Chapter 7 : A Monetary Intertemporal Model (Part 1)

EE312

Macroeconomics, Stephen Wiliamson, Chapter 12

March 2014

* *Note: Much of the contents in this lecture presentation are from Dr.Pichit's. He kindly allowed us to use his lecture presentation. All rights and credits go to Dr.Pichit. Please note that I modified/added some parts on my own. Hence, any mistake is my own responsibility. Please notify me if you find any. Thank you!*

Definitions of the money supply

- **M0**: the monetary base, outside money, or high-powered money.
  - Liabilities of the central bank to the public.
  - Currency outside the central bank + deposits of financial institutions at the central bank.
- **M1** = currency + demand deposits + other checkable accounts.
  - The most liquid form of money.
- **M2** = M1 + savings deposits + small time deposits + retail money market mutual funds.
  - M1 plus highly liquid non-money assets.
- **M3** = M2 + large time deposits + institutional money market mutual funds + repurchase agreements.
  - M2 plus less liquid non-money assets.
  - Take time and cost to change to liquid assets.

The inflation rate

- Inflation is the rate of change of the price level.
- P = the current price level;
- P' = the future price level;
- i = the inflation rate.

$$i = \frac{P' - P}{P}$$

$$(1 + i) = \frac{P'}{P}$$

The Fisher relation

- R = nominal interest rate, the rate of return on a nominal bond in units of money.
- (1+R) = the return on a nominal bond in terms of money in the future period.
- The buyer must give up $\frac{1}{P}$ goods in the current period for $\left(\frac{1+R}{P'}\right)$ goods in the future period.
- r = real interest rate, the rate of return in terms of goods. The gross rate of return on the nominal bond in real terms:

$$1+r = \frac{\frac{1+R}{P'}}{\frac{1}{P}}$$

$$= \frac{1+R}{1} \times \frac{P}{P'}$$

The rate of return on money

- The nominal rate of return on money is zero.
- The nominal rate of return on a nominal bond is positive, or R > 0.
- So the real rate of return on money (r^m) :

$$1 + r^m = \frac{1+0}{1+i} = \frac{1}{1+i} < 1 + r = \frac{1+R}{1+i}$$

Simplified Fisher Relation

- Multiply each side of the Fisher relation by 1 + i. If i and r are very small, then ir is negligible.

$$
\begin{aligned}
1 + r &= \frac{1 + R}{1 + i} \\
(1 + r)(1 + i) &= 1 + R \\
1 + r + ri + i &= 1 + R \\
r &= R - ri - i \\
r &\approx R - i
\end{aligned}
$$

$$\text{Real interest Rate} \approx \text{Nominal Interest Rate -Inflation Rate}$$

Intertemporal model with money

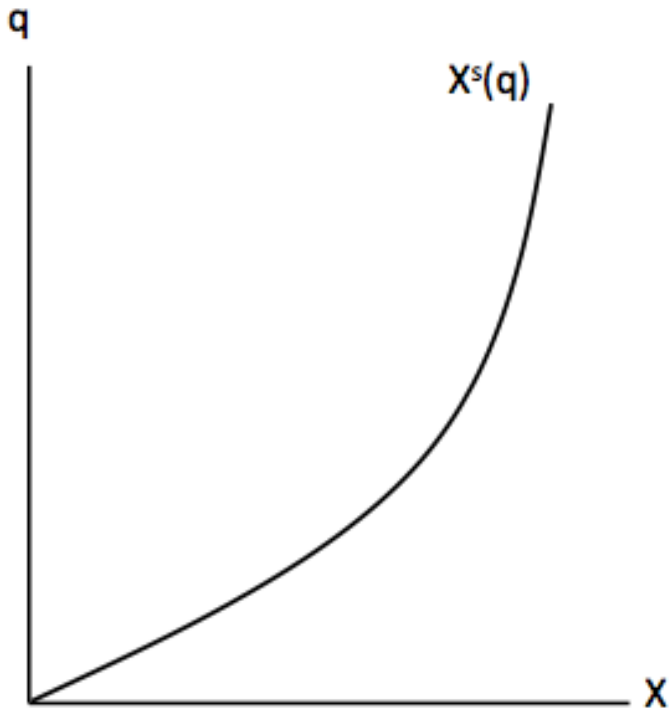
- **The labor market**: labor demand and supply, the real wage, employment.
- **The goods market**: output supply and demand, total output.
- **The credit market**: the real interest rate.
- **The money market**:
  - **Demand for money**: the consumer and the firm.
  - **Supply of money**: the central bank.
- **The market for credit card services**
  - **The supply of credit card services** by banks.
  - **The demand for credit card services** by consumers and firms.
  - The market equilibrium for credit card services.
  - The determination of the **demand for money**.

Currency and credit card services

- Money = money outside banks = currency.
- The economic agents (the consumer, the firm and the government) purchase goods.
  - Choices between currency and credit cards.
- Firms sell goods at the same price (P) for payments in money or credit cards.
- **Credit card services** are provided by banks with increasing costs.
- The economic agent buys goods using a credit card.
  - The agent acquires a debt with the bank.
  - Zero interest when paid off at the end of the current period.
- Credit card services are provided for purchase transactions only.
- The consumer, the firm and the government borrow or lend in the credit market.

Supply of credit card services

- q = the price of credit card services in terms of goods in transaction.
- X = quantity of credit card services in terms of goods.



Demand for credit card services

- Y = units of goods to be purchased by the economic agents.
- $X^d(q)$ = quantity of goods purchased by credit cards.
- Y – $X^d(q)$ = quantity of goods purchased by currency.
- Marginal benefit = marginal cost of buying one more unit of goods using credit cards.

- **Marginal benefit (MB)** of credit card services:
  - One additional unit of goods purchased with a credit card = P units of money available for lending in the credit market to receive P(1+R) units in the future.

$$MB = P(1 + R)$$

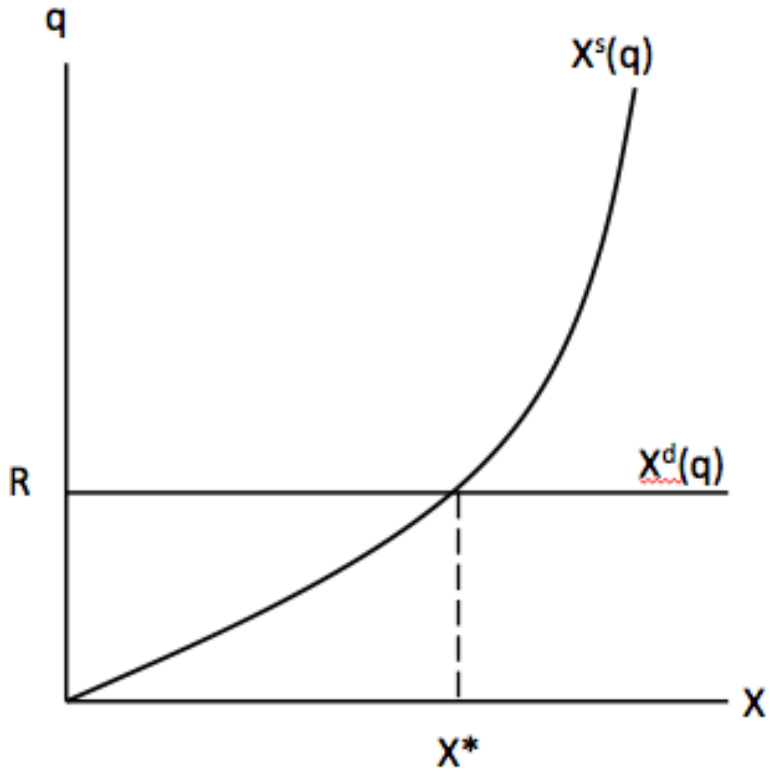
- **Marginal cost (MC)** of credit card services:
  - The agent pays off the credit card debt and fees at the end of the current period = P(1+q) units of money.

$$MC = P(1 + q)$$

- If P(1 + R) > P(1 + q) or R > q, the agent will purchase all goods with the credit card.
- If P(1 +R) < P(1 + q) or R < q, the agent will purchase all goods with currency.
- If R = q, the agent is indifferent between currency and the credit card.
- The demand for credit card services is perfectly elastic at q = R.

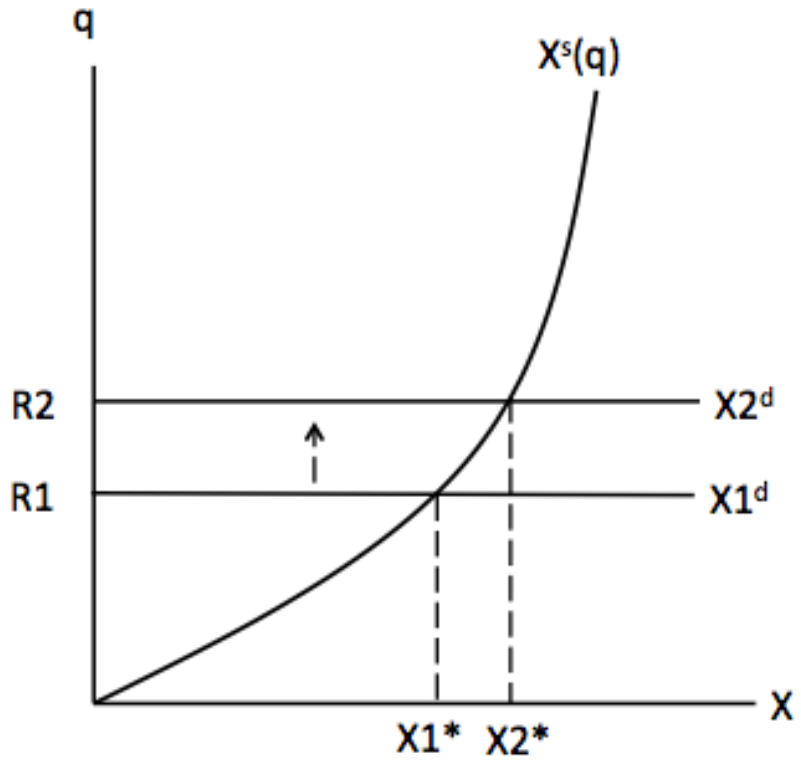
Market equilibrium

- R = equilibrium price for credit card services.
- X* = equilibrium quantity of credit card services.



X* as a function of R

- If R increases, X* will also increase.
- So X^d is a function of R, or
- X^d= X*(R) while R = q.



The nominal money demand

$$M^d = P\left[Y - X^*(R)\right]$$

$$M^d = P \times L(Y, R)$$

- The nominal demand for money is an increasing function of Y and decreasing function of R.
  - Equilibrium relationship in the bank's choices of supply and the agent's choice of currency and credit card uses.

$$M^d = PL(Y, R);\ \frac{\partial M^d}{\partial Y} > 0,\ \frac{\partial M^d}{\partial r} < 0$$

- The function is proportional to the price level.
- The consumer's and the firms' choices on the real quantity of money ($\frac{M^d}{P}$). Real money demand rises with real income (Y).
- Negative relationship with the nominal interest rate (R) — opportunity cost of holding cash.

Nominal money demand function

$$M^d = PL(Y, R)$$

as $r = R - i$

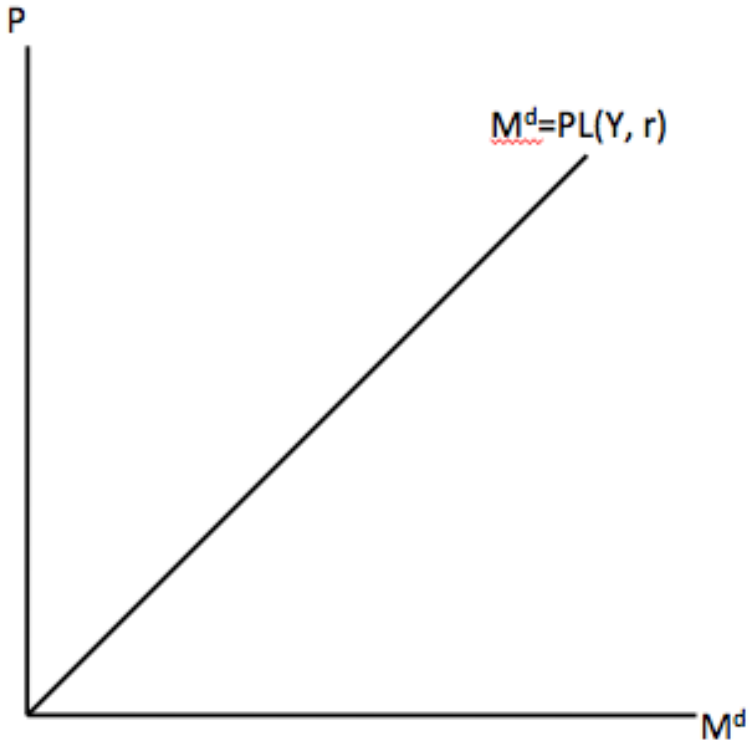
$$M^d = PL(Y, r + i)$$

$$M^d = PL(Y, r); \quad \frac{\partial M^d}{\partial Y} > 0, \ \frac{\partial M^d}{\partial r} < 0$$

when i is negligible.

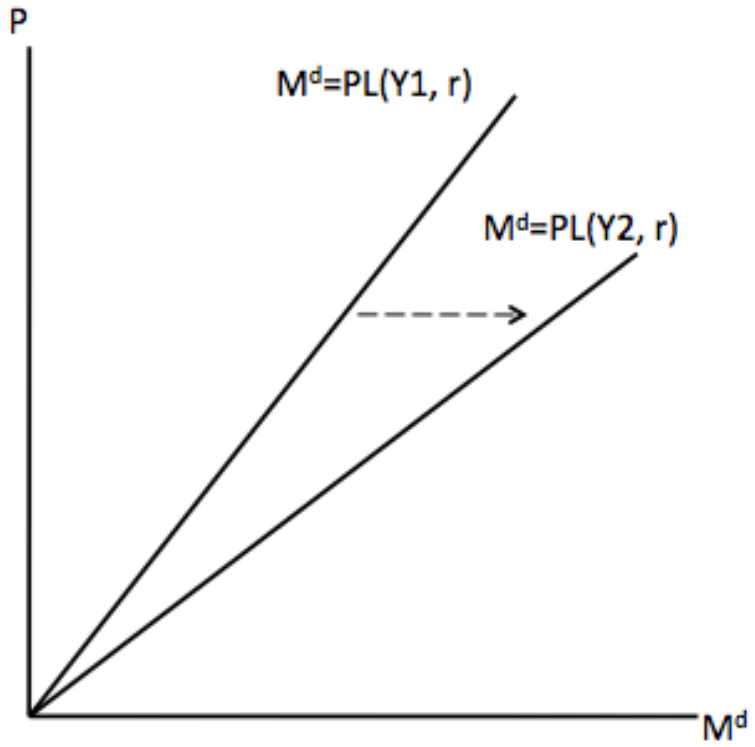
Money demand curve

- Money demand is a linear function of the price level with slope L(Y, r).



Shift in Money Demand

- An increase in Y or a decrease in r rotates the M^d curve rightwards (more money demand).



Government

- The government purchases consumption goods (PG) and pays nominal interest and principal on past bonds, (1+R^-)B^-.
- The revenue constraint consists of nominal taxes (PT), current bond issue (B) and money creation (M-M^-).

$$PG + (1 + R^-)B^- = PT + B + M - M^-$$

The money market

- The money supply (M^s) is exogenously determined by the central bank.
- $M^s = M^d$ determines the equilibrium price.