ECON 310 - MACROECONOMIC THEORY

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Chapter 12: Money, Banking, Prices and Monetary Policy

Chapter 12: Money, Banking, Prices and Monetary Policy

- So far only real side of the economy
- Introduce nominal side via money
- *Neutrality of Money*: one-time change in money supply has no real consequence on the economy
- More complicated models can generate short-run non-neutralities
- Chapter 12: Monetarist model of misperceptions (Lucas islands)
- Chapter 13: Keynesian model of price-rigidities
- Need a money-demand function (raison d'être for agents having money)

Topics

- What is money?
- Monetary Intertemporal Model
- Demand for Money – Banks and alternative means of payment.
- Real and nominal interest rates
- Neutrality of money
- Monetary policy: targets and rules

What is Money?

1. Medium of exchange - alleviate double coincidence of money
2. Store of value - trading of current/future goods
3. Unit of account - prices and contracts denominated in terms of money

Commodity Money

Figure 1:

Paying the bill with a "Yap" stone

Figure 2:

Measuring Money Supply

Different definitions of money - depends on definition:

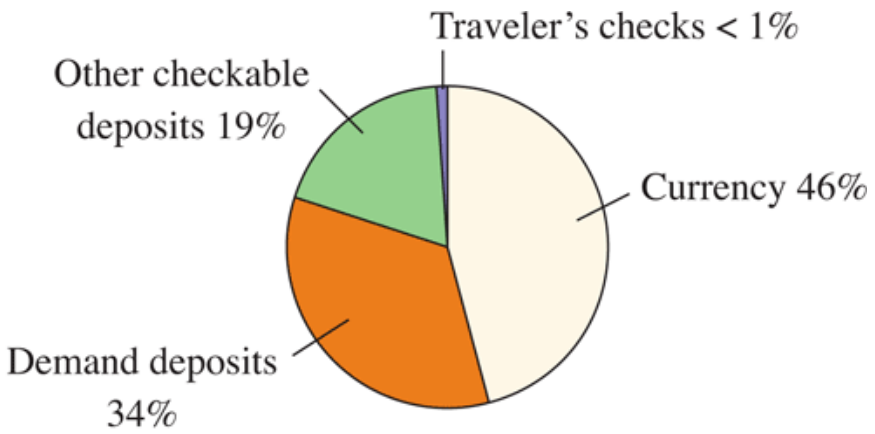
1. M0 aka **monetary base, outside money, high-powered money**
   Liabilities of the Federal Reserve System (FED)
2. M1 = M0 + currency + travellers' check, demand deposits, checkable deposits
   Private sector uses for transactions
3. M2 = M1 + savings + small time deposits + retail MMF
   Assets that cannot be used directly in transactions
4. M3 = M2 + large time deposits + wholesale MMF + Repos + Eurodollars
   Similar to M2 but less liquid

M1

M1 is the sum of

1. currency in the hands of the public,
2. demand deposits (checking accounts),
3. other checkable deposits, and
4. traveler's checks

- In 2015 $\rightarrow$M1 = 3,102 billion $\rightarrow$ 16% of GDP



M1 (cont.)

- M1 is the most narrowly constructed aggregate.
- Principally, M1 consists of cash and its very close substitutes: Demand deposits Checking deposits Travelers checks

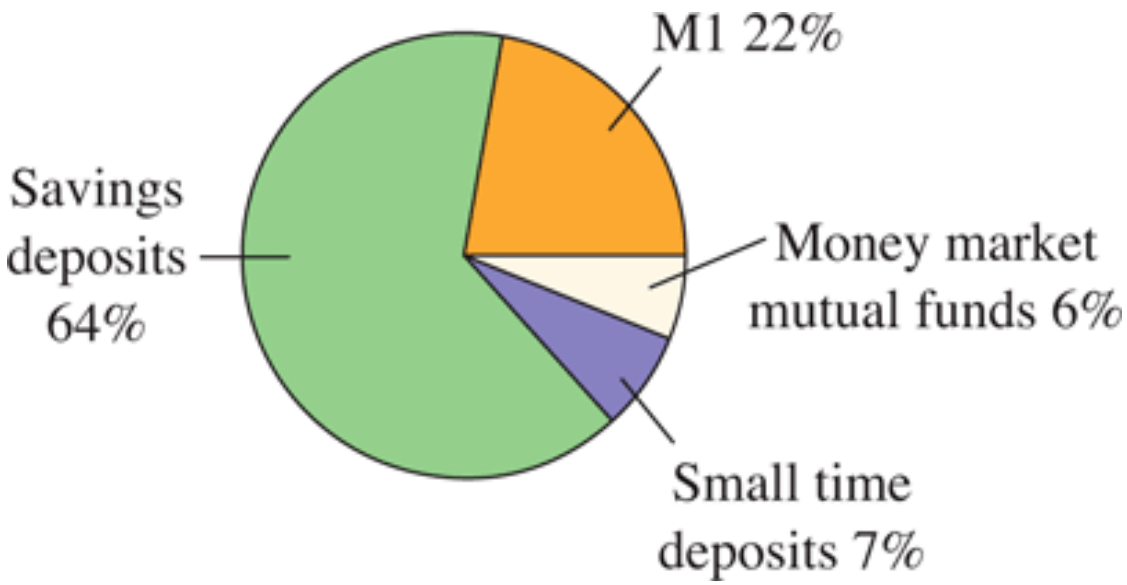
M2

M2 = M1 +

1. savings accounts
2. retail money market mutual fund balances
3. small denomination time deposits
4. overnight repurchase agreements (REPO) below $100,000.

- A REPO is an agreement to buy sell treasury bonds and buy them back the next day $\rightarrow$ very short term loan
- Cashing out these additional assets may involve small penalties, but households typically treat these assets as very good substitutes for cash.

M2 (cont.)



- Savings deposits are the largest component of M2, followed by M1, small time deposits, and money market mutual funds
- In 2015 $\rightarrow$ $M2 = 12,472$ billion $\rightarrow$68% of GDP

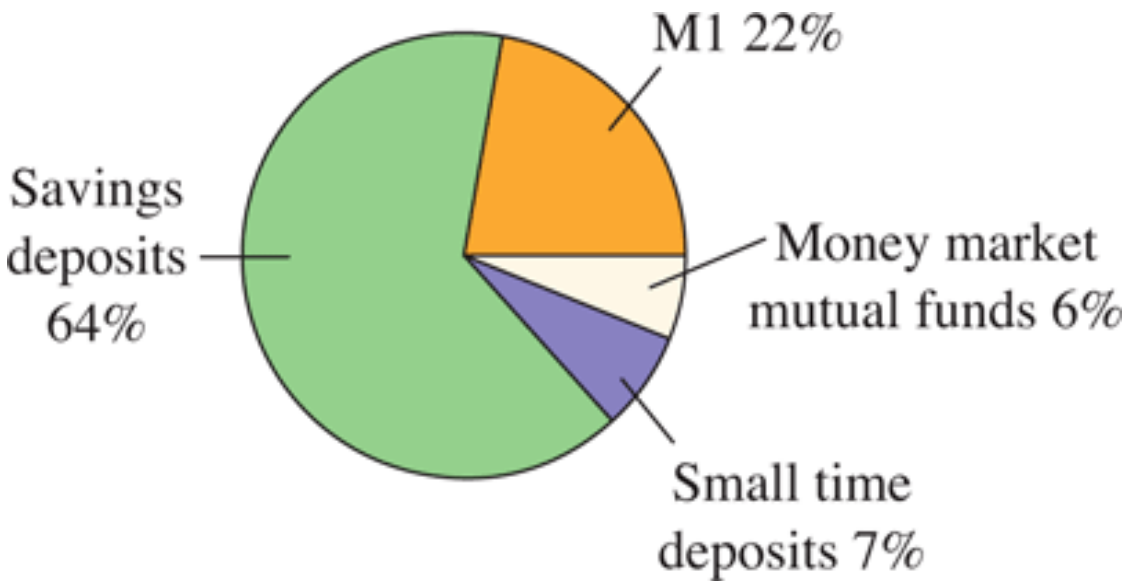
M3

M3 = M2 +

1. time deposits and repurchase agreements over $100,000
2. money market deposits owned by firms
3. Eurodollars ($ held abroad→started with dollars in Europe because of Marshall Plan)

- M3 is closely watched by some central banks (the Bundesbank after 1988, for instance, and the ECB currently)
- M3 is thought by some to bear a more stable relation to other macroeconomic variables

M3 (cont.)



- Savings deposits are the largest component of M2, followed by M1, small time deposits, and money market mutual funds
- M3 is no longer published after 2006 by FED

Monetary Aggregates in billions, June 2009

Money Aggregates (March 2016 in $-Billions)		in % of GDP
M0	3,898	21.66
M1	3,181	17.67
M2	12,661	70.34

- M0 is outside money $\rightarrow$U.S. currency outside the Fed and the deposits of depository instituns with the Fed, i.e. reserves.
- M0 $>$ M1 after 2008-2009 because of the large deposits and reserves that bank held with the Fed

Fisher Relationship

- Nominal bond payoff of $(1 + R)$
- Inflation rate is then

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

- Fisher relation

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

- Can rearrange $r = R - i - i \times r$
- For small values i and r can forget $i \times r$ term and $r \approx R - i$

Fisher Relationship (cont.)

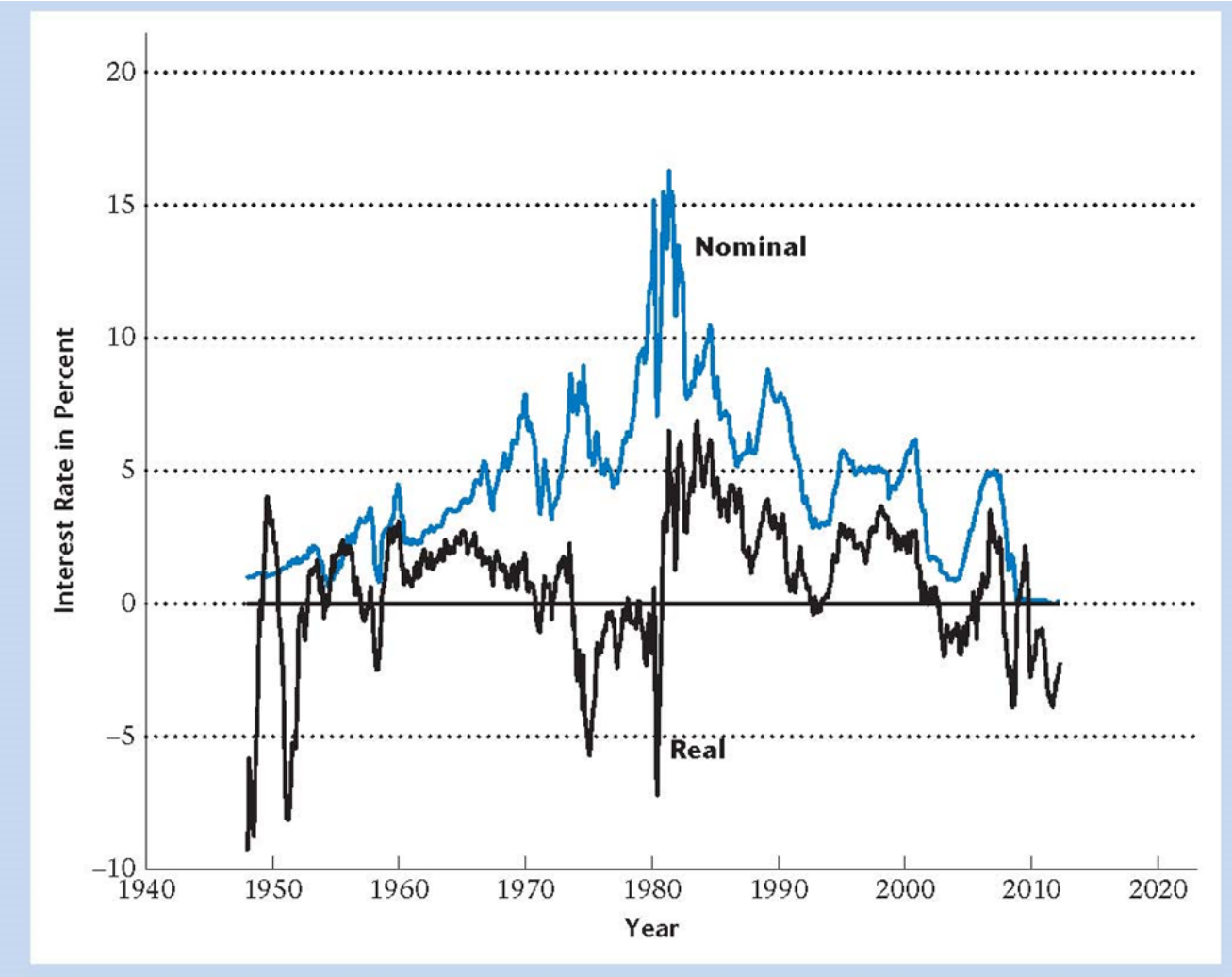
- Money does not offer a rate of return, so $R^m = 0$ and if $i > 0$then

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

- Therefore, $R > 0$ then $r > r^m$ - why do people hold money relative to bonds?

- **Enforce a CIA constraint**: agents must buy goods with money not bonds or other goods

Figure 3: Real and Nominal Interest Rates



Reasons for Holding Money

1. Transactions demand $\rightarrow$ overcome transaction frictions (single-coincidence of wants)
2. Liquidity demand $\rightarrow$ accessibility, quick to make transactions
3. Speculative demand $\rightarrow$ guard against speculative bubbles, money is a safe form of asset

Heated debate over modeling of money - J.H. Moore summarize 3 views:

1. Those who do not care
2. Those who do care but just use ad-hoc models
3. Fundamentalists who provide micro-foundations of money

To reduce complexity adopt (2) - assume agents need money to buy goods: **cash-in-advance (CIA)** constraint

Federal Reserve System

Federal Reserve and Open Market Operations

- Central Bank
  - A banker's bank: an official bank that controls the supply of money in a country
  - Lender of last resort A central bank is the lender of last resort, the last place, all others having failed, from which banks in emergency situations can obtain loans
  - Federal reserve can increase or decrease the total amount of reserves in the banking system

Tools of Fed

1. Open Market Purchase
   - Fed buys \$1 million of bonds and writes a check to the public
   - Public brings check to its bank and deposits increase by \$1 million
   - Banks cash in the check with Fed, which increases the total funds available to the banking system
   - With the extra cash the banks then starts the loan cycles $\rightarrow$ money has been increased

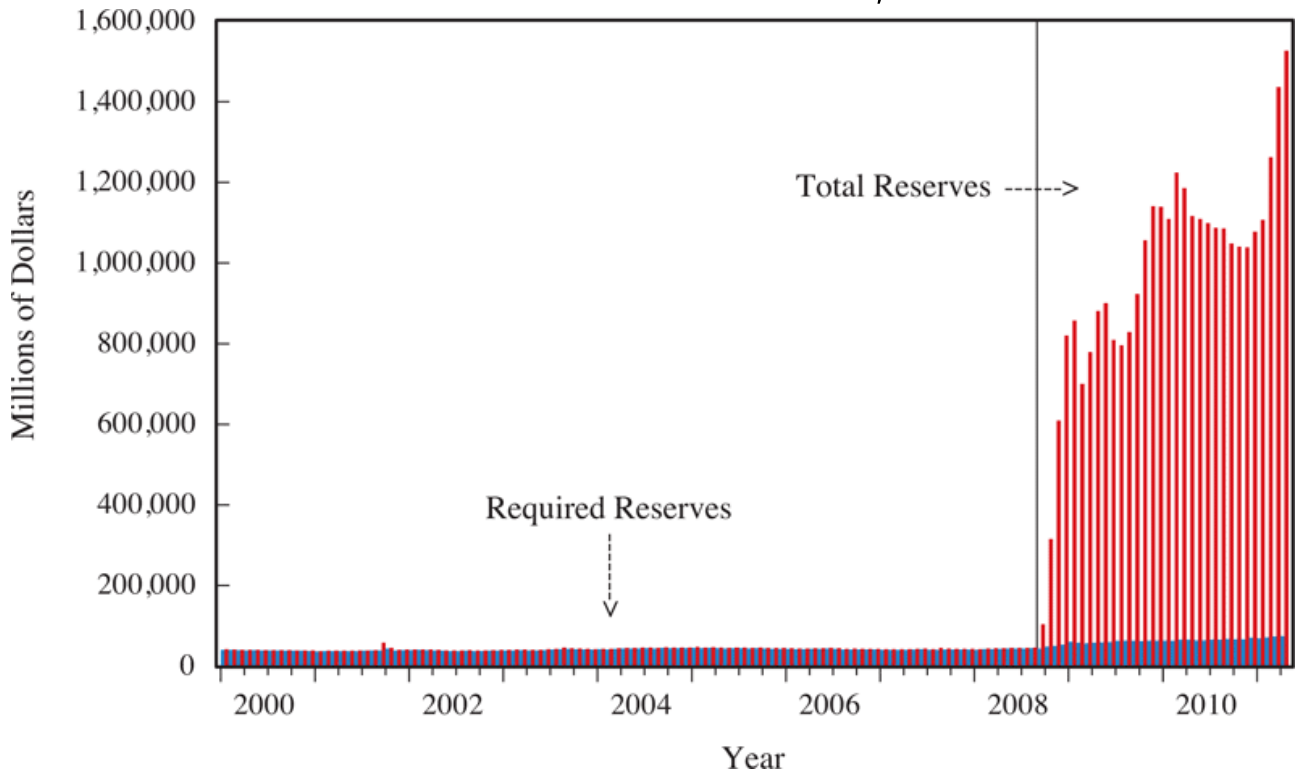
2. Open Market Sales
   - Fed sells \$1 million to a Wallstreet firm
   - Firm writes a check to Fed and gets bonds
   - Fed cashes in check with the bank of the firm
   - Bank reduces its reserves with the Fed
   - Since bank's reserves are reduced it has to make fewer loans to meet the reserve requirement $\rightarrow$ money destruction

3. Change reserve requirements (the % banks have to hold as reserves)

Tools of Fed (cont.)

- Not used often, since it is very disruptive to the banking system

4. Change the discount rate (interest rate)
   - Fed lends reserves to banks at an interest rate, the discount rate



   - Until September of 2008, banks held few excess reserves so total reserves (in red) were very close to required reserves (in purple)

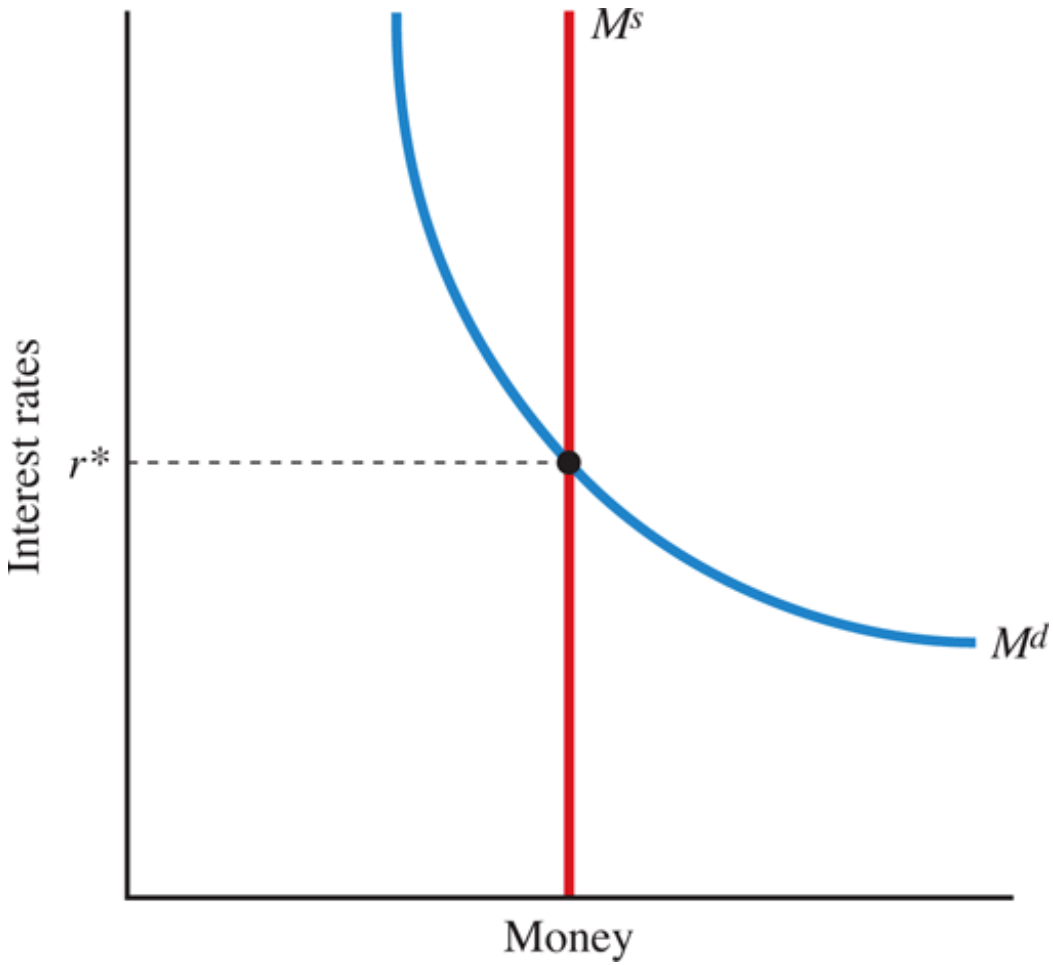
Tools of Fed (cont.)

- In response to the financial crisis of 2008, the Fed injected large amounts of reserves into the system and began paying interest on reserves in October
- As a result, excess reserves rose and total reserves now exceed required reserves

Discount Rate and Federal Funds Rate

- **Discount rate** $\rightarrow$ bank borrows from FED at this rate
- **Federal Funds Rate** $\rightarrow$ bank borrows from another bank at this rate
- In practice the two rates are very similar, in order to avoid large swings in borrowed reserves
- Changes in the discount rate are a major "signal" to the market about the Fed's intentions
- The Fed typically announces a target for the **Federal Funds Rate** $\rightarrow$ then uses open market transactions to keep rate at these targets $\rightarrow$by shifting M^s appropriately

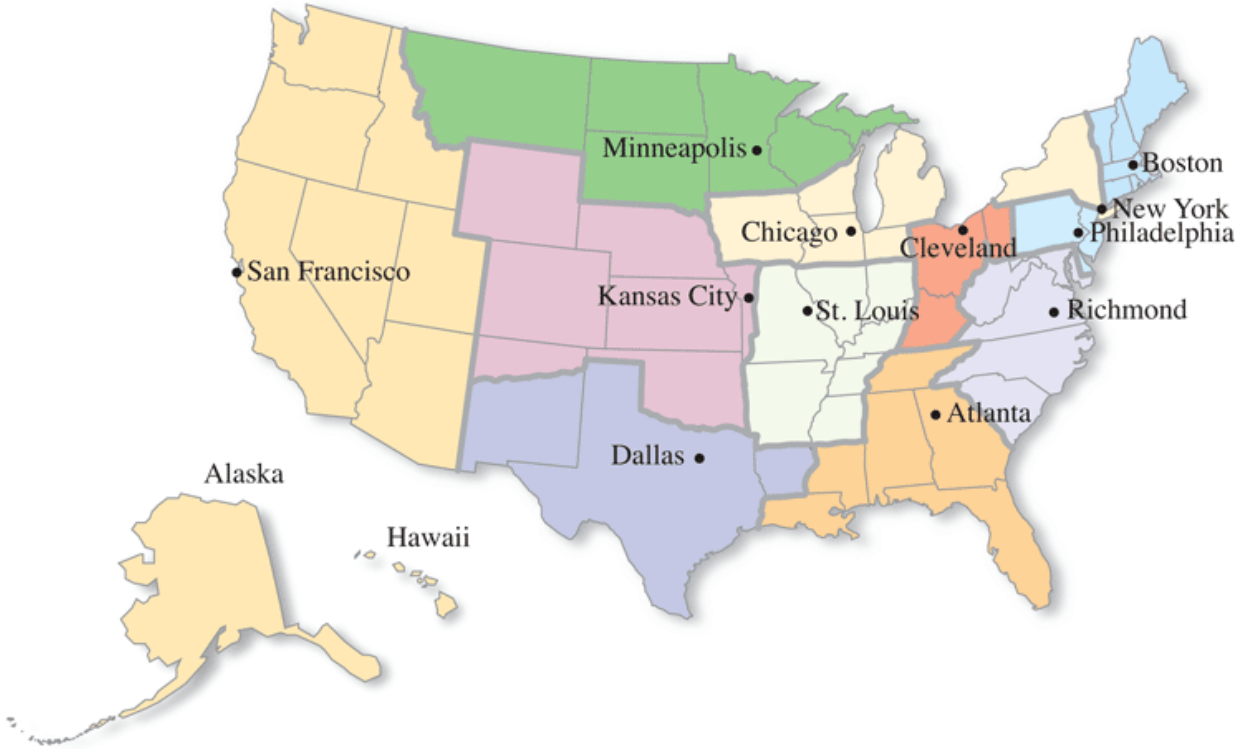
Discount Rate and Federal Funds Rate (cont.)



Structure of the Fed

- The Federal Reserve System was created in 1913 following a series of financial panics in the United States
- Congress created the Federal Reserve to be a central bank, serving as a banker's bank
- One of the Fed's primary jobs was to serve as a lender of last resort—lending funds to banks that suffered from panic runs
- Split into 3 sub-parts
  1. Federal Reserve Banks (12 districts)
  2. Board of Governors
  3. Federal Open Market Committee

Structure of the Fed (cont.)



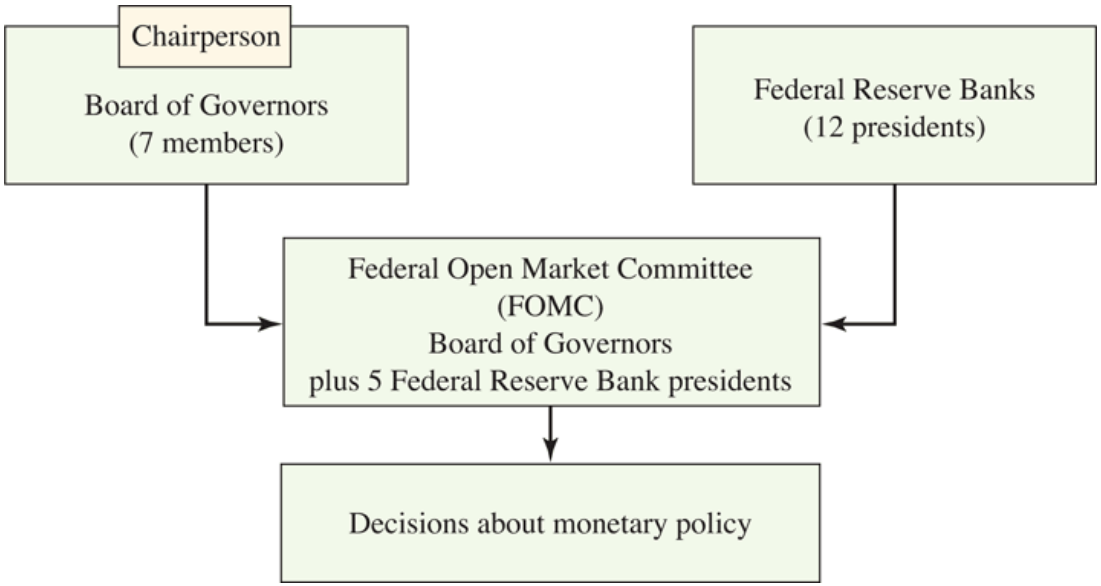
1. The 12 Federal Banks
   - Provide advice on monetary policy
   - Take part in decision-making on monetary policy
   - Provide a liaison between the Fed and the banks in their districts

Structure of the Fed (cont.)

2. Board of Governors of the Federal Reserve
   - The seven-person governing body of the Federal Reserve System in Washington, D.C.
   - Appointed for **14 years** by the President and confirmed by the Senate
   - Chairperson of the Board serve a four-year term
   - And everybody is carefully watching Janet Yellen

3. Federal Open Market Committee (FOMC)
   - The group that decides on monetary policy:
   - 12-person board
     - 7 members of the board of Governors
     - 1 president of Fed New York
     - 4 rotating members of the other regional Feds
   - Chairperson of the Board of Gov. is also chairperson of the FOMC
   - The chairperson has to report to congress on a regular basis

Structure of the Fed (cont.)



Policies and Power

- The Fed is independent of the Treasury Dept.
- The Fed has to do what the Congress tells it
- However, in practice the Fed acts "independently" and reports to the congress afterwards
- Should the Fed be independent?

Modeling Banks and Credit

Monetary Intertemporal Model

- How do we get positive money demand into a model?

1. Money in Utility function (MIU)
2. Cash in Advance Constraint (CIA)
3. Micro Foundations of Money (Money Search Models)

- A type of **cash-in-advance** (CIA) model: modifying the intertemporal investment model by adding **CIA**
- Representative consumer, representative firm, banks, and government
- Consumers and firms require cash on hand to purchase goods, or can use **credit cards**, which involves obtaining credit from the bank
- The quantity of credit card balances is determined by the supply (from banks) and the demand (from consumers and firms)

Banks

- Assets are money, credit card balances (credit extended to firms and consumers), and nominal government bonds.
- Liabilities are transactions deposits and savings deposits.
- Essentially 2 separate businesses – money and credit card balances back transactions deposits, bonds back savings deposits.

Transactions Deposits, Savings Deposits, Credit Card Balances

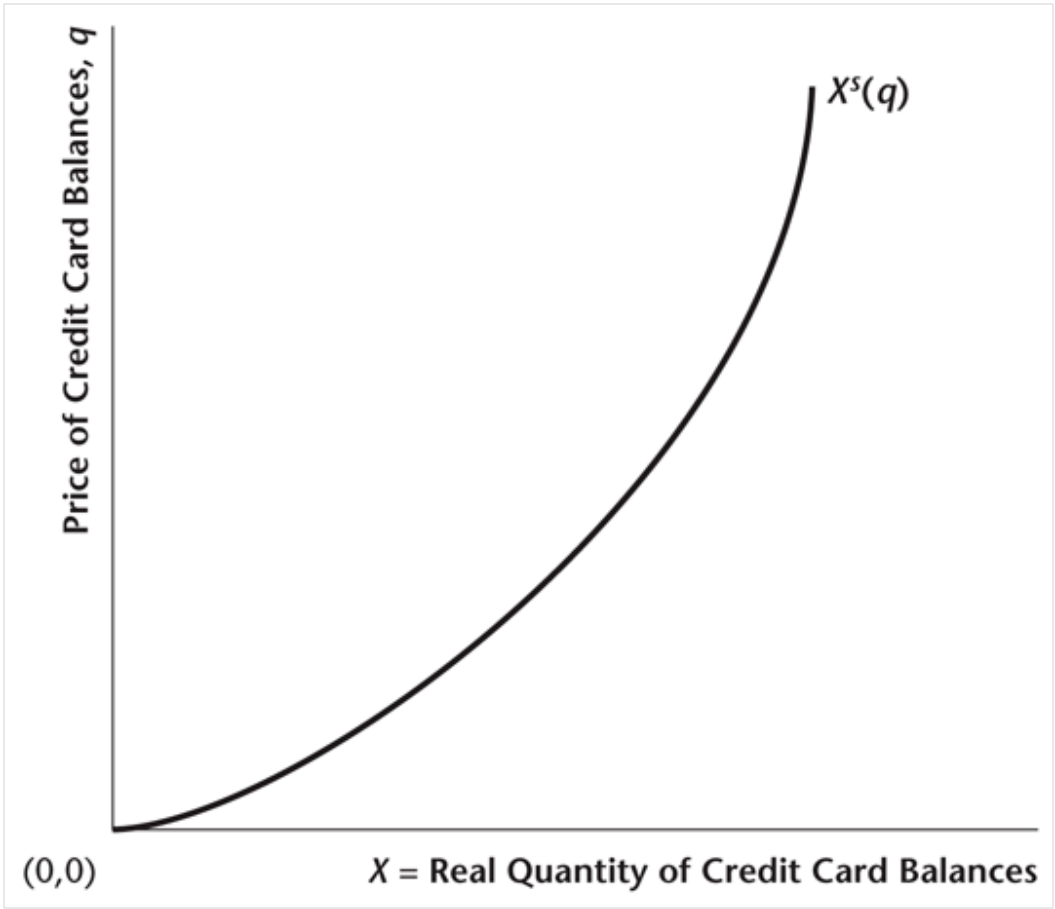
- Transactions deposits – can be withdrawn as currency at the beginning of the period. No interest within the period.
- Savings deposits – held until the following period, earning nominal interest rate R.
- Credit card balances – cost to the bank of q per unit (in real terms) to issue credit.

Typical Bank's Balance Sheet

Table 11.2 A Typical Bank's Balance Sheet

Assets	Liabilities
Money	Transactions Deposits
Credit Card Balances	
Nominal Government Bonds	Savings Deposits

The Supply Curve for Credit Card Balances



Demand for Money

- Y is all the goods
- $X^d(q)$ is demand for credit card services
- $Y - X^d(q)$ quantity that needs to be purchased with currency
- The demand for money depends on not only income
- but also the demand for credit card balances

Demand for Credit Card Services

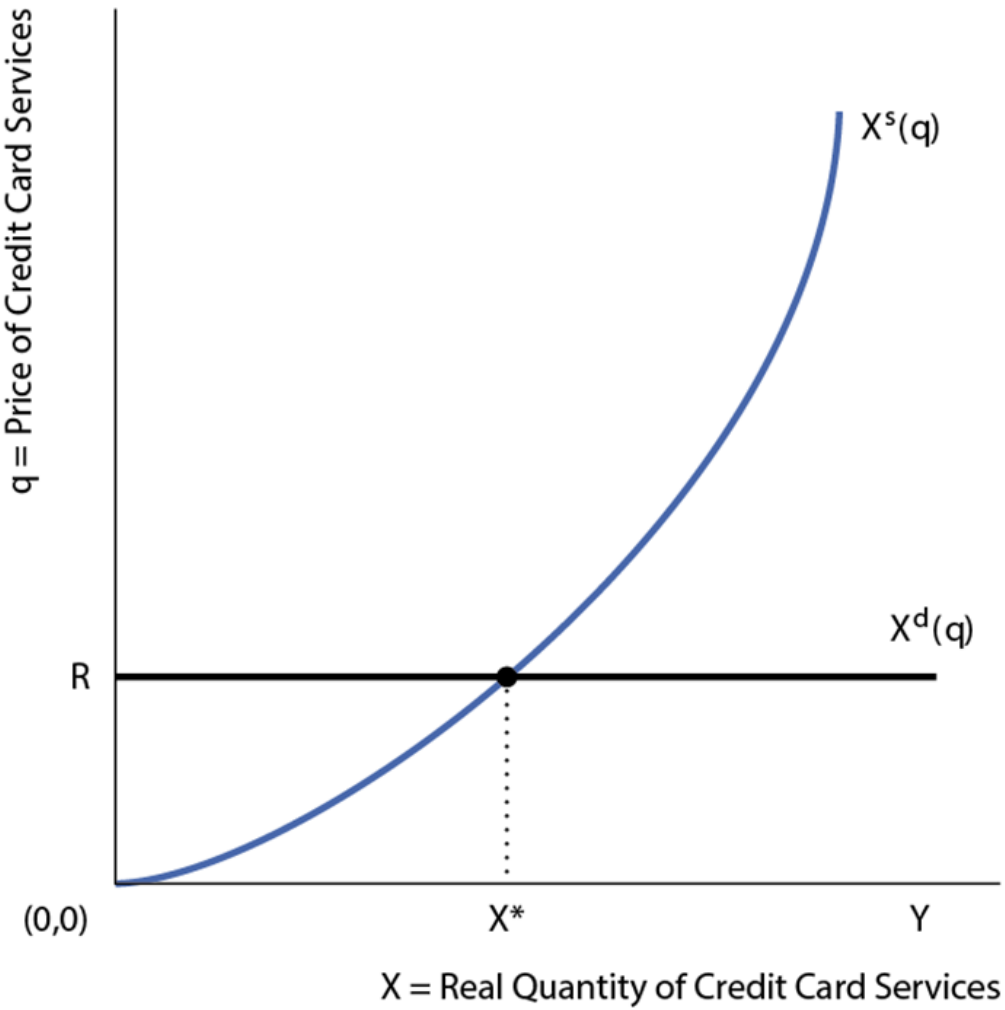
- Assume that credit card balances are paid off at the end of the period
  - Never pay interest R when using credit card

- One dollar in credit card purchases will result in
  - Marginal benefit (MB): $(1 + R) \times P \rightarrow$ can save the extra dollar
  - Marginal cost (MC): $(1 + q) \times P \rightarrow$ repays credit card debt at end of period
  - The net benefit $= MB - MC$:

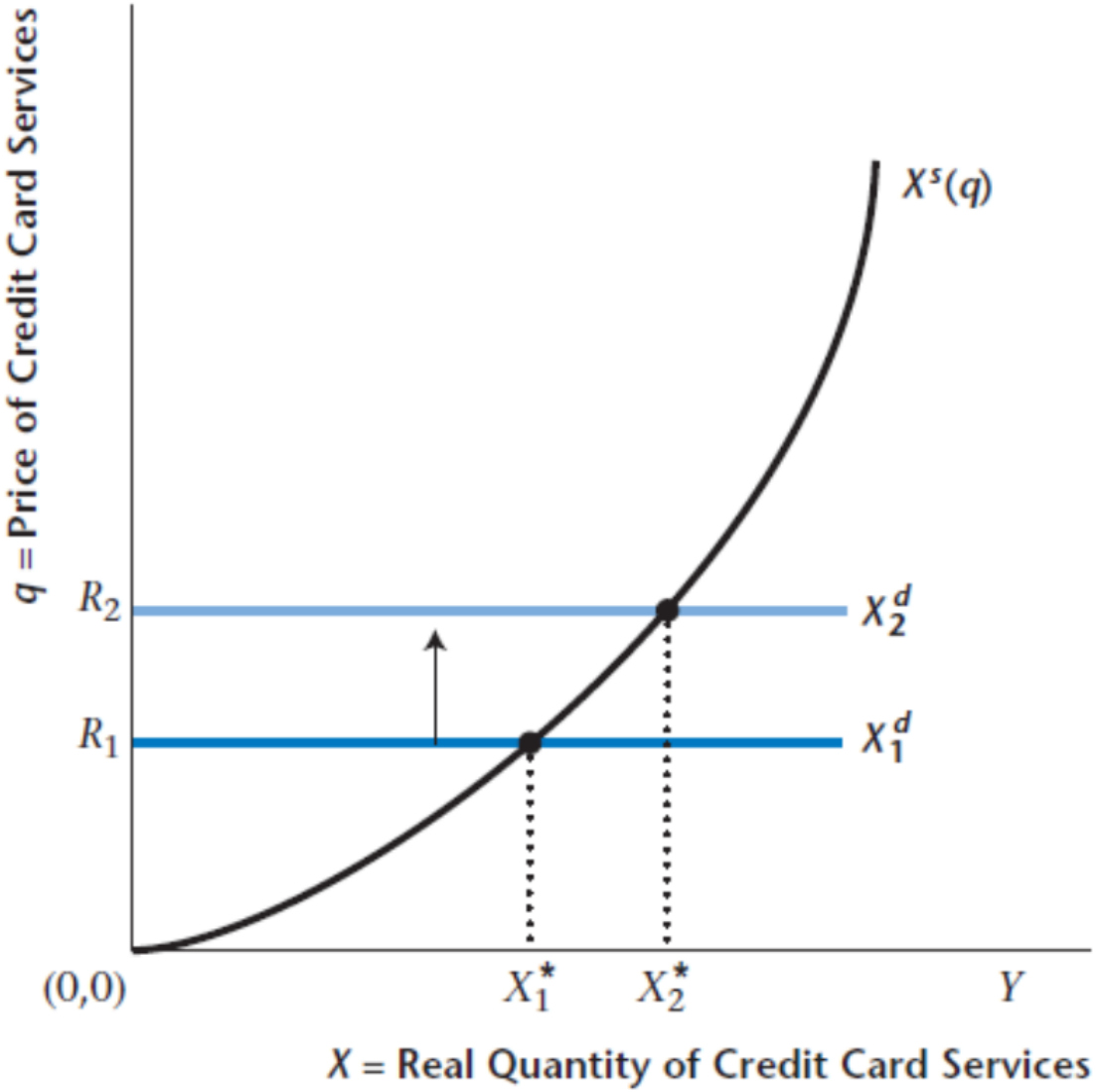
$$(1 + R)P - (1 + q)P = (R - q)P$$

- Three cases:
  1. $MB > MC$: only use credit cards for all purchasing
  2. $MB < MC$: use only currency for all purchases
  3. $MB = MC \rightarrow R = q$ indifferent between using currency and a credit card (perfectly elastic demand)

Equilibrium in the Market for Credit Card Balances



Increase in Interest Rate



- $R\uparrow \Rightarrow X^* \uparrow \Rightarrow M^d \downarrow$

The Demand for Money

Demand for Money

- Equilibrium demand quantity of credit card services is: $X^*(R)$
- Demand for money is

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

- We simplify this and define

$$L(Y, R) = Y - X^*(R)$$

The Demand for Money

- Demand for money increases if:
  1. An increase in real income $Y \uparrow$
     - More currency required as the volume of transactions increases.
  2. A decrease in the nominal interest rate $R \downarrow$
     - The nominal interest rate is the opportunity cost of using currency in transactions – lower R implies $\downarrow$ use of credit in transactions, and $\uparrow$ use of currency

- The demand for money can be written as

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

  - where

$$L(Y, R) = Y - X^*(R)$$

  - We can also write money demand

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

The Demand for Money (cont.)

- Real-money demand is

$$\frac{M^d}{P} = L(Y, R)$$

which has the following properties:

$$\frac{\partial\left(\frac{M^d}{P}\right)}{\partial R} \equiv \frac{\partial L}{\partial R} < 0,$$
$$\frac{\partial\left(\frac{M^d}{P}\right)}{\partial Y} \equiv \frac{\partial L}{\partial Y} > 0.$$

- Then

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

- Using Fisher relation in $M^d = P \times L(Y, R)$ yields:

$$M^d = P \times L(Y, i + r)$$

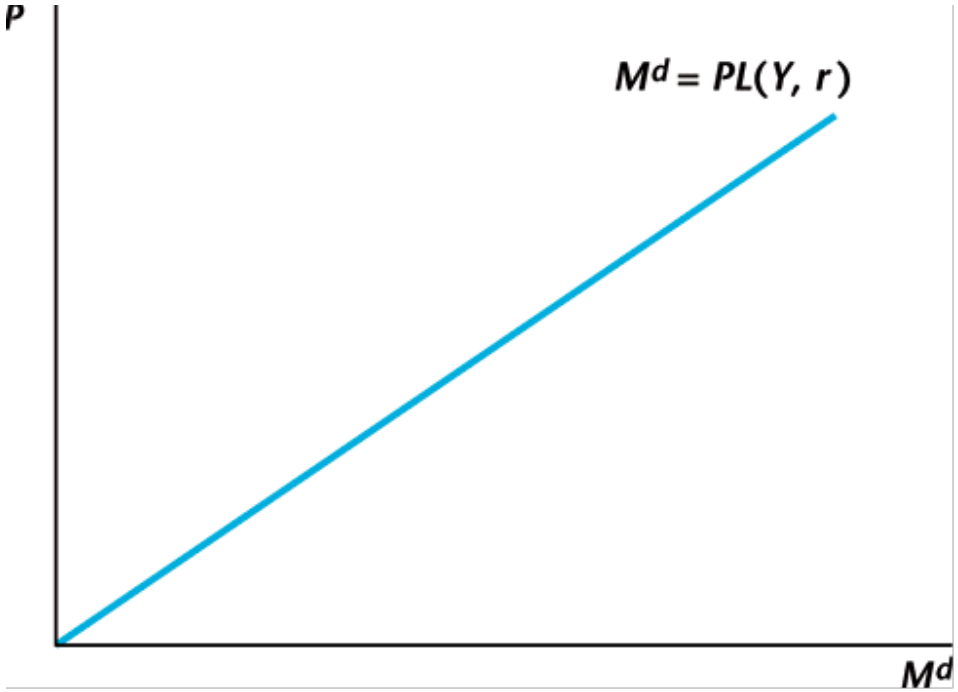
The Demand for Money (cont.)

- Leaving inflation i constant we get:

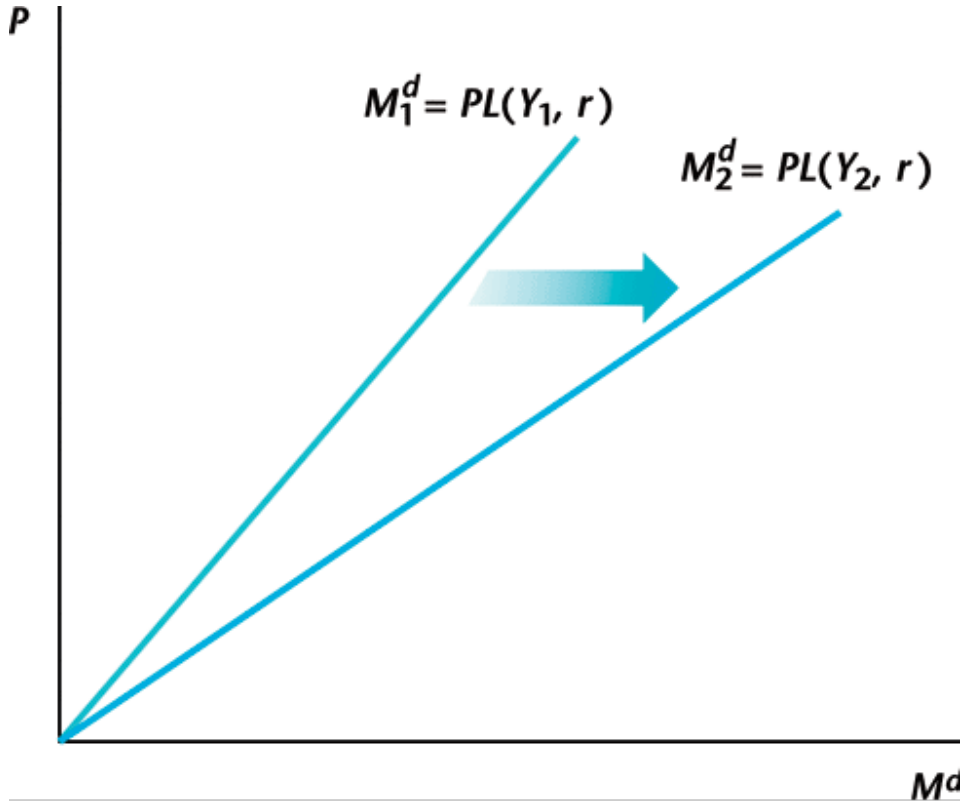
$$M^d = P \times L(Y, r)$$

- Shifts in M^d are Y, r and i

Nominal Money Demand



↑ in Y on Nominal Money Demand



- $Y_2 > Y_1 \Rightarrow M^d \uparrow$
- Same if $r_2 < r_1 \Rightarrow M^d \uparrow$ (opportunity cost of money goes down, so demand more)

Role of Fiscal/Monetary Authority

- Usually separate but just put them together label Government
- Current Government Budget Constraint

$$P \times G + B^{-}(1 + R^{-}) = P \times T + B + \overbrace{M - M^{-}}^{\text{new money}},$$

  where M is current money supply and M^{-} is previous period's money supply

- $M - M^{-}$ is the **new money** printed this period
- Note the government can finance spending through printing money
- Revenue from printing money is called **seigniorage** revenue.

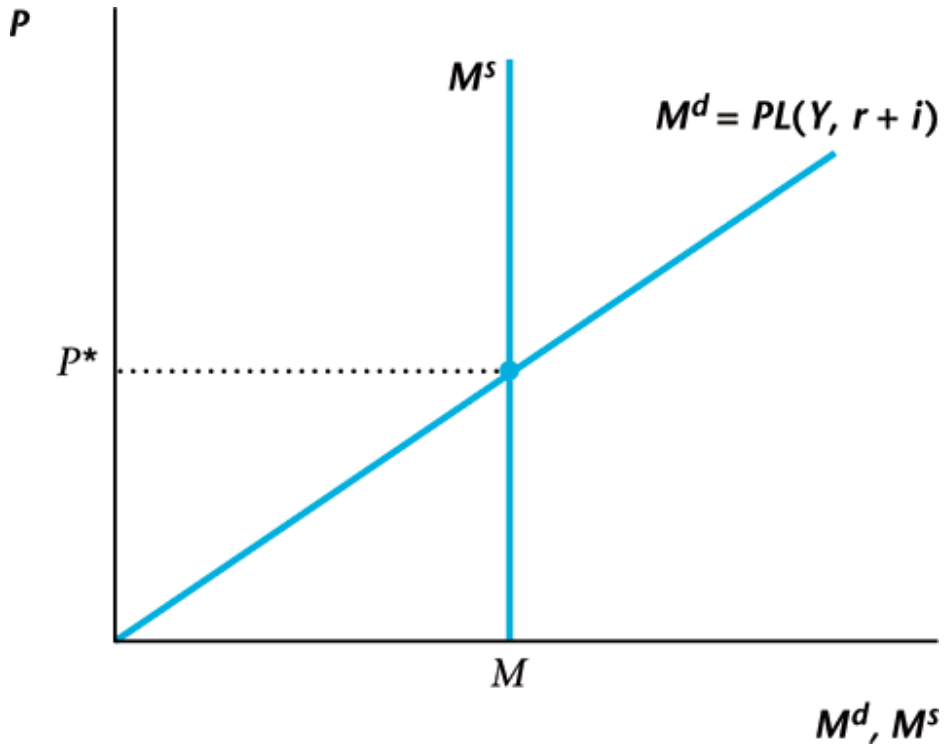
Means of Increasing Money Supply

The government has power to increase money supply through different channels:

$$P \times G + B^{-}(1 + R^{-}) = P \times T + B + \overbrace{M - M^{-}}^{M_s},$$

1. Reduce taxes without changing other fiscal policy - **Helicopter Drop**
2. Reduce quantity of bonds, B, in the current period via **Open Market Purchase (of bonds)**
3. Increase the amount of government spending G without changing other fiscal policy
   - Financed through **Seigniorage** revenue aka revenue from Inflation Tax $\Rightarrow$ **Printing money**

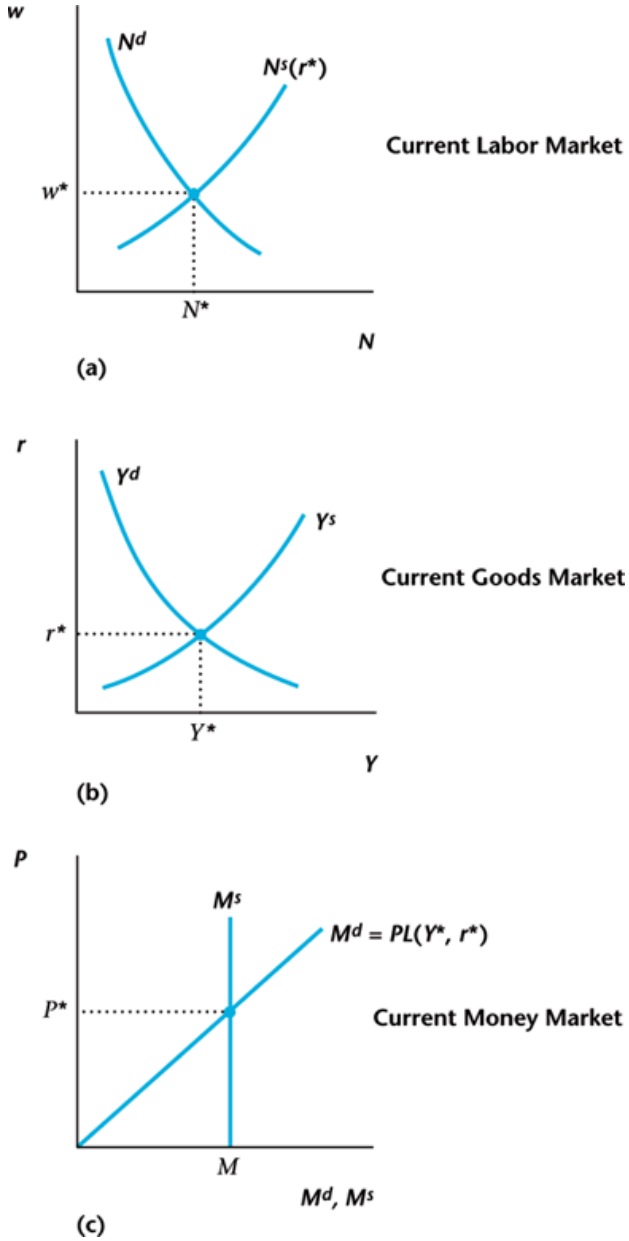
Money Market



Competitive Equilibrium

- Four markets but only consider three: goods, labor, and money (Walras Law).
- Supply of money is exogenously determined $M^s = M$ [see Fig 11.7]
- Money market determines the price-level in economy
- Integrating all three markets yields the complete monetary intertemporal model [see Fig 12]

Complete Monetary Intertemporal Model

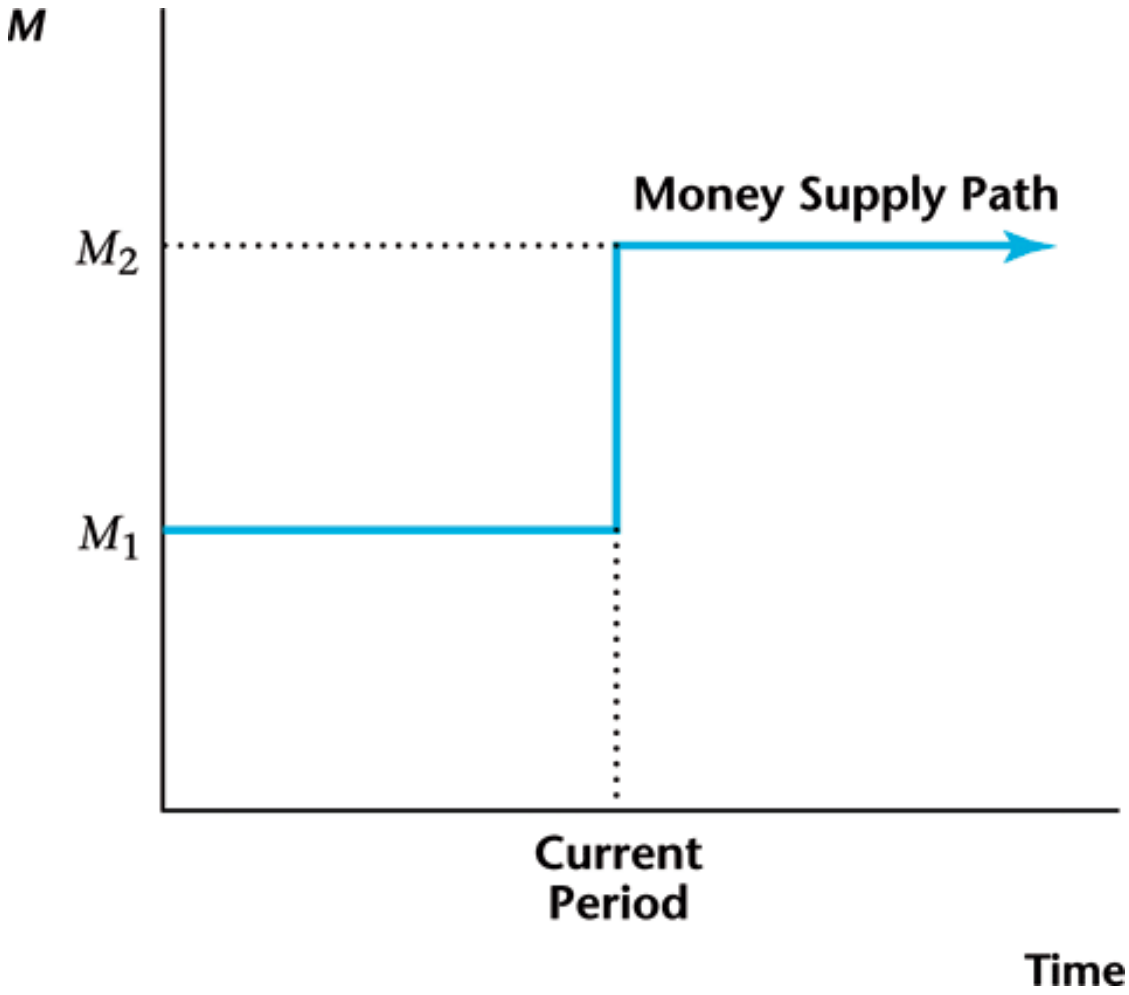


Money Neutrality

Increase in Money Supply

- What is the effect on the economy?
  - No effect due to **classical dichotomy**
  - Real and nominal markets are separate
  - Changes to nominal markets do not affect real markets
  - Labor and goods market do not rely on the price level
- $\uparrow$ in money supply just affects the price level
- Other markets are unaffected because no effect on r, w, N, or Y

↑ in Money Supply



The Neutrality of Money

- In the monetary intertemporal model,
- a level increase in the money supply
  - increases the price level and the
  - nominal wage in proportion to the money supply increase,
- but has **no effect** on any real macroeconomic variable
- Price level $P\uparrow$ needs to adjust to accommodate change in $M\uparrow$ so that $M^s = M^d$ holds:

$$\frac{M}{P} = L(Y, r)$$

  - real money demand $L(Y, r)$ is unchanged
- **Neutrality:** Change in money supply followed by a proportional change in price level

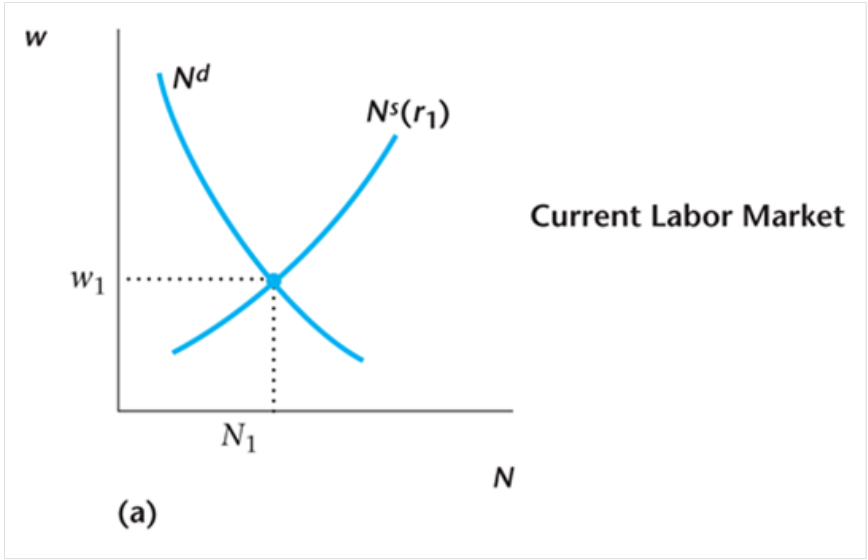
- $M^s \uparrow \rightarrow P \uparrow$ and $T \downarrow$ s.t.
  - HH wealth does not change

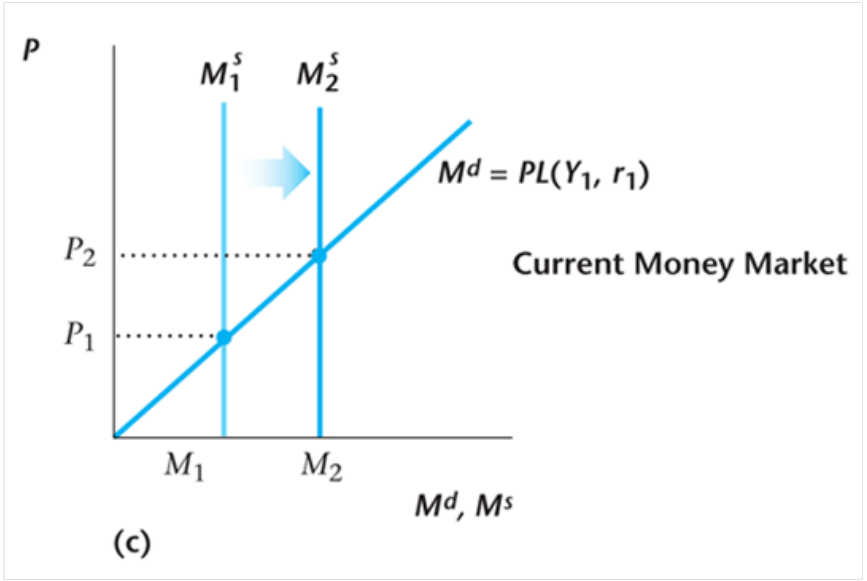
The Neutrality of Money (cont.)

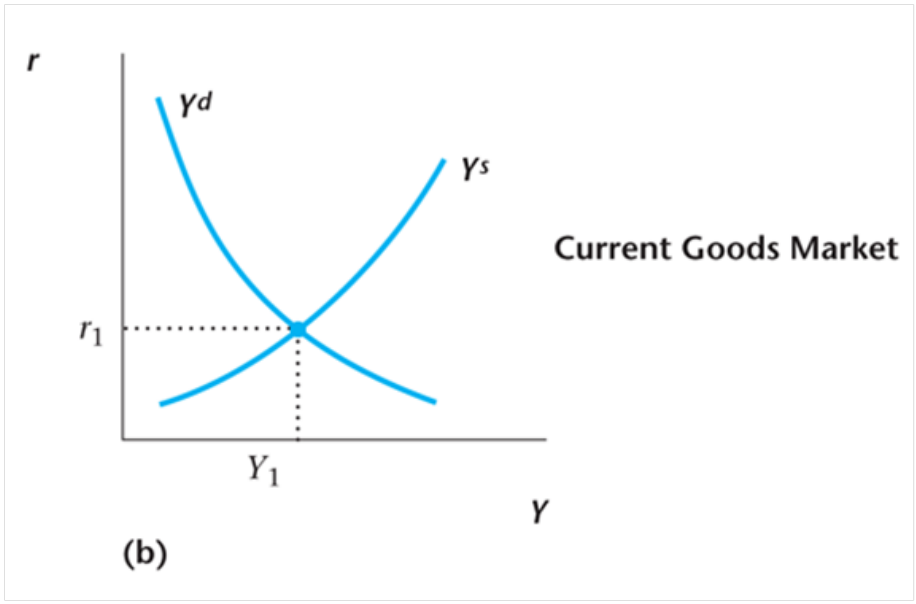
- no labor market adjustment

- No effect on real side: $W \uparrow$ and $P \uparrow$
  - leaves real wage $\frac{W}{P}$ unchanged and (again)
  - no labor market adjustment
- Money still matters $\rightarrow$ used in trade for goods (CIA constraint)
- Without money, no trade!
- In real life: Money is not neutral in short-run
- Some agreement that money is neutral in the long-run

The Neutrality of Money (cont.)







Shifts in Money Demand

Money Demand

- Money Demand determined by
  - households,
  - firms and
  - bank credit card services.

Shifts in Money Demand

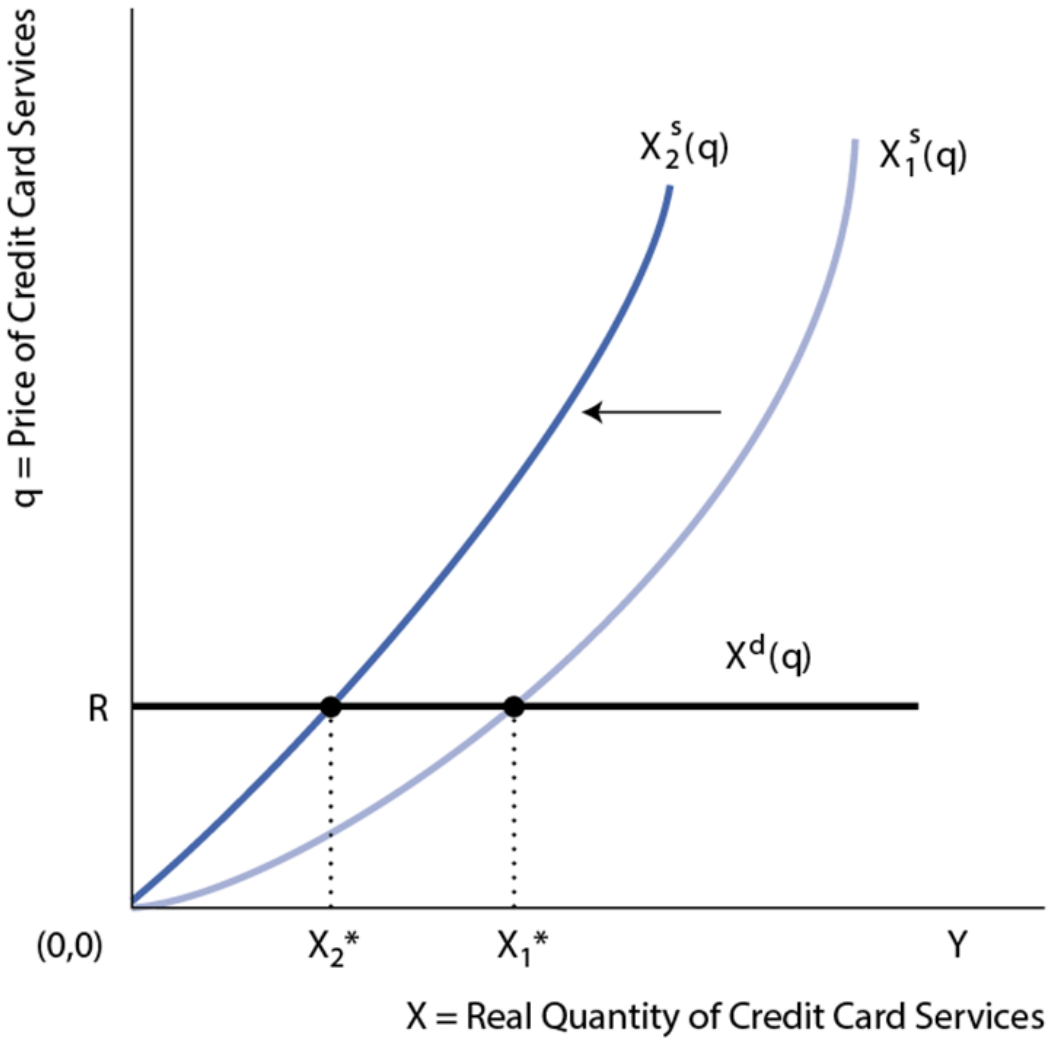
What causes shifts in Money Demand?

1. Change in costs of using other assets as means of payments (debit cards) (i.e., new technologies, etc.)
2. Change in costs of converting other financial assets into money (i.e., new account types etc.)
3. Change in government regulations
4. Change in inflation risk
5. Change in perceived riskiness of banks
6. Change in riskiness of other assets

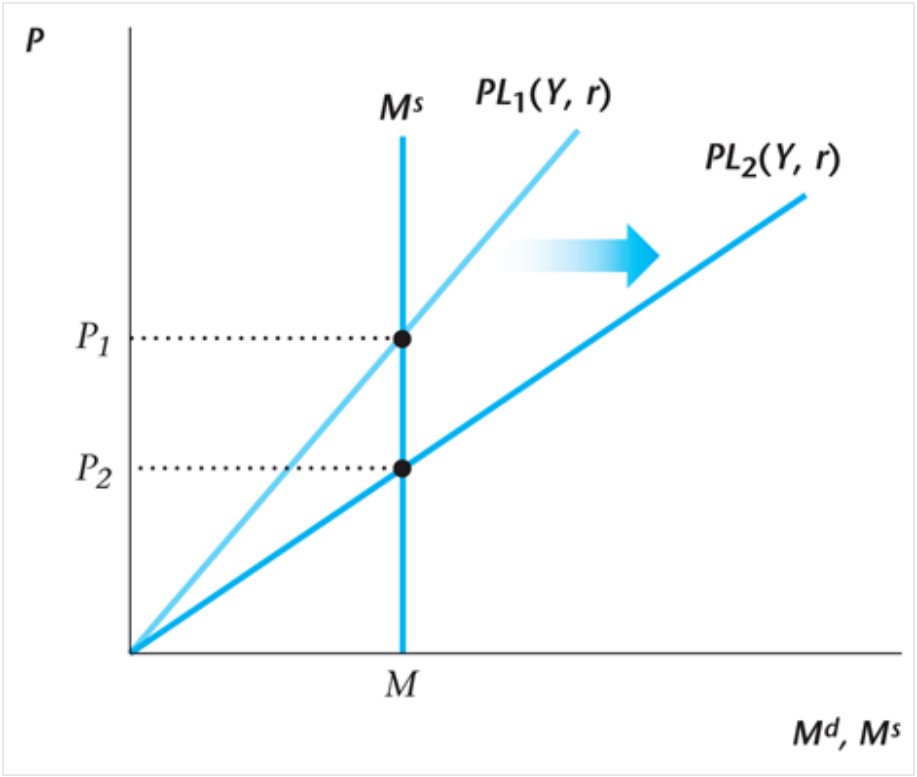
Why does this matter?

- Shifts in money demand affect velocity!
- These shifts are important for how monetary policy should be conducted

A Decrease in the Supply of Credit Card Balances



A Shift in the Demand for Money

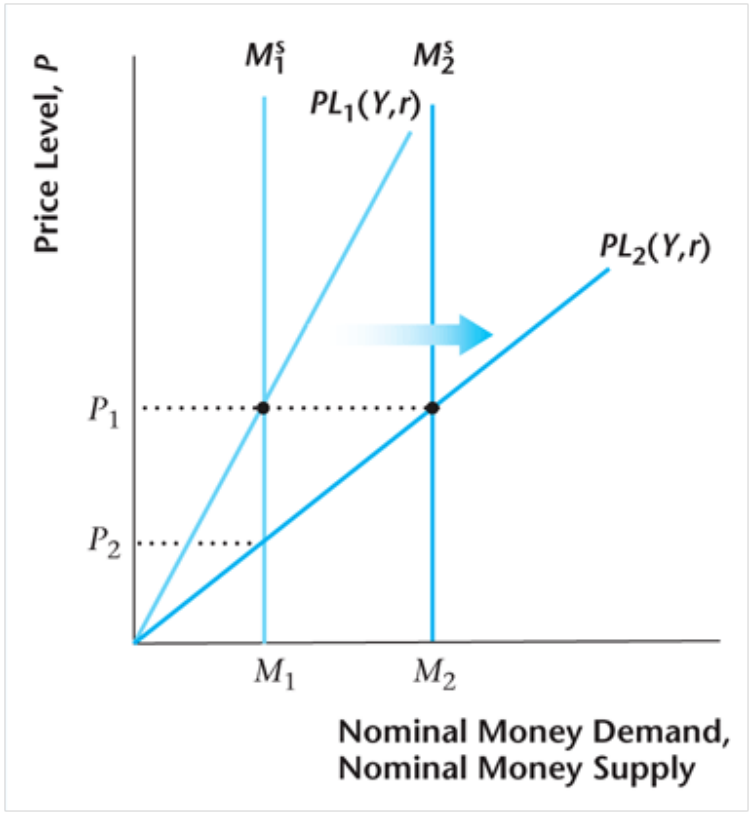


- Deflation $\rightarrow$ change from P_1 down to P_2
- A dollar becomes more valuable

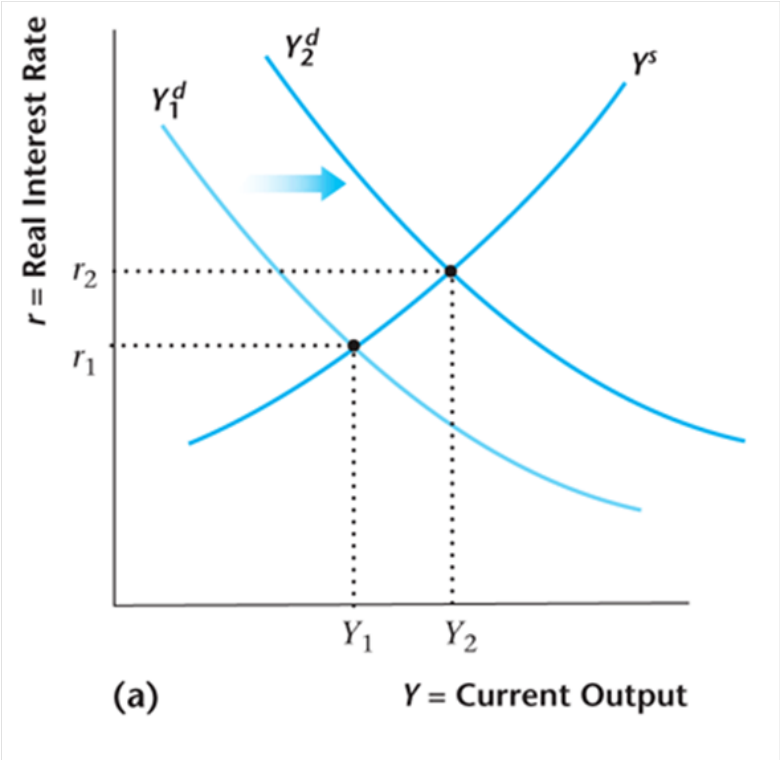
Central Bank responses

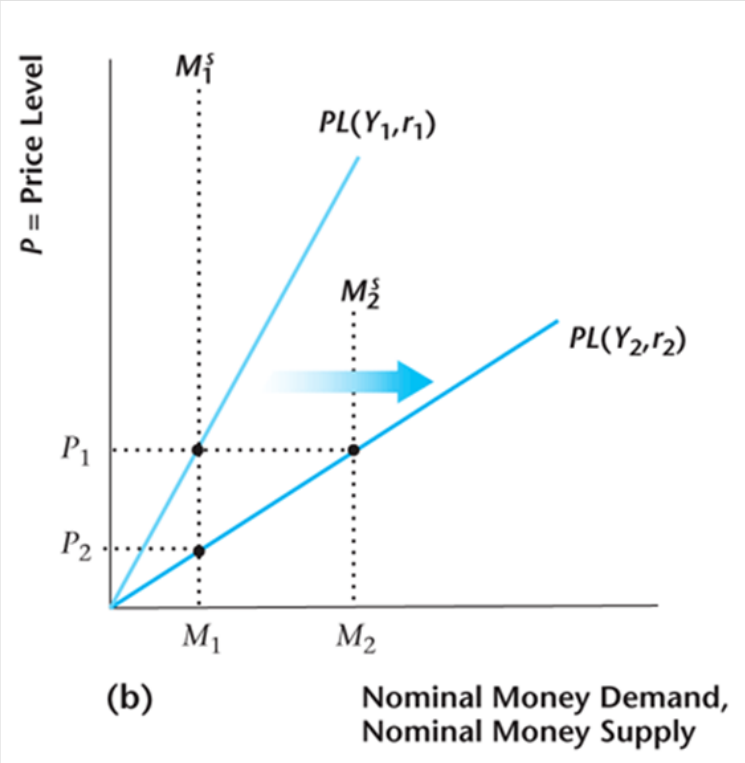
- Suppose CB observes Y and r moving predicts money demand function
  - To hold price level steady increases Money Supply
- Alternatively, Money demand shifts left but CB does not observe
  - Does not contract Money supply
  - Price level increases
- Important monitoring of economy is money supply and or interest rates
- Role of the Federal Reserve

A Shift in the Demand for Money + CB Response



A Shift in the Output Demand Curve + CB Response



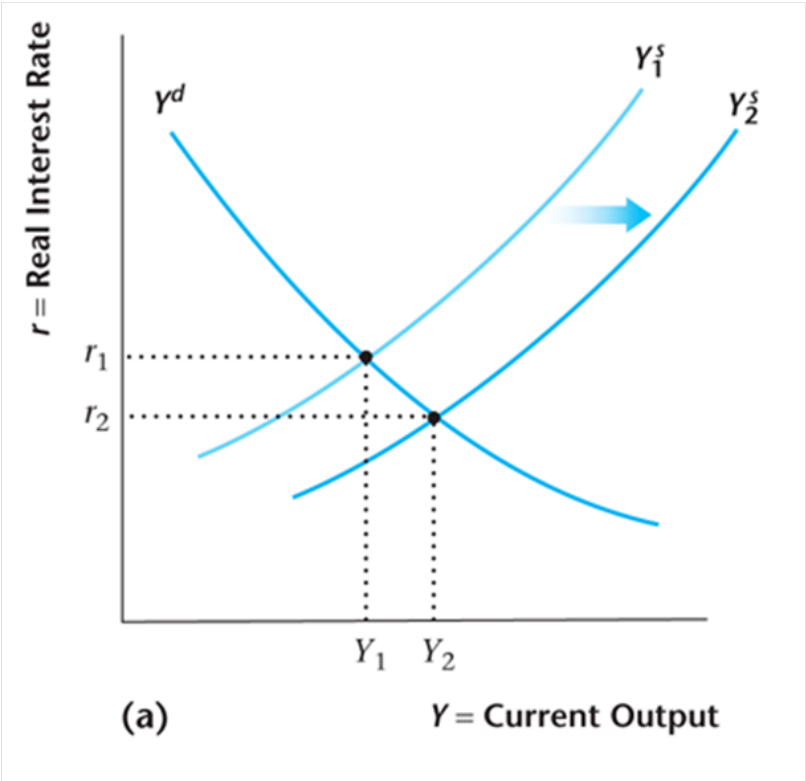


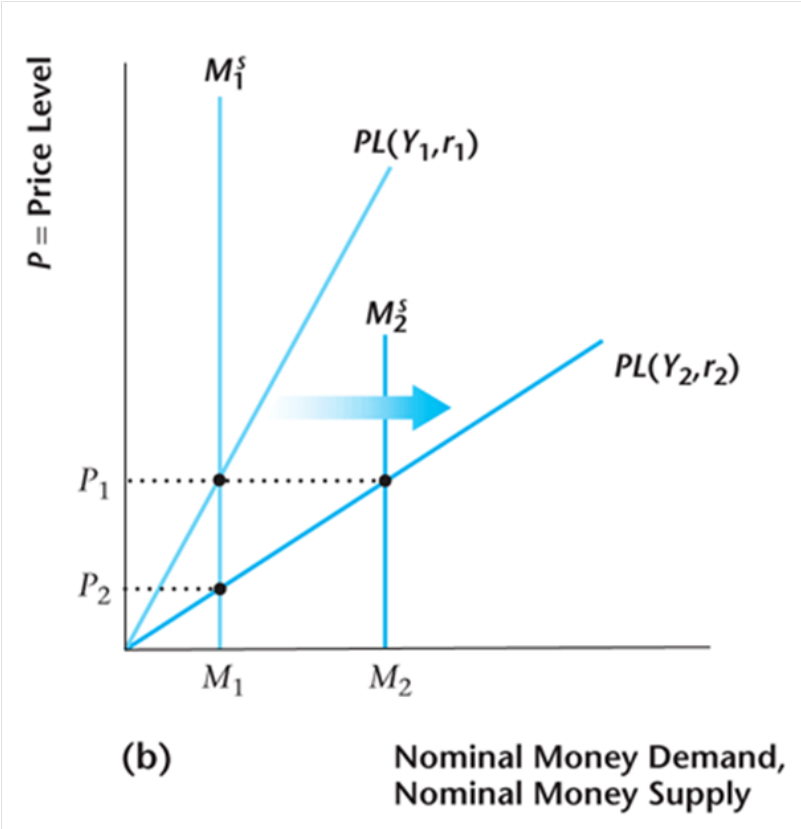
1. Increase in $Y^d \Rightarrow \uparrow M^d$
2. $\uparrow r \Rightarrow \downarrow M^d$

A Shift in the Output Demand Curve + CB Response (cont.)

3. Assume the first dominates the second $\Rightarrow$ overall M^d rotates "out"
4. CB increases M^s to stabilize price level

A Shift in the Output Supply Curve + CB Response





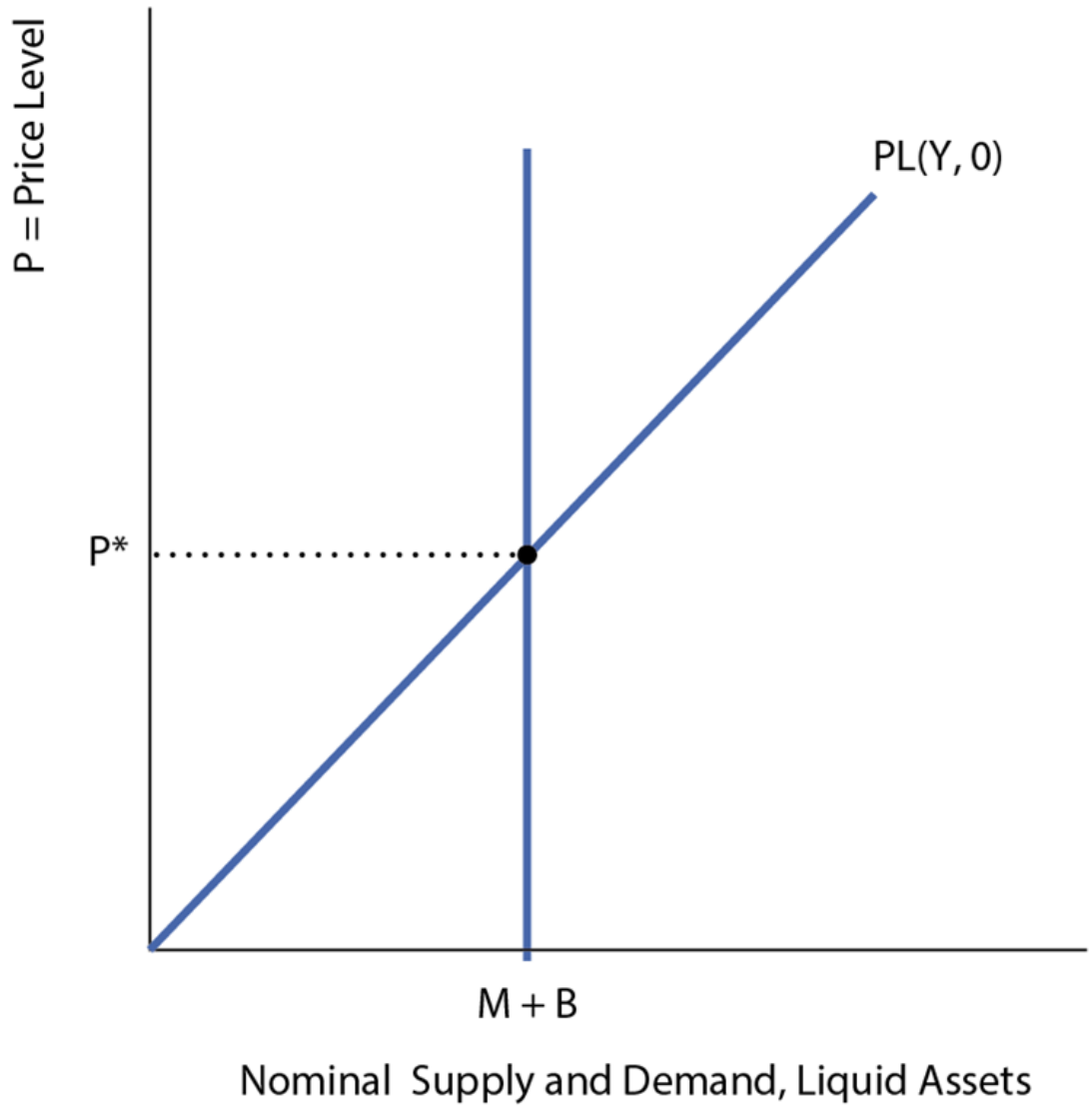
1. Increase in $Y^s \Rightarrow \downarrow r$
2. $\downarrow r \Rightarrow M^d$ rotates out/down

A Shift in the Output Supply Curve + CB Response (cont.)

3. CB increases M^s to stabilize price level
4. $M^s \uparrow \Rightarrow P \uparrow$ back to where it was

Liquidity Trap and Quantitative Easing

Liquidity Trap - Quantitative Easing



Liquidity Trap

- Nominal interest rate is near 0
- $\uparrow M^s$ is not lowering short term interest rate anymore
- Bonds and money are now perfect substitutes, so that total money supply $= M + B$
- Buying B with M is not moving money supply anymore $\rightarrow$ **Open Market** policy becomes ineffective

- If long-term interest is still > 0 this could keep I^d low
- Typically short-term interest determines long-term interest$\rightarrow$ but we reached lower bound
- Intervene directly in long-term market and CB buy up long-term bonds
- Will lower long-term interest rate and hopefully $\uparrow I^d \rightarrow \uparrow y$

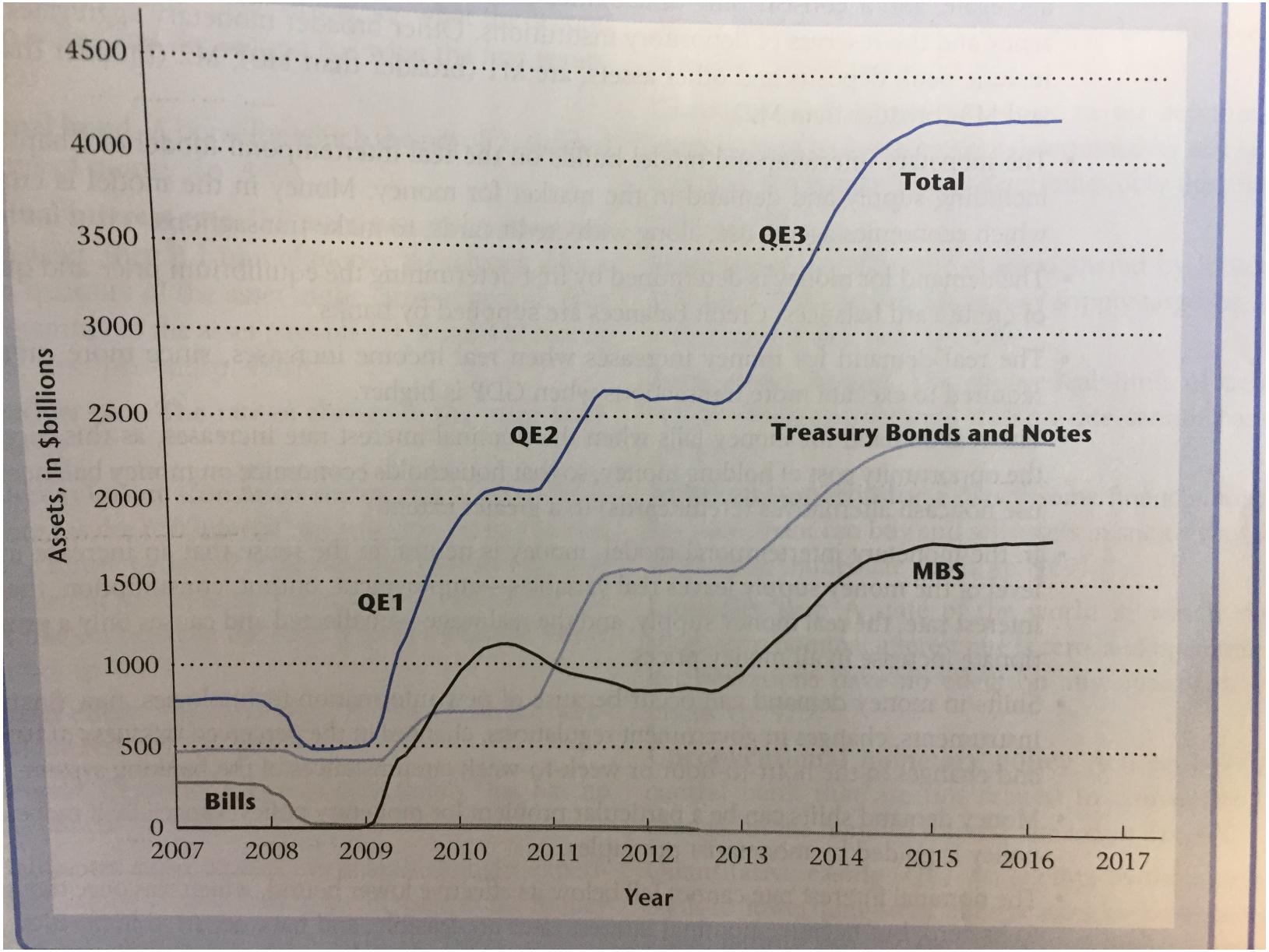
New Central Bank Policies

- **Quantitative Easing**
  - CB buys long-term bonds ($>$ 1 year maturity)
  - This increases $M + B$ as you now make long-term stocks more "liquid"
  - Whether QE works is debatable
  - It hasn't really influence inflation between $2014 - 2016$
- **Negative Nominal Interest Rate**
  - Effective lower bound is not zero, but somewhat lower
  - Maybe holding negative interest bonds ($R < 0$) is more convenient than holding currency ($R^m = 0$)

Liquidity Trap - Quantitative Easing

- 3 phases total
- Phase 2 and 3 saw intervention in mortgage backed securities (MBS)
  - This $\downarrow$ interest on mortgage but can $\uparrow$ interest on corporate bonds $\Rightarrow$ Fed becomes political!
- Fed profits go back to treasury $\Rightarrow$ large profits because of securities holdings

Liquidity Trap - Quantitative Easing (cont.)

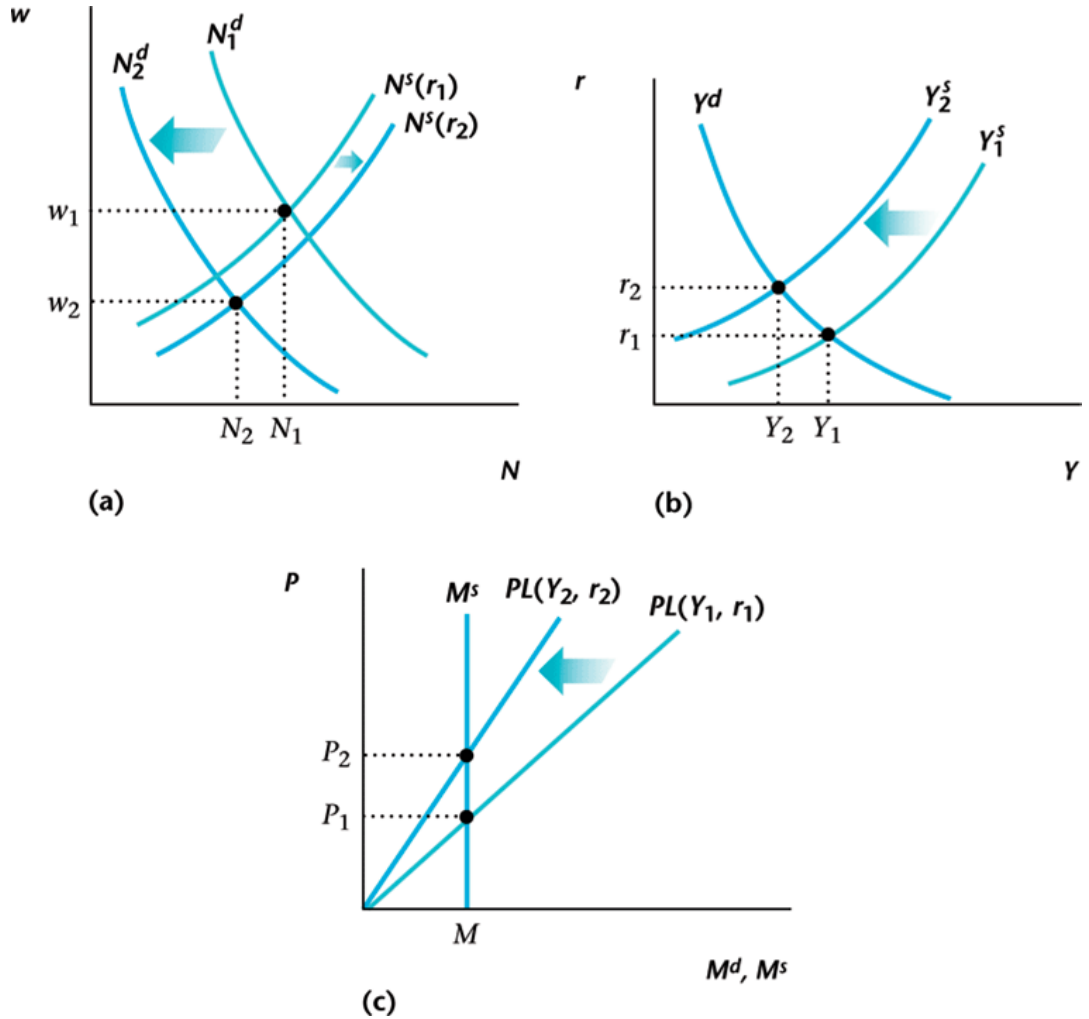


Optional: Technology Shock

A Temporary Decrease in TFP

1. Find initial equilibrium
2. $\downarrow z$
   1. Cause decrease MPN shift left N_1^d to N_2^d
   2. Reduced N leads Y_1^s to shift left to Y_2^s
3. Results in $\uparrow r$
4. Intertemporal substitution for labor (higher r causes work more) $N^s(r_1)$ to $N^d(r_2)$ (small effect)
5. $\downarrow w, Y$ and $\uparrow r$
   1. Since $\downarrow Y$ and $\uparrow r$ decreases Money demand $\rightarrow$ Price level $\uparrow$
   2. Prices increase to equate Money demand and supply

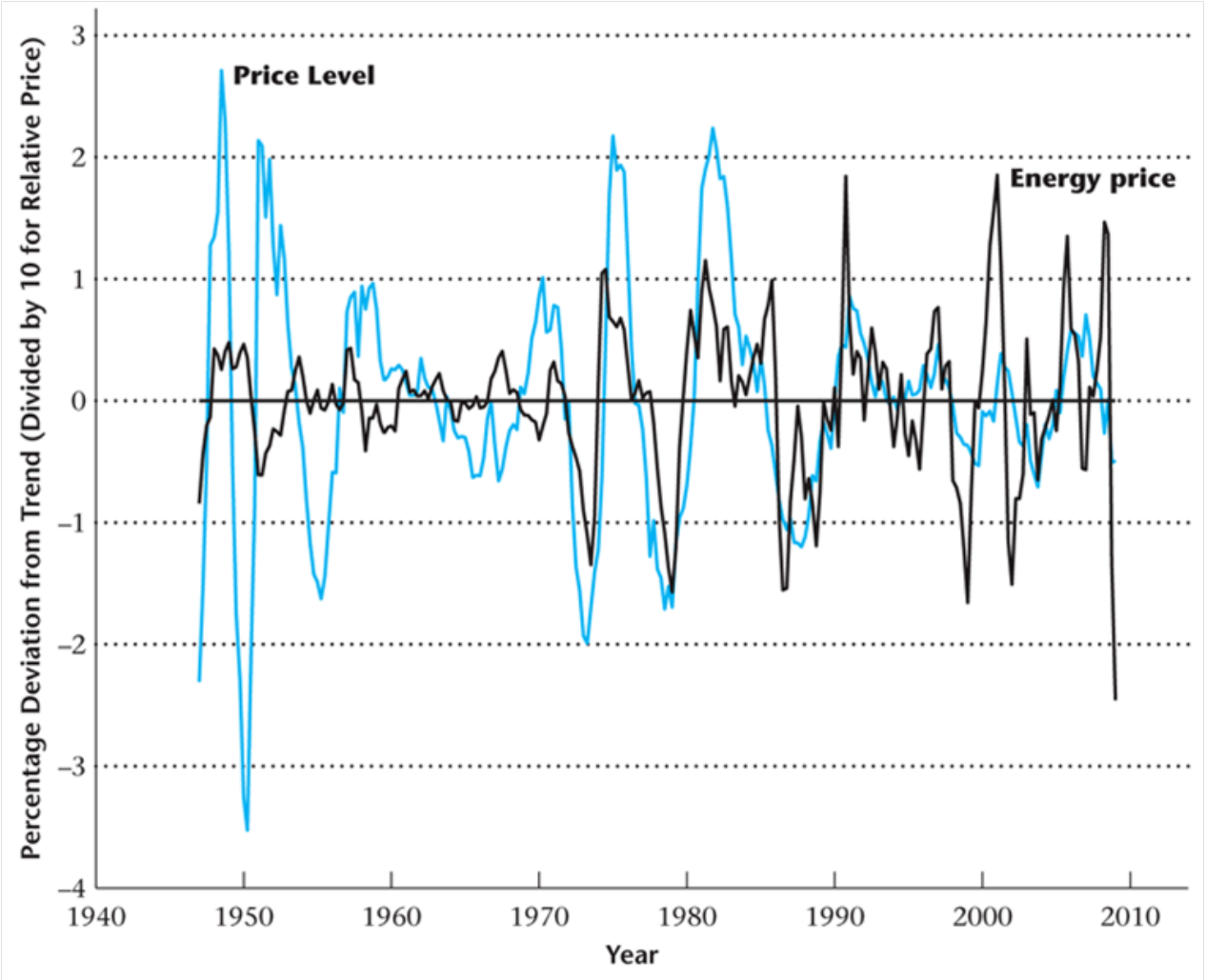
A Temporary Decrease in TFP



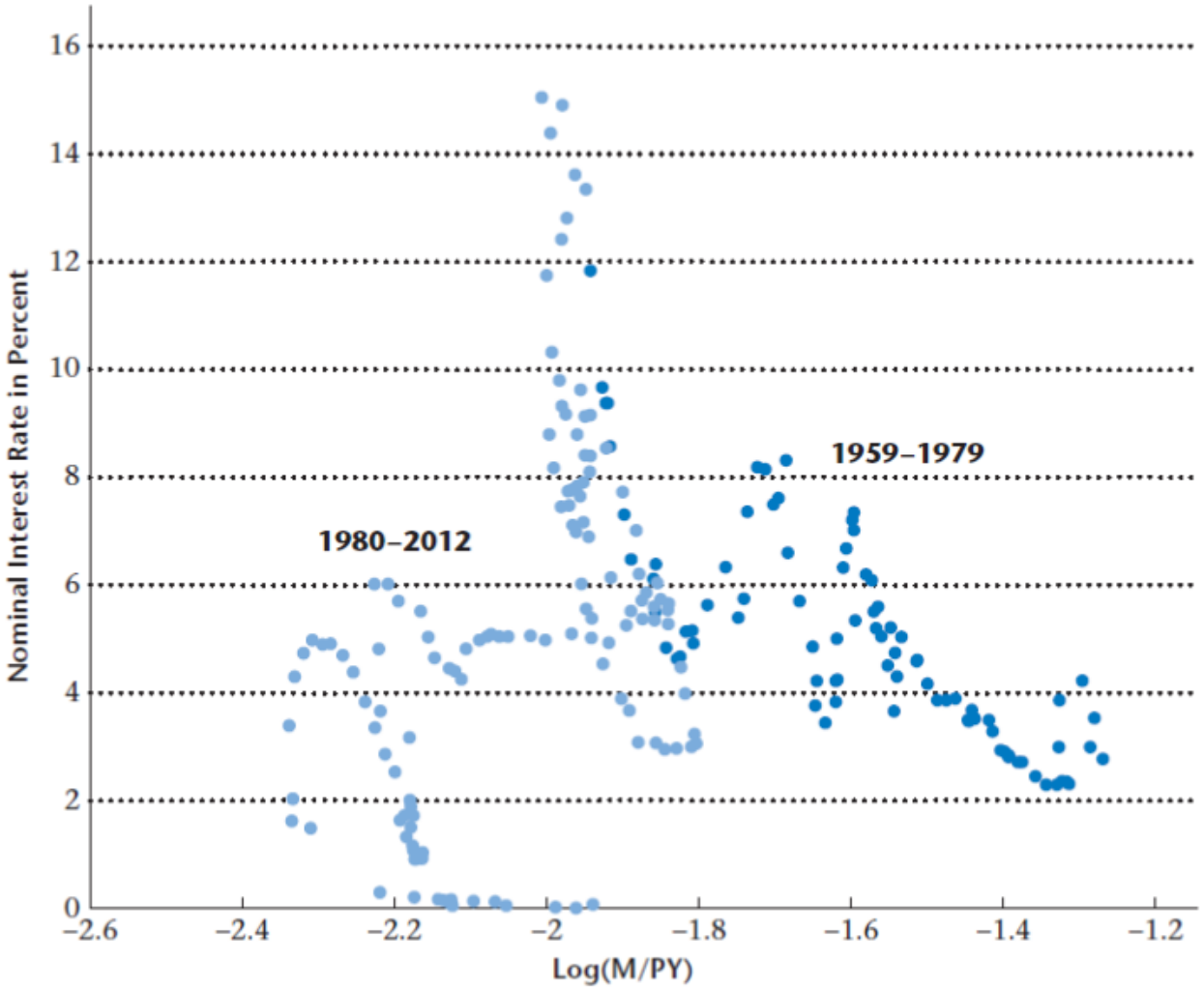
Energy Prices as TFP shocks

- model predicts that decrease in TFP causes price level to increase
- oil price shocks as proxy for TFP shocks
- price level lags energy price
- stickiness in nominal prices and wage contracts

Percentage Deviations from Trend in the Price Level and in the Relative Price of Energy



Scatter Plot of the Price Level Versus the Relative Price of Energy for 1947–2009



- Money demand is not stable empirically