Economics of Financial Markets – Lecture 3

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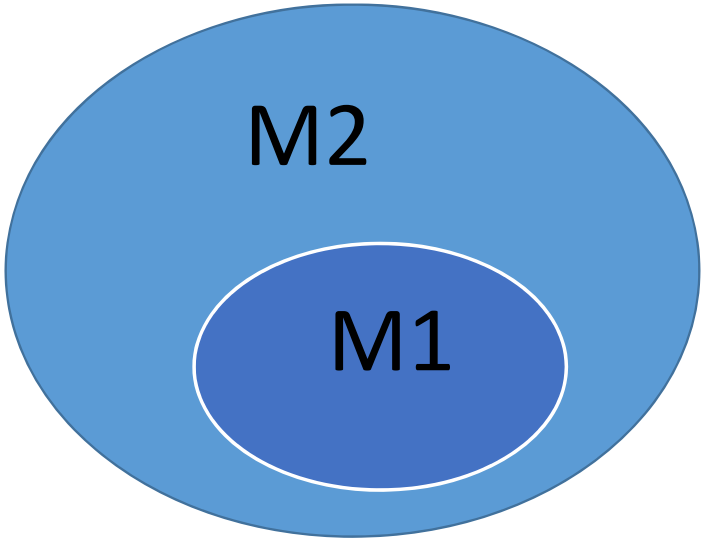
From Week 1

For each of the following assets, indicate which of the monetary aggregates (M1 and M2) includes them:

1. *Currency (M1+M2)*
2. *Money market mutual funds (M2)*
3. *Small-denomination time deposits (M2)*
4. *Checkable deposits (M1+M2)*

- Key Point:

$$M1 \subset M2$$



Coupon Bond

Using the same strategy used for the fixed-payment loan:

P = price of coupon bond

C = yearly coupon payment

F = face value of the bond

n = years to maturity date

Equation 3: $$P = \frac{C}{1+i} + \frac{C}{(1+i)^2} + \frac{C}{(1+i)^3} + \ldots + \frac{C}{(1+i)^n} + \frac{F}{(1+i)^n}$$

When yield to maturity equals coupon rate

- When the coupon bond is priced at its face value, the yield to maturity equals the coupon rate.
- The yield to maturity is greater than the coupon rate when the bond price is below its face value.
- When n=1, we have

$$P=\frac{C}{1+i}+\frac{F}{(1+i)^1}.$$

From $P = \frac{C}{1+i} + \frac{F}{(1+i)^1}$,

$(1+i) \times P = C + F.$

$P + P \times i = C + F.$

When $P = F$

$P \times i = C.$

$i = \frac{C}{P}.$

When $P < F$

$F = P + d$ for some $d > 0$

$P + P \times i = C + P + d.$

$i = \frac{C+d}{P} > \frac{C}{P}.$

When $P > F$

$F = P - d$ for some $d > 0 \& d < P$

$P + P \times i = C + P - d.$

$i = \frac{C-d}{P} < \frac{C}{P}.$

Table 1: From Equation 3

TABLE 1 Yields to Maturity on a 10%-Coupon-Rate Bond Maturing in Ten Years (Face Value = $1,000)

Price of Bond ($)	Yield to Maturity (%)
1,200	7.13
1,100	8.48
1,000	10.00
900	11.75
800	13.81

Interest-Rates Risk

- The risk level associated with an asset's return that results from interest-rate change is called **interest-rate risk**.
- Example: Consider the situation where interest rates rise from 10% to 20%.
- We study One-Year Returns on Different-Maturity 10% Coupon-Rate and Bonds.

Again One More Time

- Rate of return is given by the following relationship:

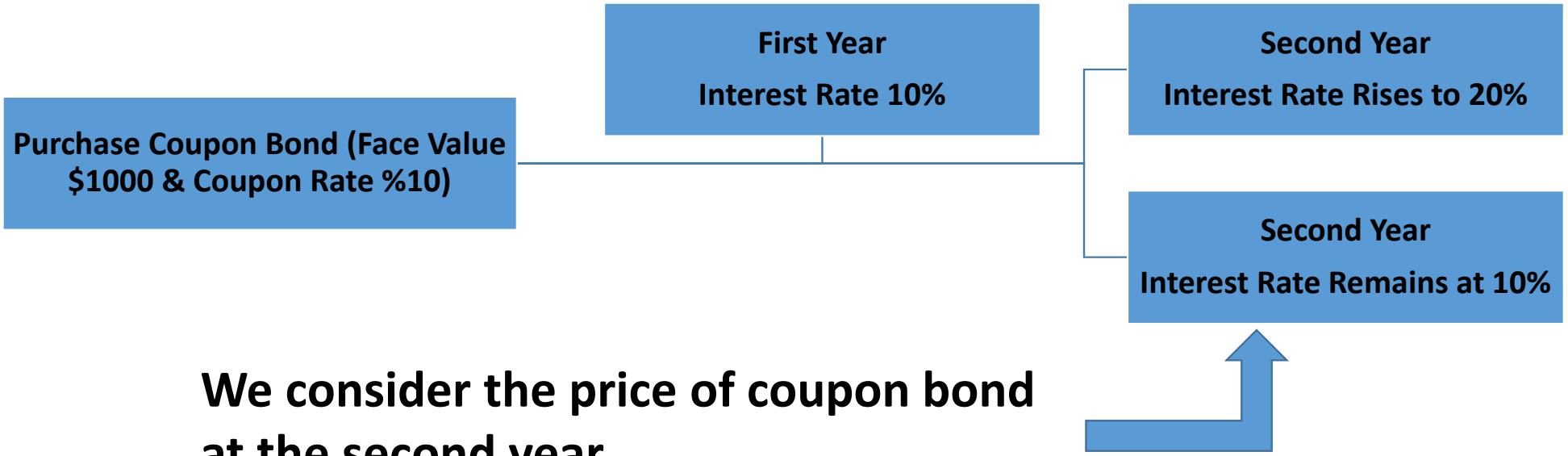
$$\text{Rate of Return} = R = \frac{C}{P_t} + \frac{P_{t+1} - P_t}{P_t}.$$

- Thus, Rate of Return = the Current Yield + the Rate of Capital Gain.
- Because

$$\text{Current Yield} = \frac{C}{P_t}.$$

$$\text{Rate of Capital Gain} = \frac{P_{t+1} - P_t}{P_t}.$$

Time Span



We consider the price of coupon bond at the second year.

Example: if interest rates rise to 20%

When year to maturity is 2 years,

$$P = \frac{\$100}{1+0.2} + \frac{\$1000}{(1+0.2)^1} = \$83.33333.. + \$833.333.. \approx \$916.666...$$

When year to maturity is 5 years,

$$P = \frac{\$100}{1+0.2} + \frac{\$100}{(1+0.2)^2} + \frac{\$100}{(1+0.2)^3} + \frac{\$100}{(1+0.2)^4} + \frac{\$1000}{(1+0.2)^4}$$

$$= \$83.33 + \$69.44 + \$57.87 + \$48.23 + \$482.25$$

$$= \$741.12.$$

Example: if interest rates remain at 10%

When year to maturity is 2 years,

$$P = \frac{\$100}{1+0.1} + \frac{\$1000}{(1+0.1)^1} = \$90.91 + \$909.09 \approx \$1000.$$

When year to maturity is 5 years,

$$P = \frac{\$100}{1+0.1} + \frac{\$100}{(1+0.1)^2} + \frac{\$100}{(1+0.1)^3} + \frac{\$100}{(1+0.1)^4} + \frac{\$1000}{(1+0.1)^4}$$

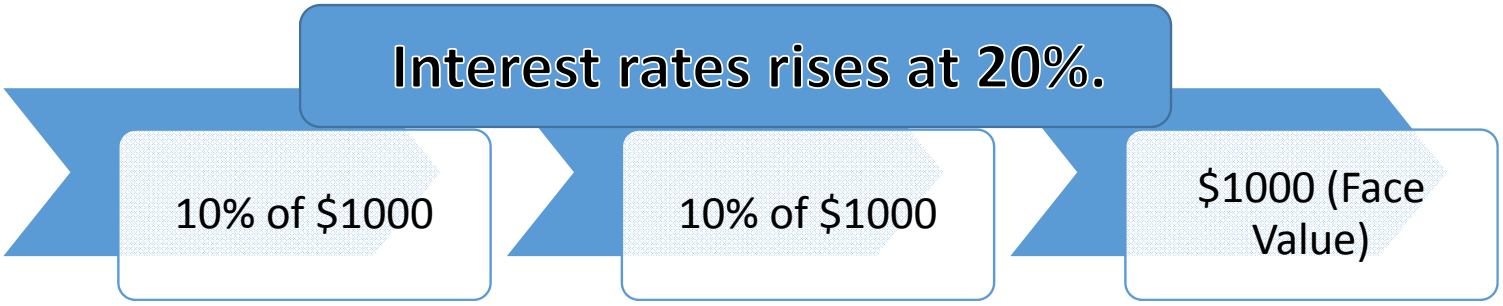
$$= \$90.91 + \$82.65 + \$75.14 + \$68.31 + \$683.09$$

$$= \$1000.$$

When initial current yield is 10%

Year to Maturity	Price at Year 2	Rate of Capital Gain	Rate of Return
2	$917	(917 – 1000)/1000 = – 0.083	10 – 8.3 = + 1.7%
5	$741	(741 – 1000)/1000 = – 0.259	10 – 25.9 = – 15.9%
10	$597	(597 – 1000)/1000 = – 0.403	10 – 40.3 = – 30.3%
20	$516	(516 – 1000)/1000 = – 0.484	10 – 48.4 = – 38.4%
30	$503	(503 – 1000)/1000 = – 0.497	10 – 49.7 = – 39.7%

Intuition for Interest-Rate Risk



Preview

- Today, we examine how the overall level of **nominal interest rates** is determined and **which factors** influence their behavior.

Learning Objectives

- Identify the factors that affect the demand for assets.
- Draw the demand and supply curves for the bond market, and identify the equilibrium interest rate.
- List and describe the factors that affect the equilibrium interest rate in the bond market.

Learning Objectives

- Describe the connection between the **bond market** and the **money market** through the **liquidity preference framework**.
- List and describe the factors that affect the **money market** and the **equilibrium interest rate**.
- Identify and illustrate the effects on the **interest rate of changes** in money growth over time.

Determinants of Asset Demand

- **Wealth**: the total resources owned by the individual, including all assets
- **Expected Return**: the return expected over the next period on one asset relative to alternative assets
- **Risk**: the degree of uncertainty associated with the return on one asset relative to alternative assets
- **Liquidity**: the ease and speed with which an asset can be turned into cash relative to alternative assets

Theory of Portfolio Choice

Holding all other factors constant:

1. The quantity demanded of an asset is **positively** related to wealth
2. The quantity demanded of an asset is **positively** related to its expected return relative to alternative assets
3. The quantity demanded of an asset is **negatively** related to the risk of its returns relative to alternative assets
4. The quantity demanded of an asset is **positively** related to its liquidity relative to alternative assets

Theory of Portfolio Choice

Variable	Change in Variable	Change in Quantity Demanded
Wealth		
Expected return relative to other assets		
Risk relative to other assets		
Liquidity relative to other assets		

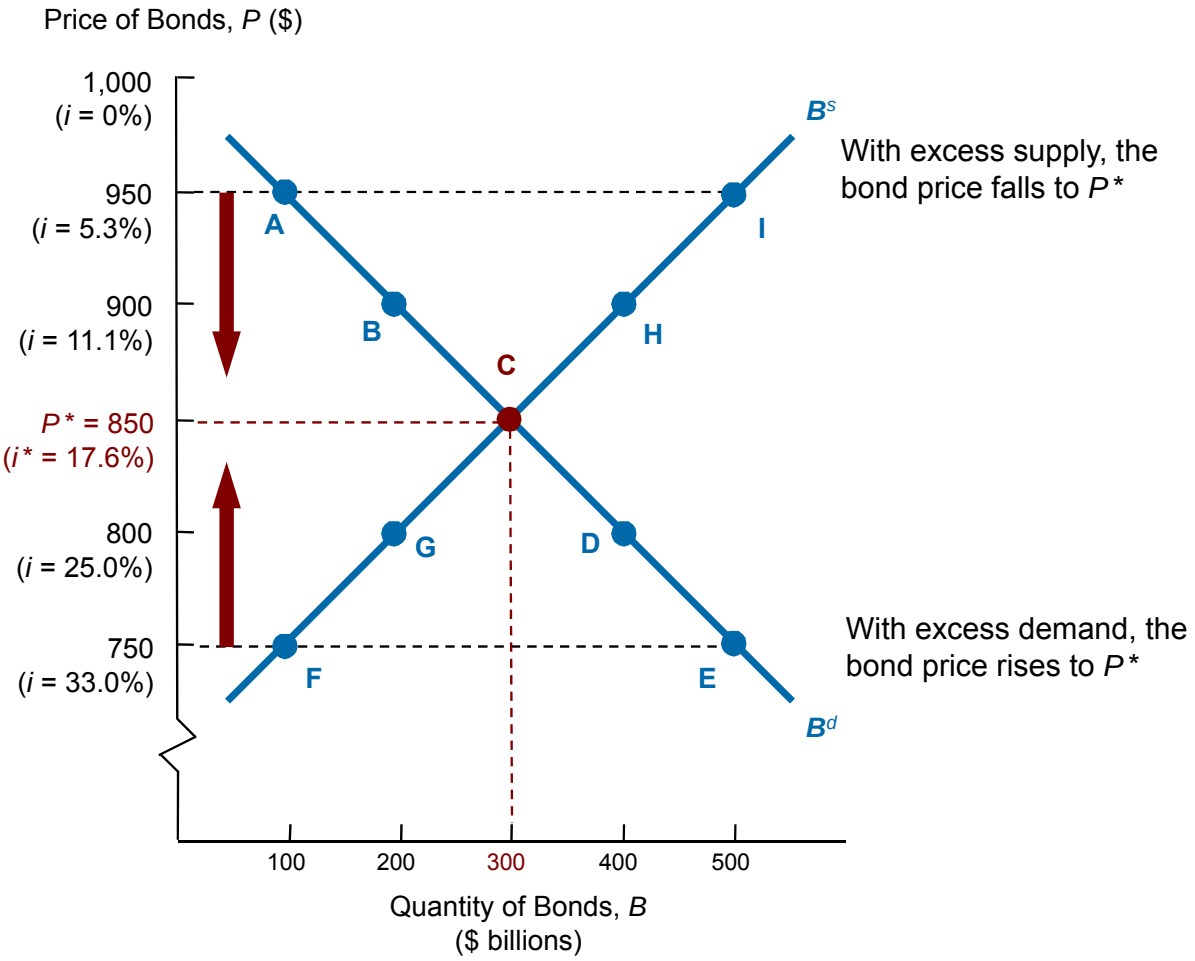
Supply and Demand in the Bond Market

- At lower prices (higher interest rates), ceteris paribus (other things equal), the quantity **demanded** of bonds is **higher**: an **inverse** relationship
- At lower prices (higher interest rates), ceteris paribus, the quantity **supplied** of bonds is **lower**: a **positive** relationship

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

Figure 1 Supply and Demand for Bonds

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



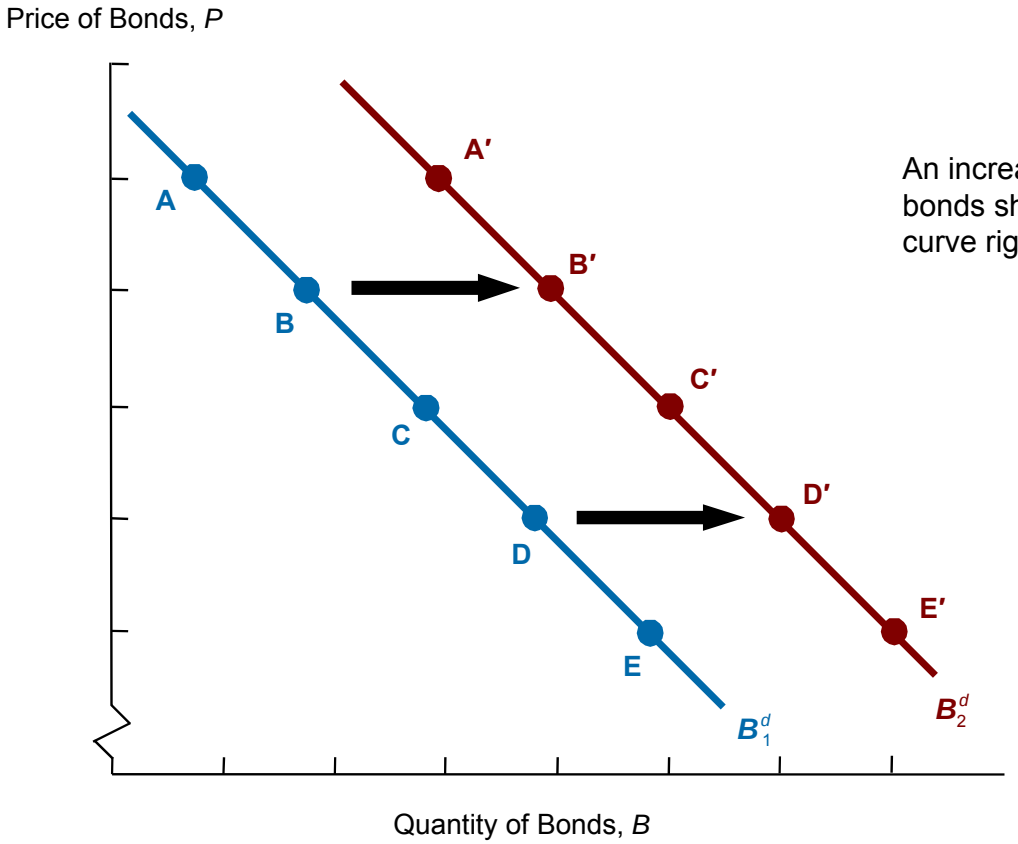
Market Equilibrium

- Occurs when the amount that people are willing to buy (**demand**) **equals** the amount that people are willing to sell (**supply**) at a given price
- $B^d = B^s$ defines the equilibrium (or market clearing) price and interest rate.
- When $B^d > B^s$, there is **excess demand**, price will rise and interest rate will fall.
- When $B^d < B^s$, there is **excess supply**, price will fall and interest rate will rise.

Changes in Equilibrium Interest Rates

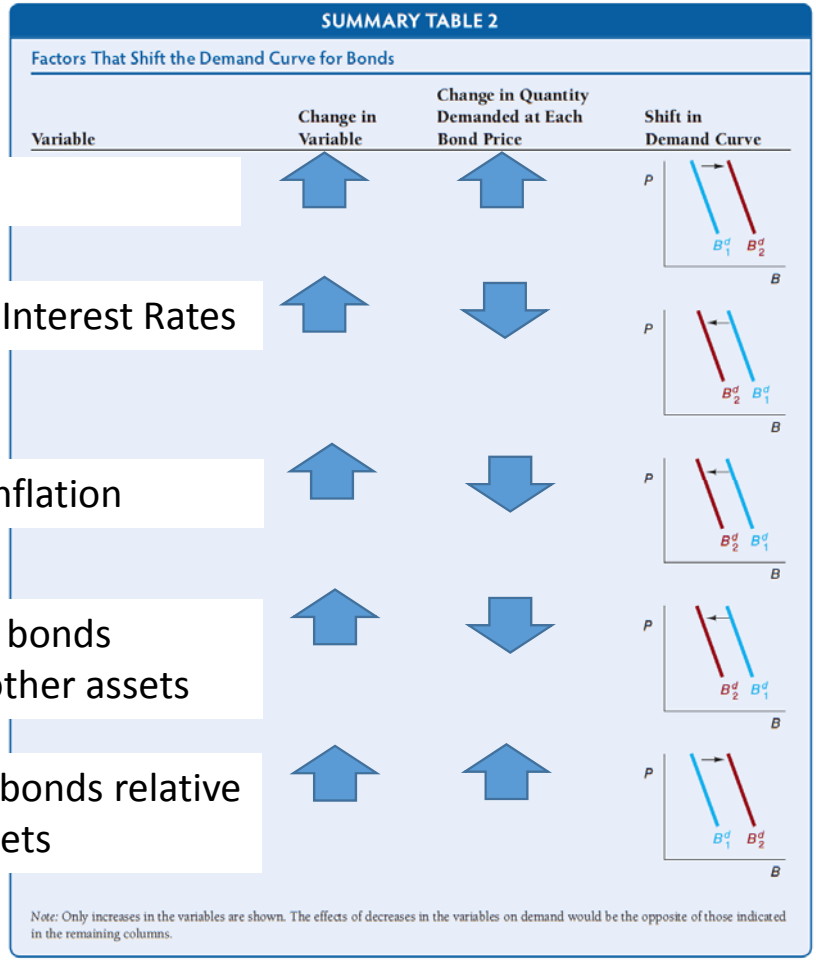
- Shifts in the demand for bonds:
  - Wealth: in an **expansion with growing wealth**, the demand curve for bonds shifts to the **right**
  - Expected Returns: **higher expected interest rates** in the future **lower** the expected return for long-term bonds, shifting the demand curve to the **left**
  - Expected Inflation: **an increase in the expected rate of inflations lowers** the expected return for bonds, causing the demand curve to shift to the **left**
  - Risk: **an increase in the riskiness of bonds** causes the demand curve to shift to the **left**
  - Liquidity: **increased liquidity of bonds** results in the demand curve shifting **right**

Figure 2 Shift in the Demand Curve for Bonds



An increase in the demand for bonds shifts the bond demand curve rightward.

Shifts in the Demand for Bonds



SUMMARY TABLE 2

Factors That Shift the Demand Curve for Bonds

Variable	Change in Variable	Change in Quantity Demanded at Each Bond Price	Shift in Demand Curve
Wealth	↑	↑	B_1^d → B_2^d (right)
Expected Interest Rates	↑	↓	B_2^d → B_1^d (left)
Expected Inflation	↑	↓	B_2^d → B_1^d (left)
Riskiness of bonds relative to other assets	↑	↓	B_2^d → B_1^d (left)
Liquidity of bonds relative to other assets	↑	↑	B_1^d → B_2^d (right)

Note: Only increases in the variables are shown. The effects of decreases in the variables on demand would be the opposite of those indicated in the remaining columns.

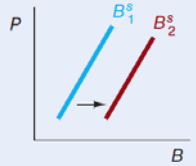
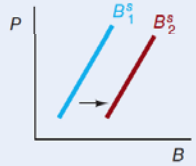
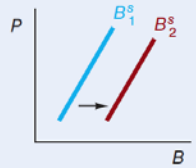
Shifts in the Supply of Bonds

- Shifts in the supply for bonds:
  - **Expected profitability of investment opportunities**: in an **expansion**, the supply curve shifts to the **right**
  - **Expected inflation**: **an increase in expected inflation** shifts the supply curve for bonds to the **right**
  - **Government budget**: **increased budget deficits** shift the supply curve to the **right**

Shifts in the Supply of Bonds

SUMMARY TABLE 3

Factors That Shift the Supply of Bonds

Variable	Change in Variable	Change in Quantity Supplied at Each Bond Price	Shift in Supply Curve
Profitability of investments	↑	↑	
Expected inflation	↑	↑	
Government deficit	↑	↑	

Note: Only increases in the variables are shown. The effects of decreases in the variables on the supply would be the opposite of those indicated in the remaining columns.

Figure 3 Shift in the Supply Curve for Bonds

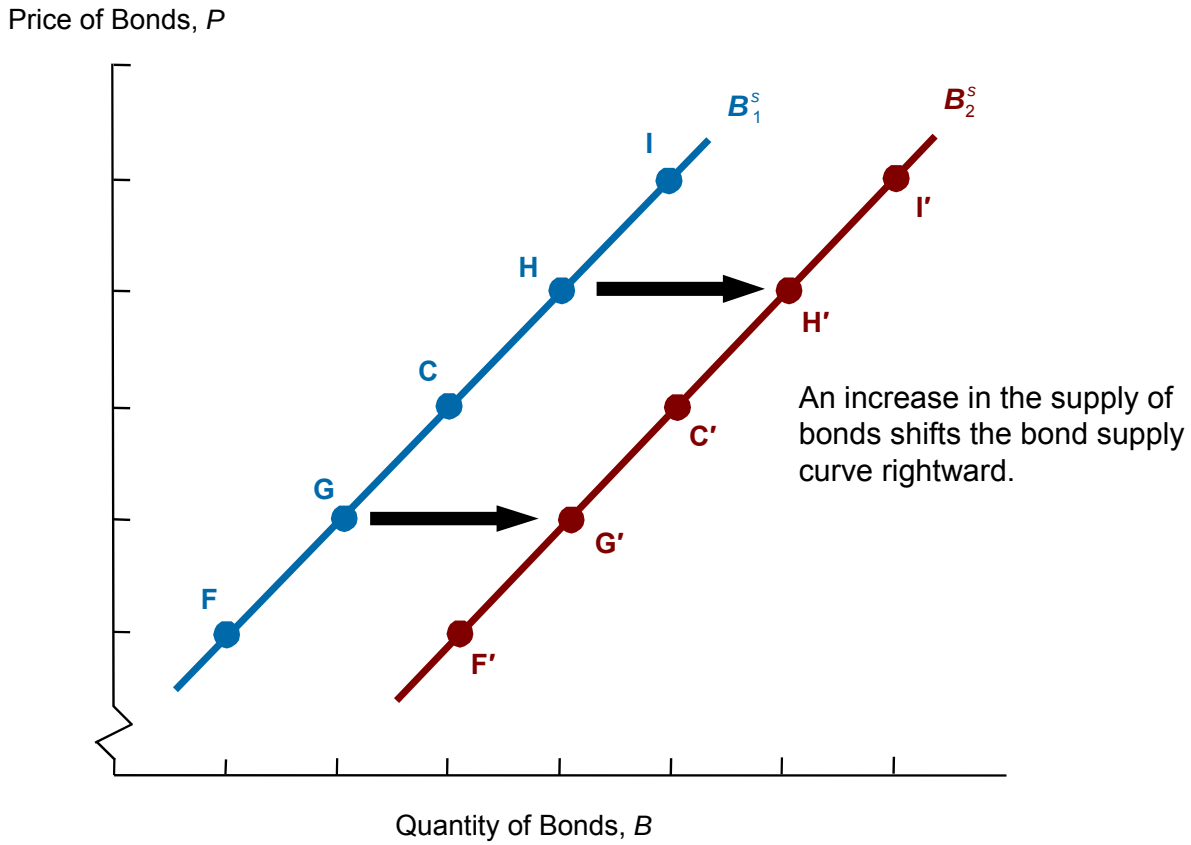
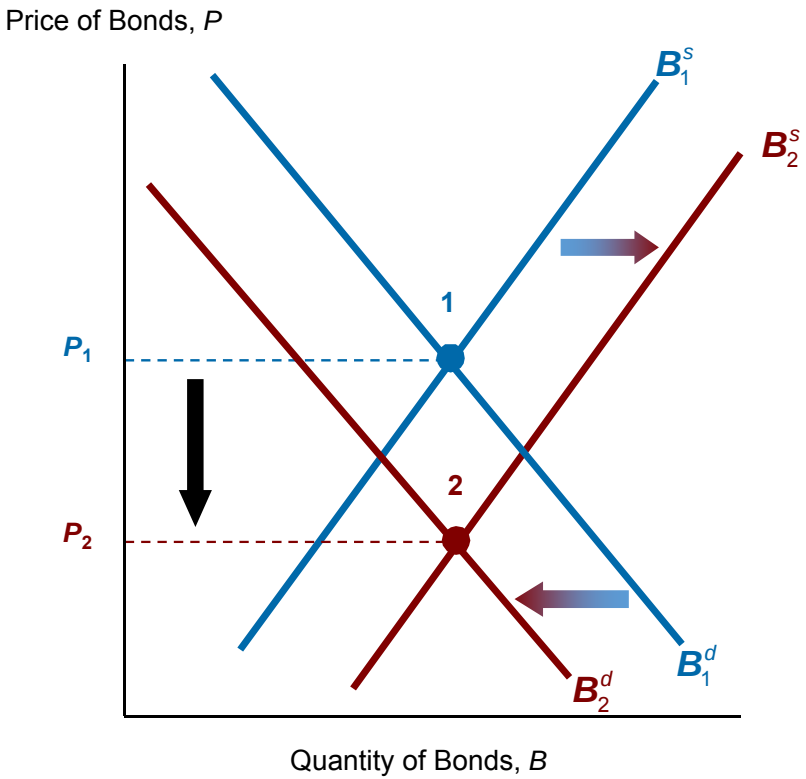


Figure 4 Response to a Change in Expected Inflation

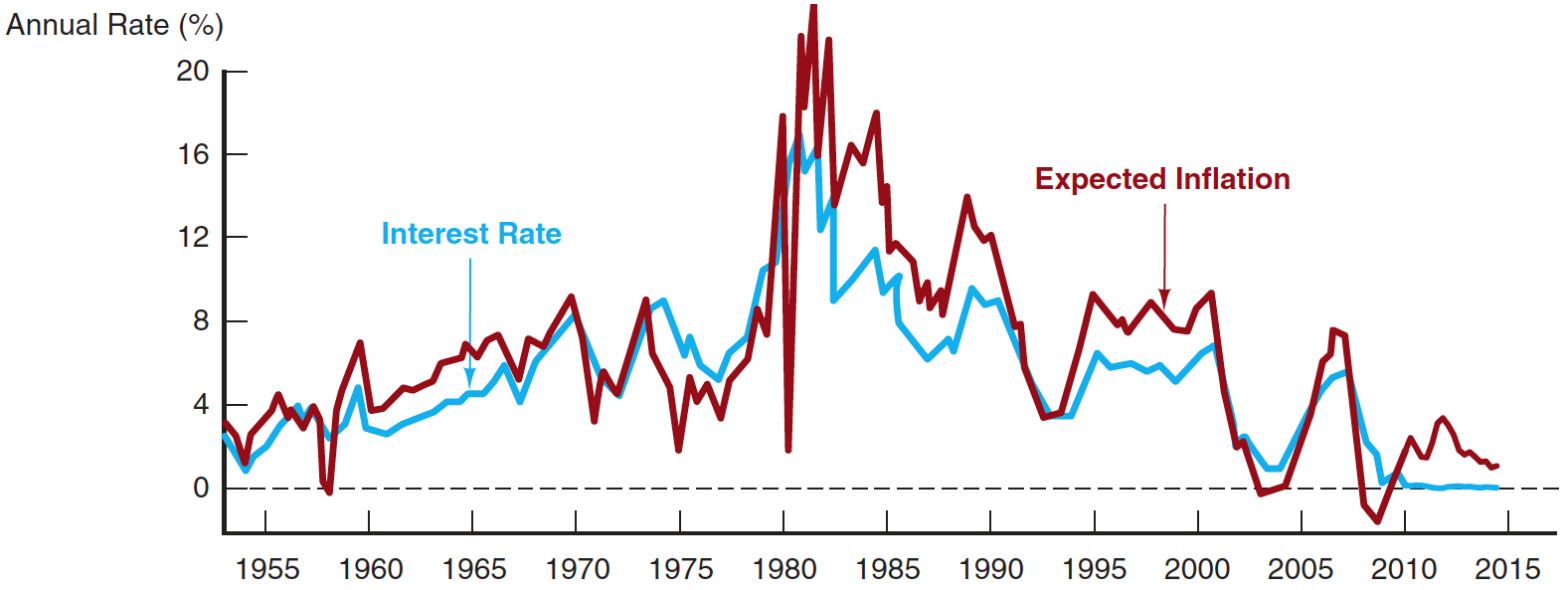


Step 1. A rise in expected inflation shifts the bond demand curve leftward . . .

Step 2. and shifts the bond supply curve rightward . . .

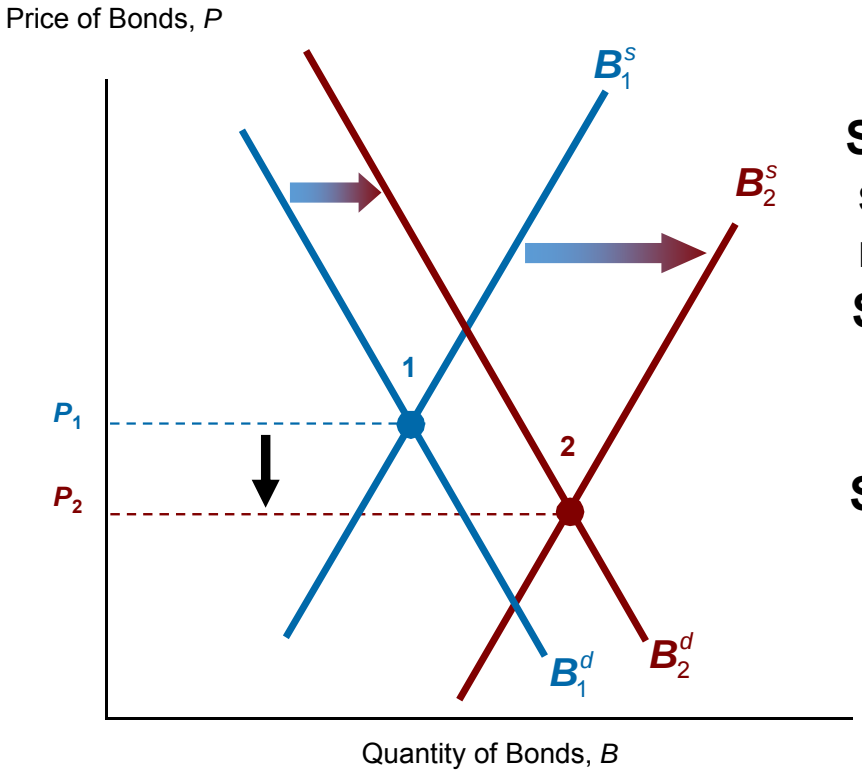
Step 3. causing the price of bonds to fall and the equilibrium interest rate to rise.

Figure 5 Expected Inflation and Interest Rates (Three-Month Treasury Bills), 1953–2014



Sources: Federal Reserve Bank of St. Louis FRE D database: http://research.stlouisfed.org/fred2. Expected inflation calculated using procedures outlined in Frederic S. Mishkin, "The Real Interest Rate: An Empirical Investigation," Carnegie-Rochester Conference Series on Public Policy 15 (1981): 151–200. These procedures involve estimating expected inflation as a function of past interest rates, inflation, and time trends.

Figure 6 Response to a Business Cycle Expansion

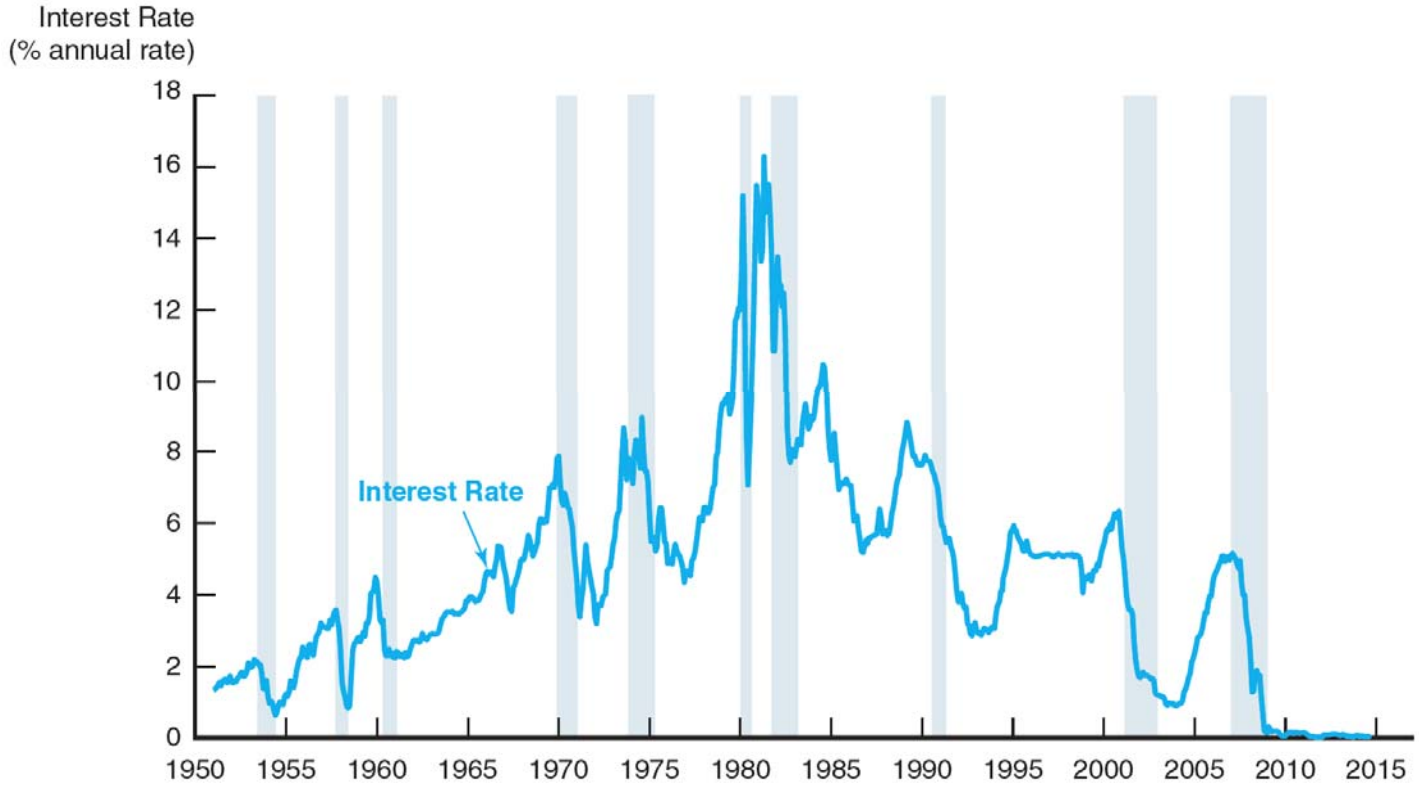


Step 1. A business cycle expansion shifts the bond supply curve rightward . . .

Step 2. and shifts the bond demand curve rightward, but by a lesser amount . . .

Step 3. so the price of bonds falls and the equilibrium interest rate rises.

Figure 7 Business Cycle and Interest Rates (Three-Month Treasury Bills), 1951–2014



Source: Federal Reserve Bank of St. Louis FRE D database: http://research.stlouisfed.org/fred2

Supply and Demand in the Market for Money: The Liquidity Preference Framework

Keynesian model that determines the equilibrium interest rate in terms of the supply of and demand for money.

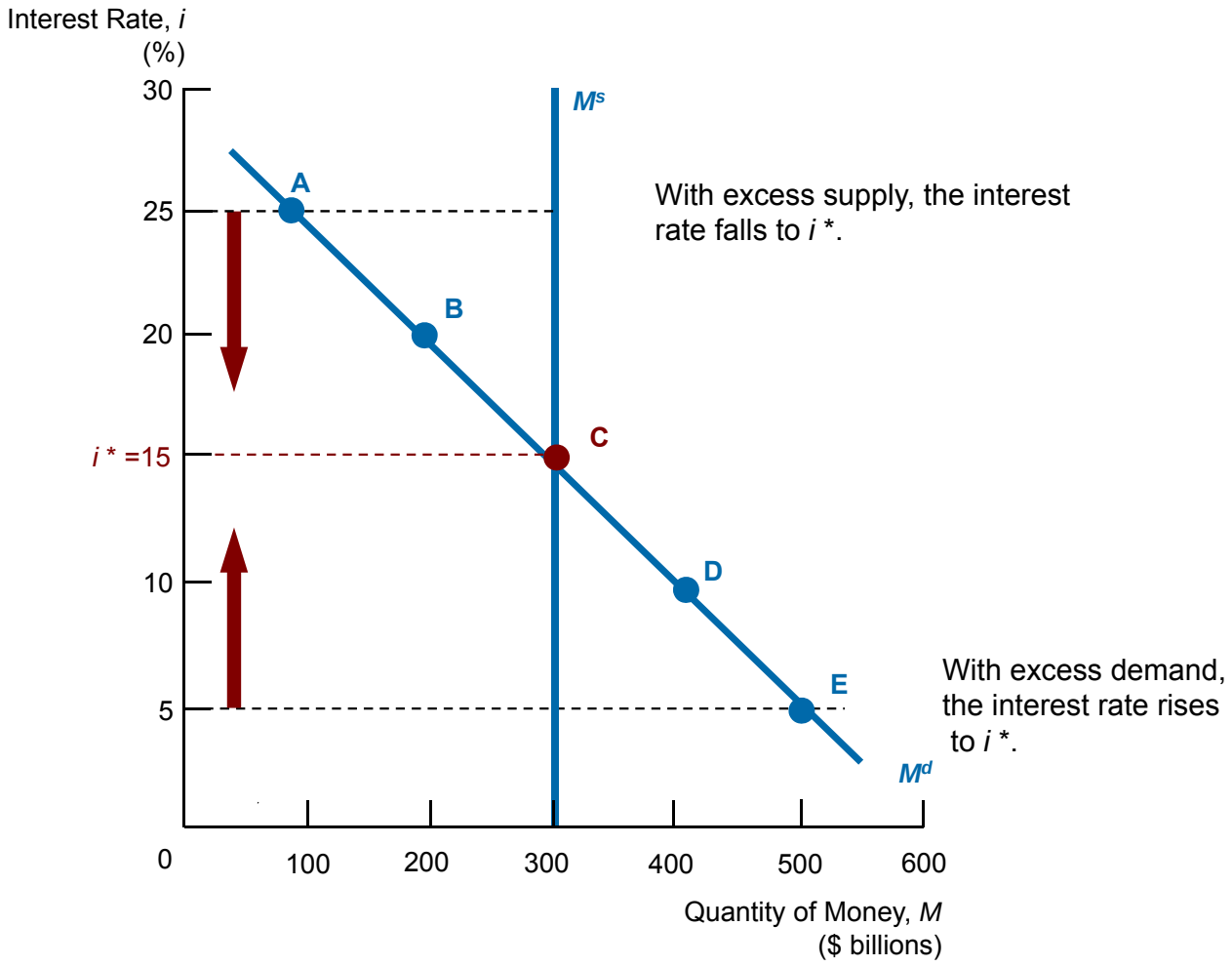
There are two main categories of assets that people use to store their wealth: money and bonds.

Total wealth in the economy = $B^s + M^s = B^d + M^d$

Rearranging: $B^s - B^d = M^d - M^s$

If the market for money is in equilibrium ($M^s = M^d$), then the bond market is also in equilibrium ($B^s = B^d$).

Figure 8 Equilibrium in the Market for Money



Supply and Demand in the Market for Money: The Liquidity Preference Framework

- Demand for money in the liquidity preference framework:
  - As the interest rate increases:
    - The opportunity **cost** of holding money **increases**…
    - The **relative expected return** of money **decreases**…
  - …and therefore the quantity demanded of money **decreases**.

Changes in Equilibrium Interest Rates in the Liquidity Preference Framework

- Shifts in the demand for money:
  - **Income Effect**: a higher level of income causes the demand for money at each interest rate to increase and the demand curve to shift to the right
  - **Price-Level Effect**: a rise in the price level causes the demand for money at each interest rate to increase and the demand curve to shift to the right

Changes in Equilibrium Interest Rates in the Liquidity Preference Framework

- Shifts in the supply of money:
  - Assume that the supply of money is controlled by the central bank.
  - An increase in the money supply engineered by the Federal Reserve will shift the supply curve for money to the right.

Changes in Equilibrium Interest Rates in the Liquidity Preference Framework

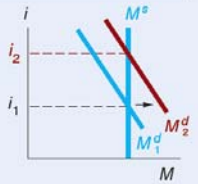
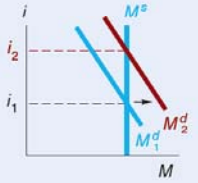
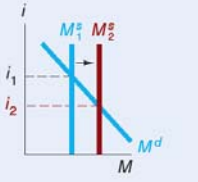
Income

Price level

Money Supply

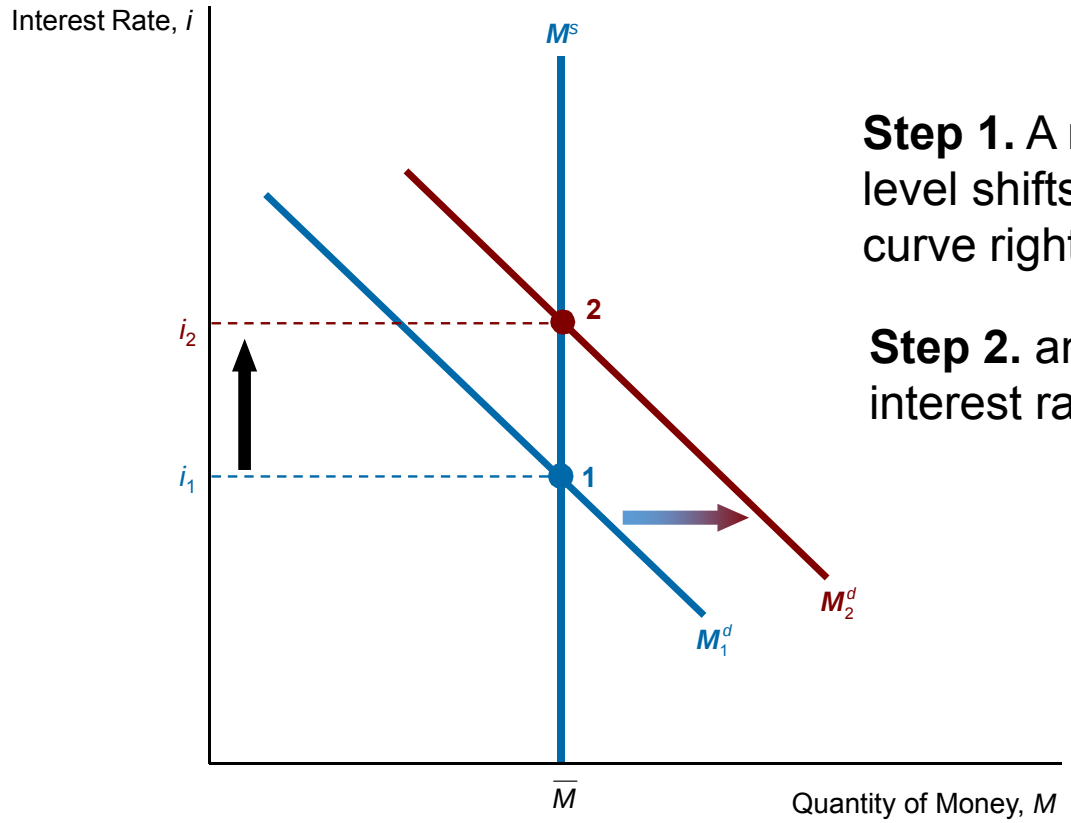
SUMMARY TABLE 4

Factors That Shift the Demand for and Supply of Money

Variable	Change in Variable	Change in Money Demand (M^d) or Supply (M^s) at Each Interest Rate	Change in Interest Rate	
Income	↑	M^d ↑	↑	
Price level	↑	M^d ↑	↑	
Money Supply	↑	M^s ↑	↓	

Note: Only increases in the variables are shown. The effects of decreases in the variables on demand and supply would be the opposite of those indicated in the remaining columns.

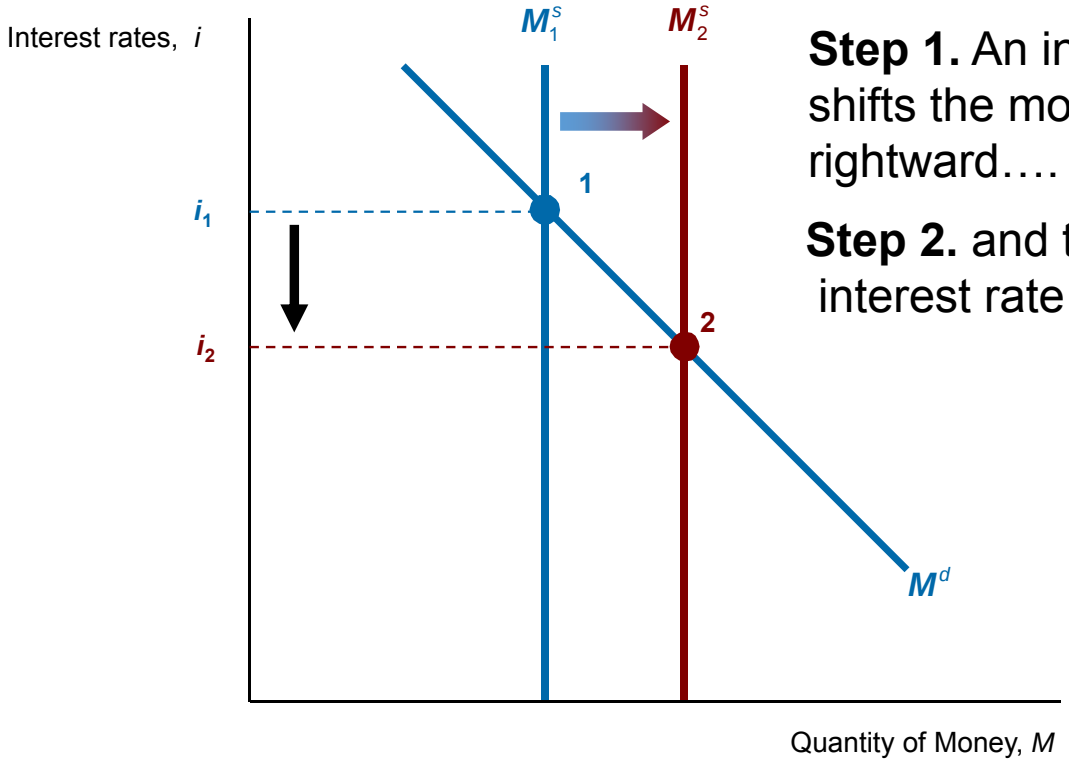
Figure 9 Response to a Change in Income or the Price Level



Step 1. A rise in income or the price level shifts the money demand curve rightward . . .

Step 2. and the equilibrium interest rate rises.

Figure 10 Response to a Change in the Money Supply



Step 1. An increases in the money supply shifts the money supply curve rightward….

Step 2. and the equilibrium interest rate falls.

Money and Interest Rates

- A one time **increase** in the **money supply** will cause **prices** to **rise** to a permanently **higher** level by the end of the year. The interest rate will **rise** via the **increased prices**.
- **Price-level effect** remains **even** after prices have stopped **rising**.
- A **rising price level** will **raise interest rates** because people will expect **inflation** to be **higher** over the course of the year. When the price level stops **rising**, **expectations of inflation** will return to **zero**.
- **Expected-inflation effect** persists only as long as the price level continues to **rise**.

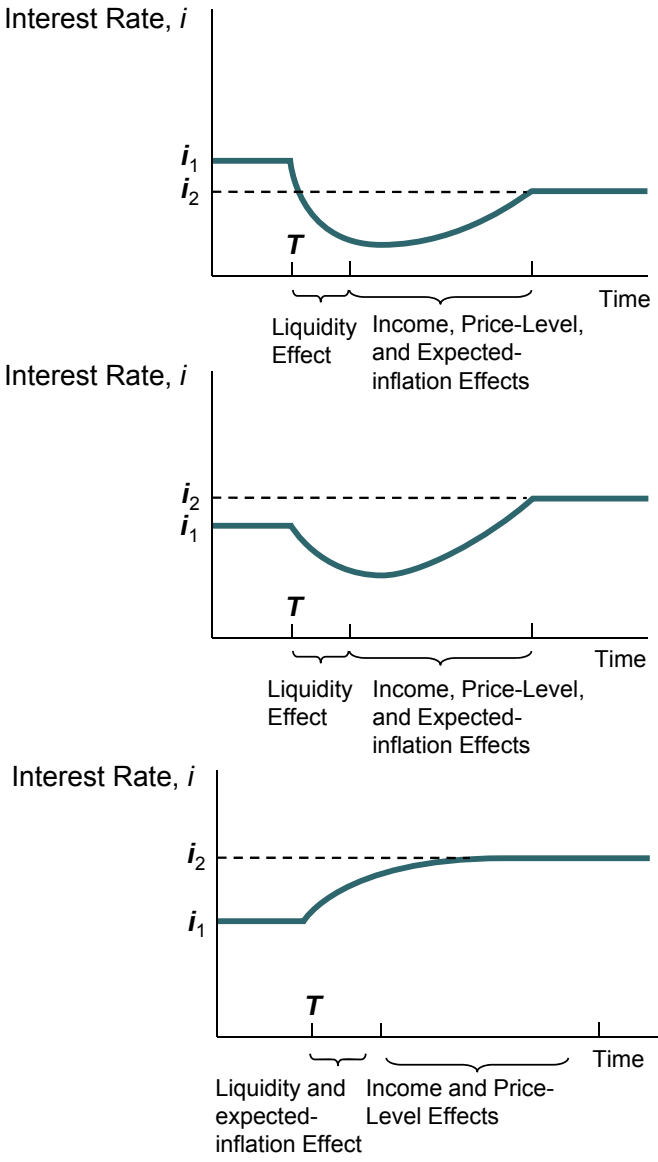
Does a Higher Rate of Growth of the Money Supply Lower Interest Rates?

- **The liquidity effect**: Liquidity preference framework leads to the conclusion that an **increase** in the **money supply** will **lower** interest rates.
- **The income effect**: Interest rates **rise** because increasing the money supply is an **expansionary** influence on the economy (the demand curve shifts to the right).

Does a Higher Rate of Growth of the Money Supply Lower Interest Rates?

- Price-Level effect predicts an increase in the money supply leads to a **rise** in interest rates in response to the **rise** in the price level (the demand curve shifts to the **right**).
- Expected-Inflation effect shows an **increase** in interest rates because an **increase** in the **money supply** may lead people to expect a **higher** price level in the future (the demand curve shifts to the right).

Figure 11
Response over Time to an Increase in Money Supply Growth

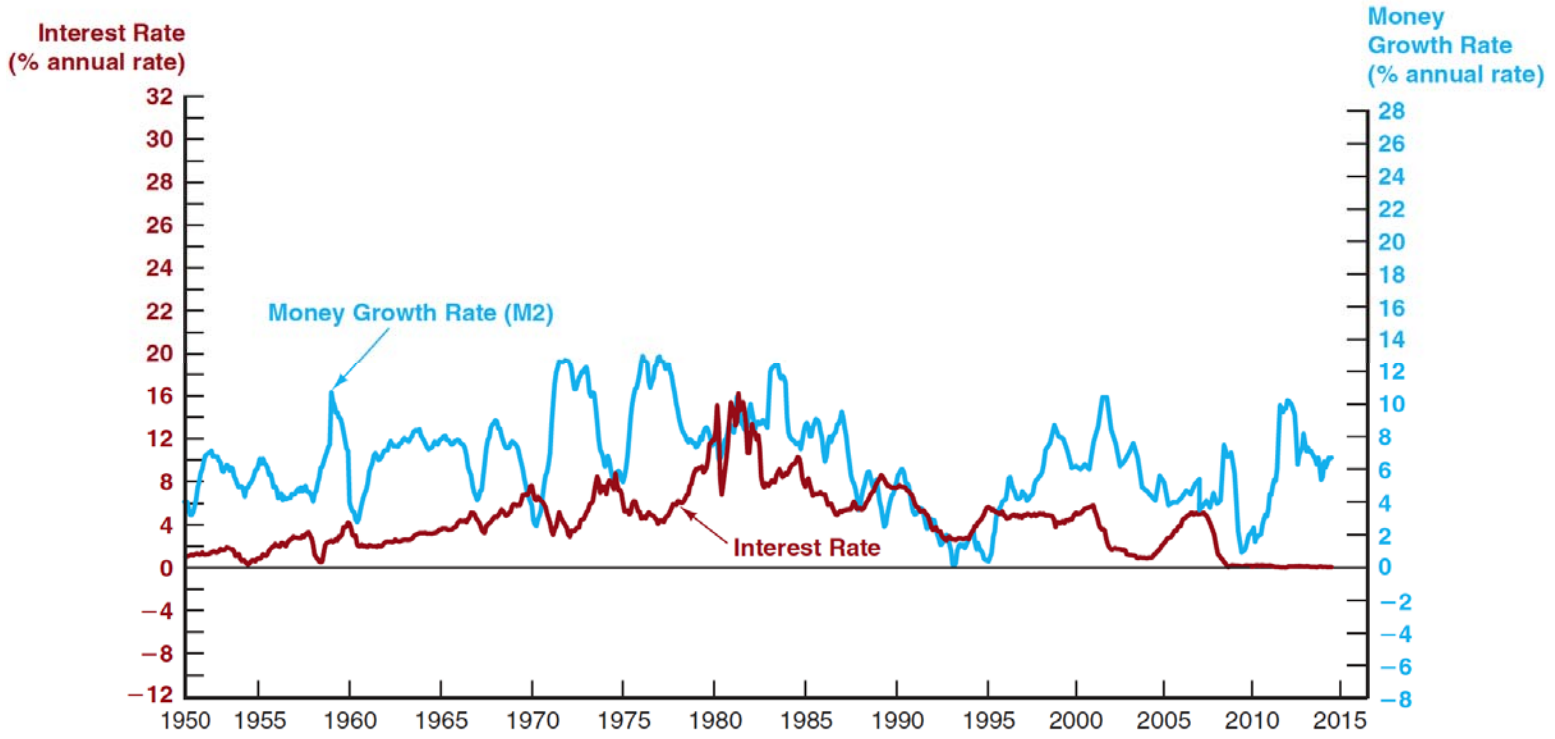


(a) Liquidity effect larger than other effects

(b) Liquidity effect smaller than other effects and slow adjustment of expected inflation

(c) Liquidity effect smaller than expected-inflation effect and fast adjustment of expected inflation

Figure 12 Money Growth (M2, Annual Rate) and Interest Rates (Three-Month Treasury Bills), 1950–2014



Source: Federal Reserve Bank of St. Louis FRE D database: http://research.stlouisfed.org/fred2