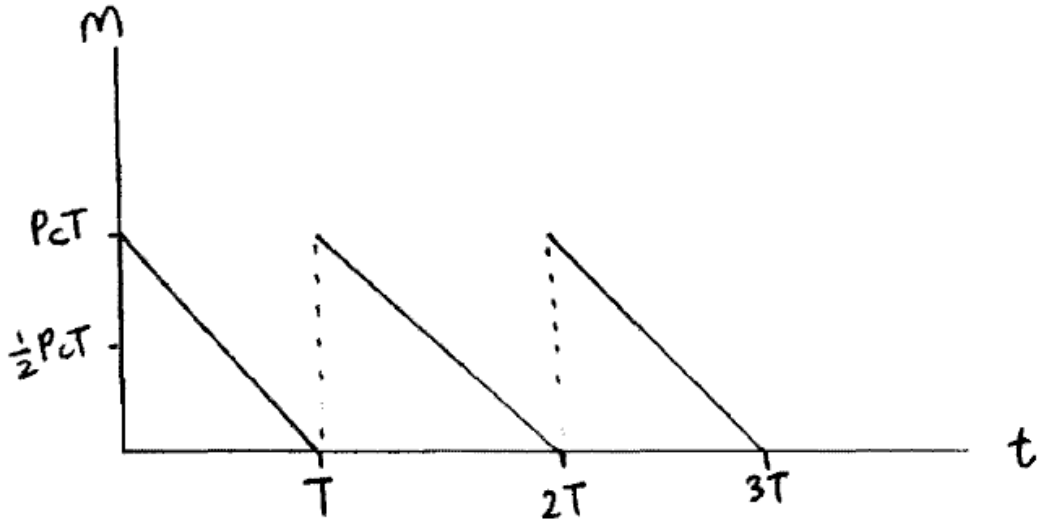
Demnad for Money

- Money Demand Models
  - Inventory Theory: Baumol Tobin model
  - Money in Utility
  - Cash in advance model
  - Transaction tehnology
  - Search models

Inventory Model: A Simple Model of Optimal Cash Management

- Consumer's problem:
  - They make consumption purchases totalling $p * c$ every year and these have to be made in **cash**
- Purchases are spread evenly throughout every day of the year (For simplicity)
- There is a nominal cost of going to the bank/ATM to get money, $\$\gamma$
- Deposits in the bank earn interest, R.
- The consumer goes to the bank at regular intervals, every T years (For simplicity).
  - ex: If $T = \frac{1}{12}$, he/she goes every month
  - Frequency = # of bank visits per year = $\frac{1}{T}$

Inventory Model



Inventory Model

- What is optimal T?
- The consumer will want to minimize costs and also have enough cash at hand for consumption.
- Costs:
  - i) bank visits $= \$\gamma$ per visit.
  - ii) foregone interest: R

Inventory Model

- i) Bank visits (transaction cost): Annual (nominal) cost of bank visits $= \gamma * \frac{1}{T}$
  - Annual (real) cost of bank visits $=$

$$\frac{\gamma}{p} * \frac{1}{T}$$

(Used to be called "shoe leather costs")

Inventory Model

- Foregone interest:
  - In each visit, consumer wants to take out just enough cash to cover expenditures until next visit.
  - Why? Because by holding too much cash, you lose interest.
  - Then the question is: how much will the consumer spend between each trip?
  - Recall: We assumed that purchases are spread evenly through every day of the year.

Inventory Model

- Total amount spent between trips =

$$p * c * T$$

  So, you withdraw pcT every time you visit.
- So, is foregone interest = $pcTR$?

Inventory Model

- NO! Because you don't hold all this money that you withdraw for the entire period, you spend it down evenly.
- Average money holdings = half the distance to the peak.

$$m = \frac{1}{2} pcT$$

- Average money holdings =

$$\frac{m}{p} = \frac{1}{2} cT$$

- Avg. real interest foregone =

$$\frac{1}{2} cTR$$

Inventory Model

- Intuition: As $T \uparrow$, you go to the bank every T years, so less often.
  - As $T \uparrow$, transaction costs $\downarrow$
  - As $T \uparrow$, avg. money holdings $\uparrow \Rightarrow$ foregone interest costs $\uparrow$ (bec. you withdraw more in each visit).

Inventory Model

- Optimal T :
  - minimize the total cost:

$$\min_T TRC = \frac{\gamma}{p} * \frac{1}{T} + \frac{1}{2} cTR$$

  - FOC$\Rightarrow$

$$T^* = \sqrt{\frac{2\gamma}{pcR}}$$

Inventory Model

- Implications: You go less often (i.e. $T \uparrow$) when
  - Transaction costs, $\gamma \uparrow$
  - Nominal consumption, $pc \downarrow$
  - Interest rate, $R \downarrow$

Inventory Model

- Money Demand:
  - Given T, let's calculate avg. money holdings

$$\begin{aligned} \frac{m}{p} &= \frac{1}{2} c T^* \\ &= \sqrt{\frac{c\gamma}{2pR}} \end{aligned}$$

Inventory Model

- Let $\gamma_{\text{real}} \equiv \frac{\gamma}{p}$
- Aggregate real money demand (rela money balances):

$$\begin{aligned} \frac{M}{P} &= \sqrt{\frac{c\gamma_{\text{real}}}{2R}} \\ &= \underset{(+,-,+)}{\Phi(C, R, \gamma_{\text{real}})} \end{aligned}$$

- Financial Innovation goes up: $\downarrow (\gamma_{\text{real}}) \Rightarrow \frac{M}{P} \downarrow$

Inventory Model

- Define $\bar{\gamma}_{\text{real}} = \frac{\gamma}{pc}$(real γ relative to total consumption (or production))
- Compare to Equation of Exchange

$$\text{Velocity} = v = \sqrt{\frac{2R}{\bar{\gamma}_{\text{real}}}}$$

$\Rightarrow$ Quantity Theory of Money

$$Mv = PY$$

Inventory Model

- Supply and Demand of Money

$$M^s = P\Phi\left(Y, R, \gamma_{\text{real}}\right)$$

- Long run: Flexible prices
  - M determines P
- Short run: Sticky prices!
  - M determines Y, R