



# Lecture 3



The Behavior of Interest Rates

# The behavior of interest rates

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- ▶ Key question for this chapter?

**What determine interest rate level and behavior?**

- ▶ How to answer?
    1. Find equilibrium interest rate using demand and supply for **bond** → **theory of portfolio choice**
    2. Find equilibrium interest rate using demand and supply for **money** → **liquidity preference framework**
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I.

# **Theory of portfolio choice**



# Theory of portfolio choice:

- ▶ **Theory tell us how much asset people want to hold in their portfolio, holding other factors constant.**
- ▶ Factors for deciding to buy/not to buy asset and choice of asset are
  1. **Wealth**: resource owned
  2. **Expected return** (relative to another asset)
  3. **Risk** (relative to another asset): degree of uncertainty associated with return
  4. **Liquidity** (relative to another asset): ease and speed with which asset turn into cash. For instance, house is not liquid (subject to brokerage fees), US T-bill is highly liquid (sold quickly at low cost in an organized market with many buyers and sellers)

# Determinants of Asset Demand

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**SUMMARY** Table 1 Response of the Quantity of an Asset Demanded to Changes in Wealth, Expected Returns, Risk, and Liquidity

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	↑	↑

*Note:* Only increases in the variables are shown. The effect of decreases in the variables on the change in demand would be the opposite of those indicated in the rightmost column.



# Examples:

▶ **Relative expected return on bond A** ↑ → **demand for bond A** ↑

-Case 1: Expected return on bond A ↑, while expected return on bond B is unchanged.

-Case 2: Expected return on bond A is unchanged, while expected return on bond B ↓.

▶ **Risk on stock A** ↑ → **demand for stock A** ↓

-Case 1: stock A has return 15% half the time and 5% half the time. Hence, expected return = 10%

-Case 2: stock B has return 10% all the time. Hence, return of 10% is a sure thing. Risk averse person prefer B

# Derivation of Bond Demand Curve

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$$i = RET^e = \frac{(F - P)}{P}$$

**Point A:**

$$P = \$950$$

$$i = \frac{(\$1000 - \$950)}{\$950} = 0.053 = 5.3\%$$

$$B^d = \$100 \text{ billion}$$



# Derivation of Bond Demand Curve

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**Point B:**

$$P = \$900$$

$$i = \frac{(\$1000 - \$900)}{\$900} = 0.111 = 11.1\%$$

$$B^d = \$200 \text{ billion}$$

**Point C:**  $P = \$850, i = 17.6\% B^d = \$300 \text{ billion}$

**Point D:**  $P = \$800, i = 25.0\% B^d = \$400 \text{ billion}$

**Point E:**  $P = \$750, i = 33.0\% B^d = \$500 \text{ billion}$

**Demand Curve is  $B^d$  in Figure 1 which connects points A, B, C, D, E.**

**Has usual downward slope**



# Derivation of Bond Supply Curve

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**Point F:**  $P = \$750, i = 33.0\%, B^S = \$100$  billion

**Point G:**  $P = \$800, i = 25.0\%, B^S = \$200$  billion

**Point C:**  $P = \$850, i = 17.6\%, B^S = \$300$  billion

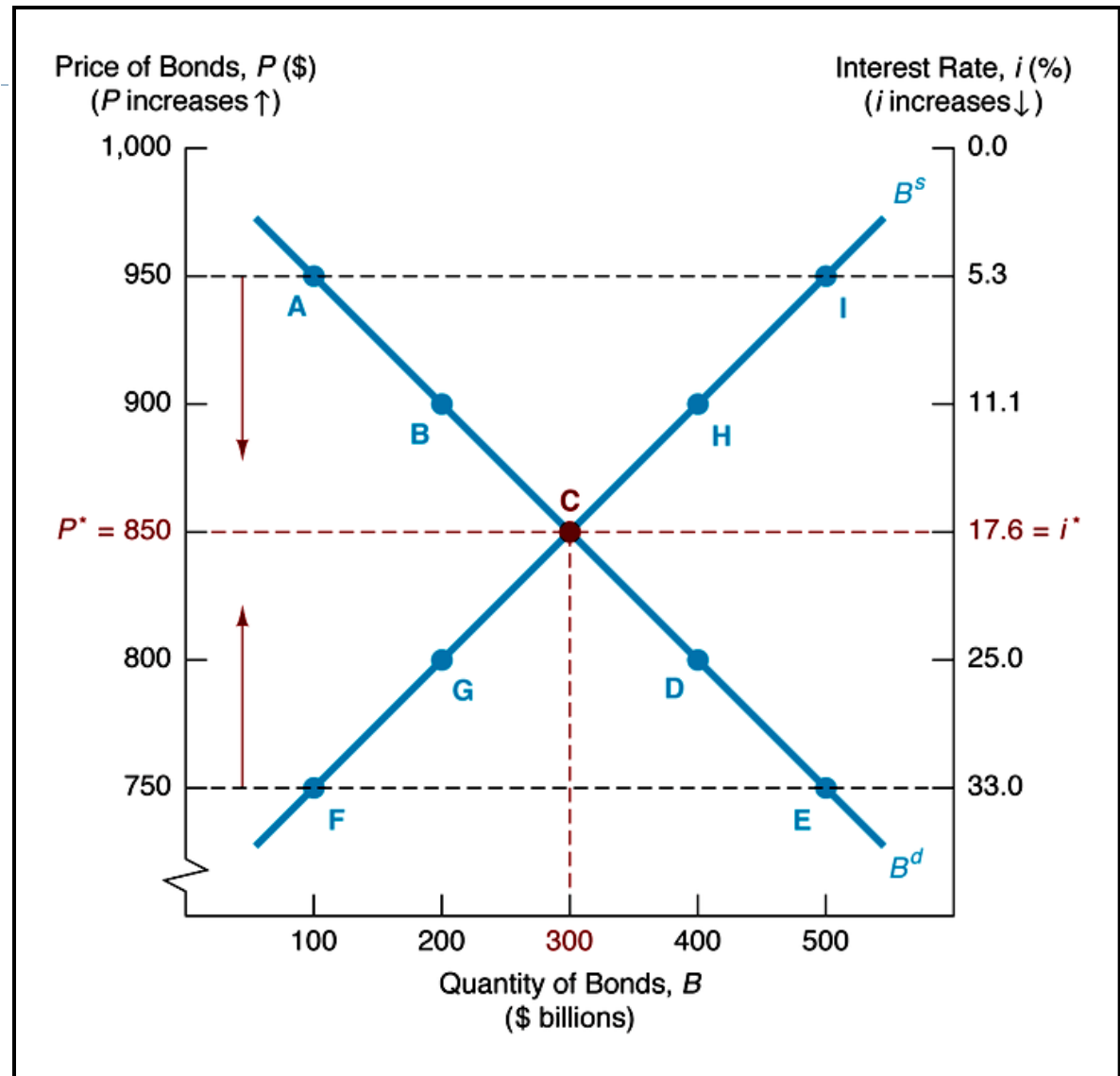
**Point H:**  $P = \$900, i = 11.1\%, B^S = \$400$  billion

**Point I:**  $P = \$950, i = 5.3\%, B^S = \$500$  billion

**Supply Curve is  $B^S$  that connects points F, G, C, H, I, and has upward slope**



# Supply and Demand Analysis of the Bond Market

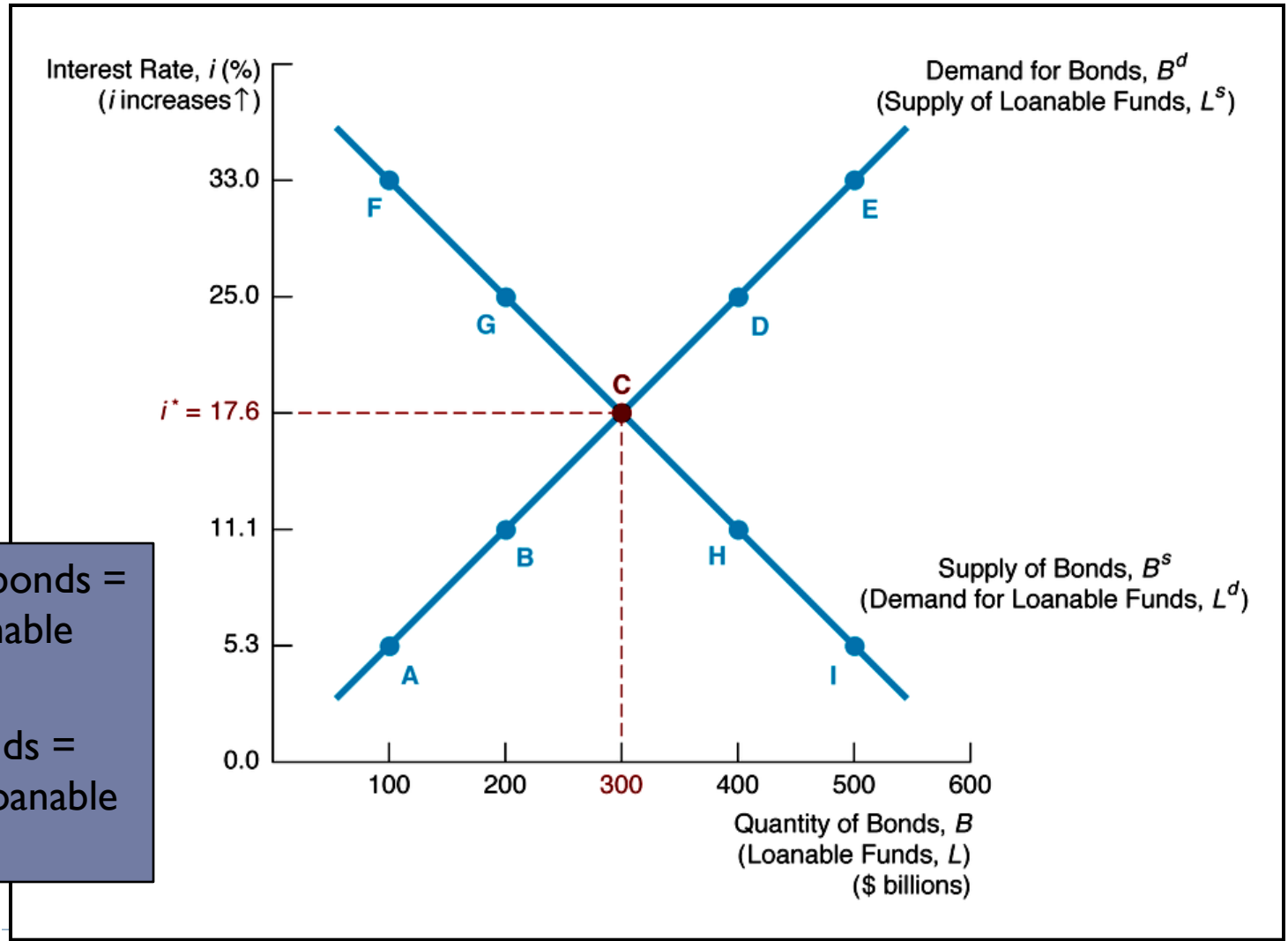


## Market Equilibrium

1. Occurs when  $B^d = B^s$ , at  $P^* = \$850$ ,  $i^* = 17.6\%$
2. When  $P = \$950$ ,  $i = 5.3\%$ ,  $B^s > B^d$  (excess supply):  $P \downarrow$  to  $P^*$ ,  $i \uparrow$  to  $i^*$
3. When  $P = \$750$ ,  $i = 33.0$ ,  $B^d > B^s$  (excess demand):  $P \uparrow$  to  $P^*$ ,  $i \downarrow$  to  $i^*$

# Loanable Funds Terminology

1. Demand for bonds = supply of loanable funds
2. Supply of bonds = demand for loanable funds



# Changes in equilibrium interest rates

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## Using the supply and demand for bond framework

- ▶ Movement along the D&S curve:

Occur when quantity D&S change as a result of a change in price of bond or interest rates.

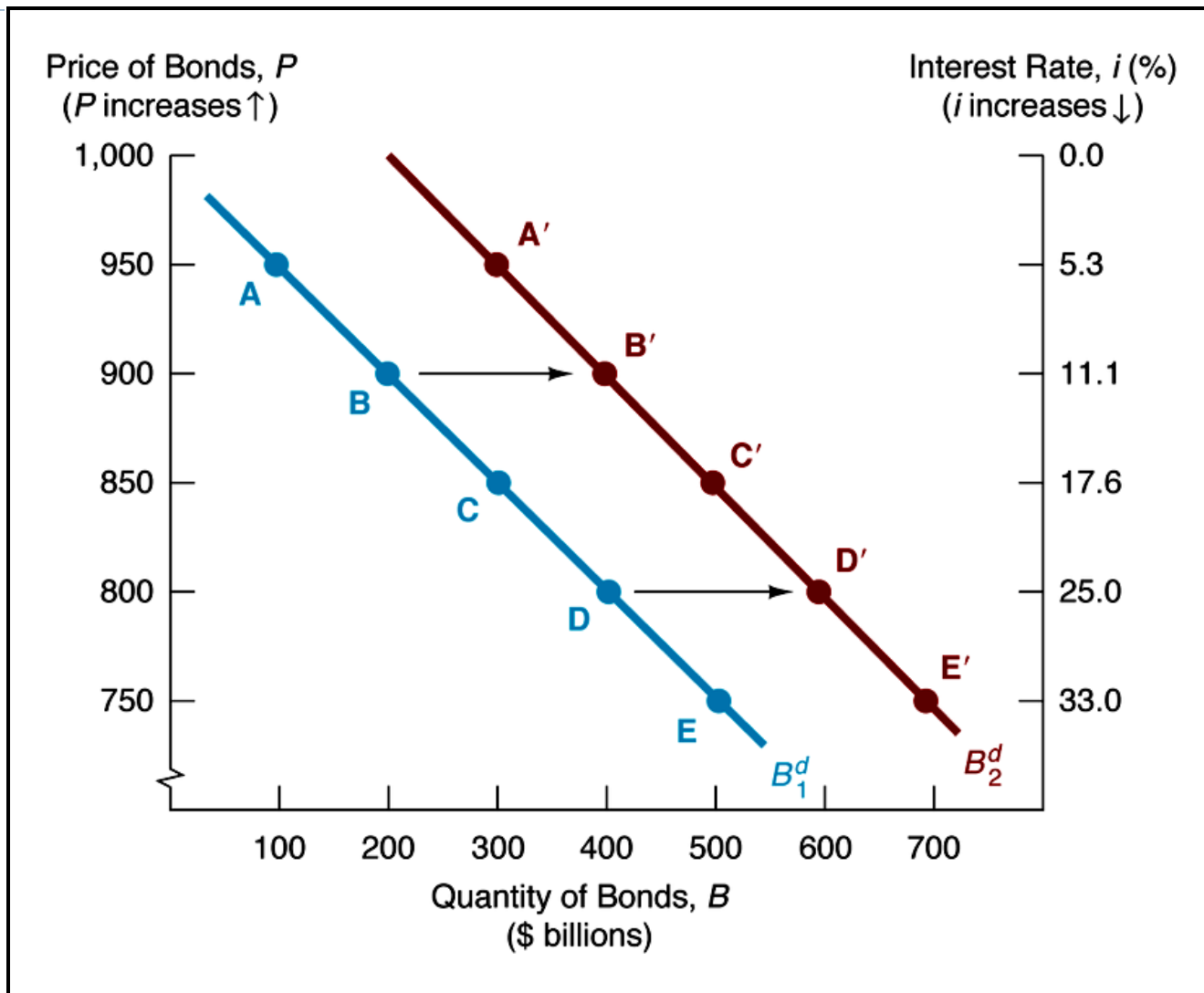
- ▶ Shift in the D&S curve:

Occur when quantity D&S change at each given price of bond or interest rates in response to change in other factors.

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# Shifts in the Bond Demand Curve



# Factors that Shift the Bond Demand Curve

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## 1. Wealth

- A. Economy grows, wealth  $\uparrow$ ,  $B^d \uparrow$ ,  $B^d$  shifts out to right

## 2. Expected Return

- A.  $i \downarrow$  in future,  $R^e$  for long-term bonds  $\uparrow$ ,  $B^d$  shifts out to right
- B.  $\pi^e \downarrow$ , Relative  $R^e \uparrow$ ,  $B^d$  shifts out to right
- C. Expected return of other assets  $\downarrow$ ,  $B^d \uparrow$ ,  $B^d$  shifts out to right

## 3. Risk

- A. Risk of bonds  $\downarrow$ ,  $B^d \uparrow$ ,  $B^d$  shifts out to right
- B. Risk of other assets  $\uparrow$ ,  $B^d \uparrow$ ,  $B^d$  shifts out to right

## 4. Liquidity

- A. Liquidity of Bonds  $\uparrow$ ,  $B^d \uparrow$ ,  $B^d$  shifts out to right
- B. Liquidity of other assets  $\downarrow$ ,  $B^d \uparrow$ ,  $B^d$  shifts out to right



# Factors that Shift Demand Curve for Bonds

Variable	Change in Variable	Change in Quantity Demanded	Shift in Demand Curve
Wealth	↑	↑	
Expected interest rate	↑	↓	
Expected inflation	↑	↓	
Riskiness of bonds relative to other assets	↑	↓	
Liquidity of bonds relative to other assets	↑	↑	

Note:  $P$  and  $i$  increase in opposite directions:  $P$  on the left vertical axis increases as we go up the axis, while  $i$  on the right vertical axis increases as we go down the axis. Only increases in the variables are shown. The effect of decreases in the variables on the change in demand would be the opposite of those indicated in the remaining columns.

# Shifts in the Bond Supply Curve

## I. Profitability of Investment Opportunities

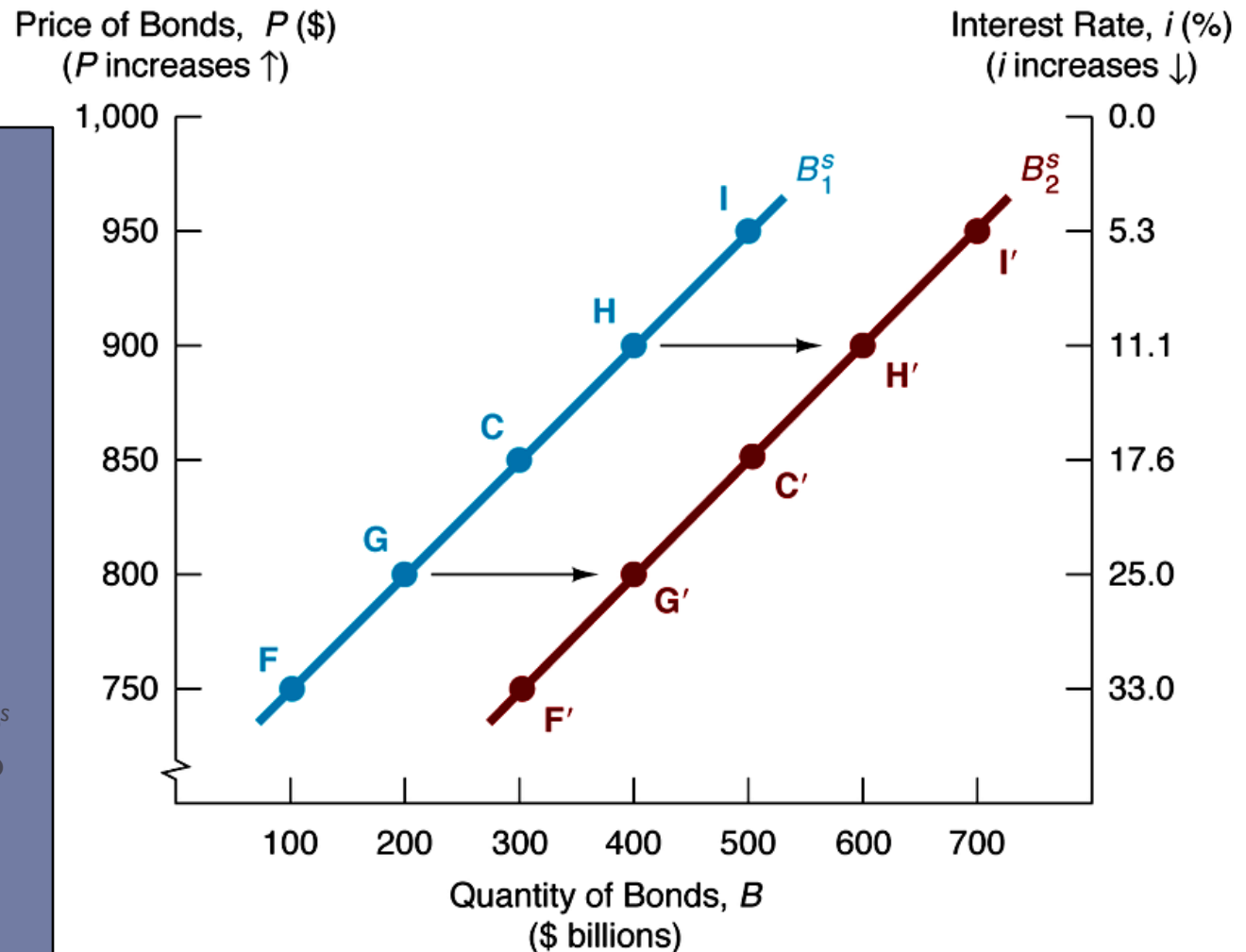
Business cycle expansion, investment opportunities  $\uparrow$ ,  $B^s \uparrow$ ,  $B^s$  shifts out to right

## 2. Expected Inflation

$\pi^e \uparrow$ , real cost of borrowing fall,  $B^s \uparrow$ ,  $B^s$  shifts out to right

## 3. Government Activities

Deficits  $\uparrow$ ,  $B^s \uparrow$ ,  $B^s$  shifts out to right



**SUMMARY** Table 3 Factors That Shift the Supply of Bonds

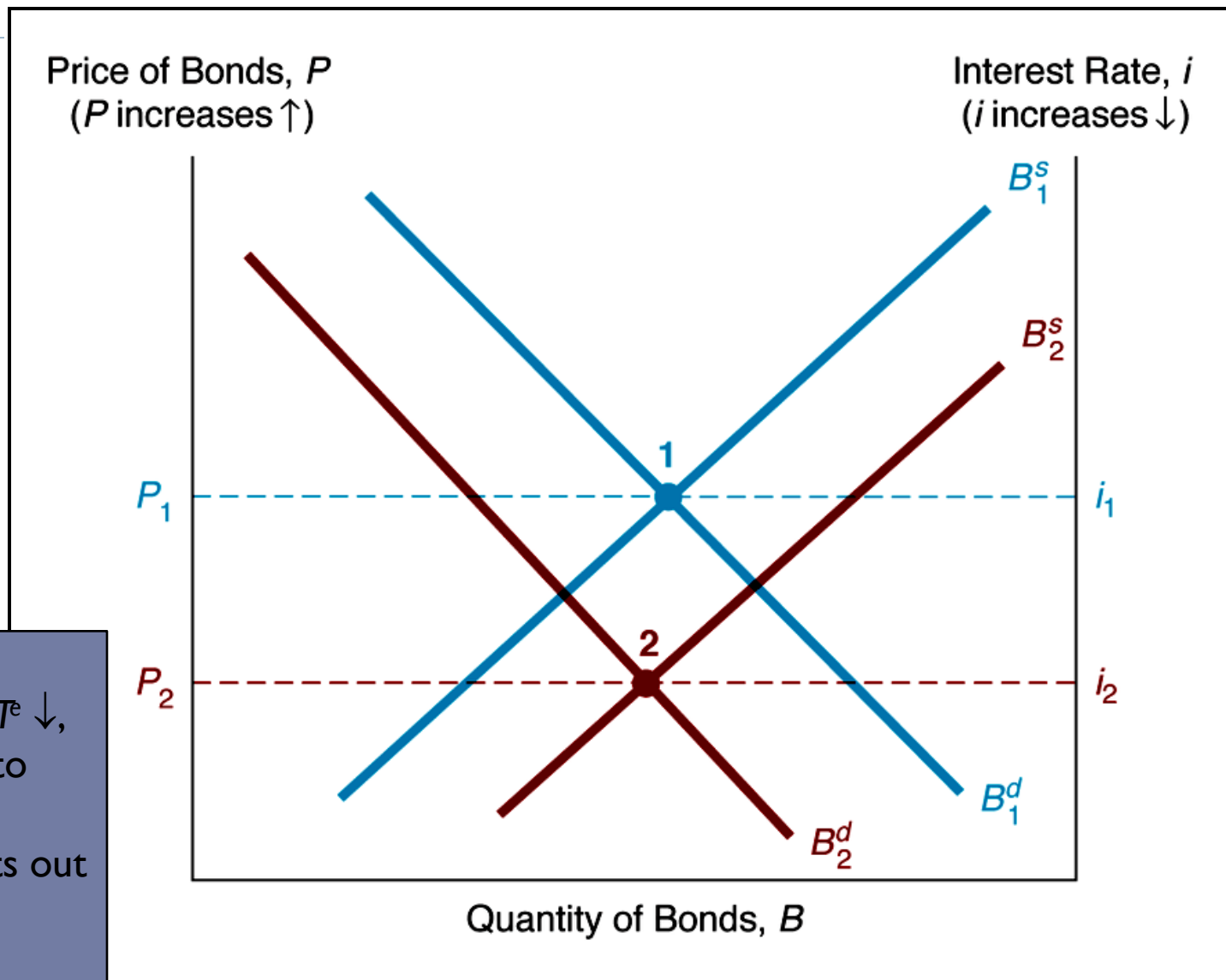
# Factors that Shift Supply Curve for Bonds

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

Note:  $P$  and  $i$  increase in opposite directions:  $P$  on the left vertical axis increases as we go up the axis, while  $i$  on the right vertical axis increases as we go down the axis. Only increases in the variables are shown. The effect of decreases in the variables on the change in supply would be the opposite of those indicated in the remaining columns.



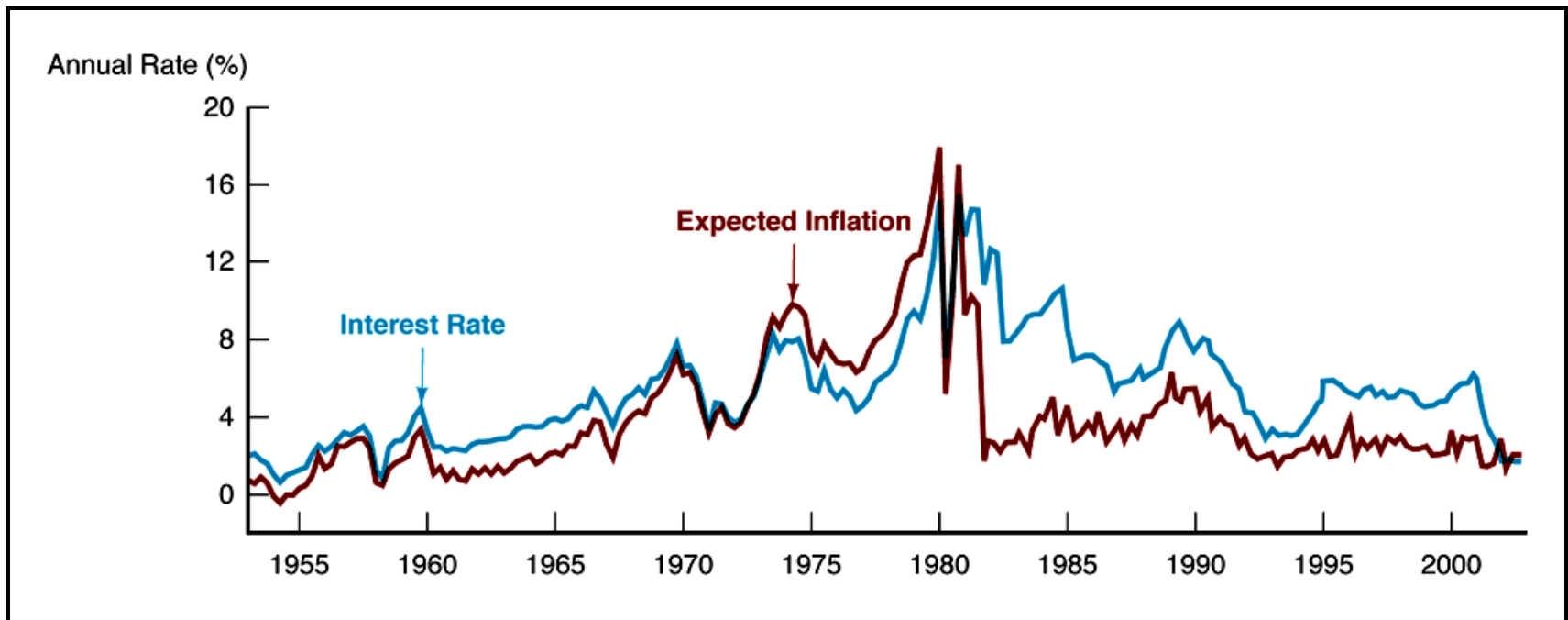
# Case 1: Changes in $\pi^e$ : the Fisher Effect



- If  $\pi^e \uparrow$
1. Relative  $RET^e \downarrow$ ,  $B^d$  shifts in to left
  2.  $B^s \uparrow$ ,  $B^s$  shifts out to right
  3.  $P \downarrow, i \uparrow$

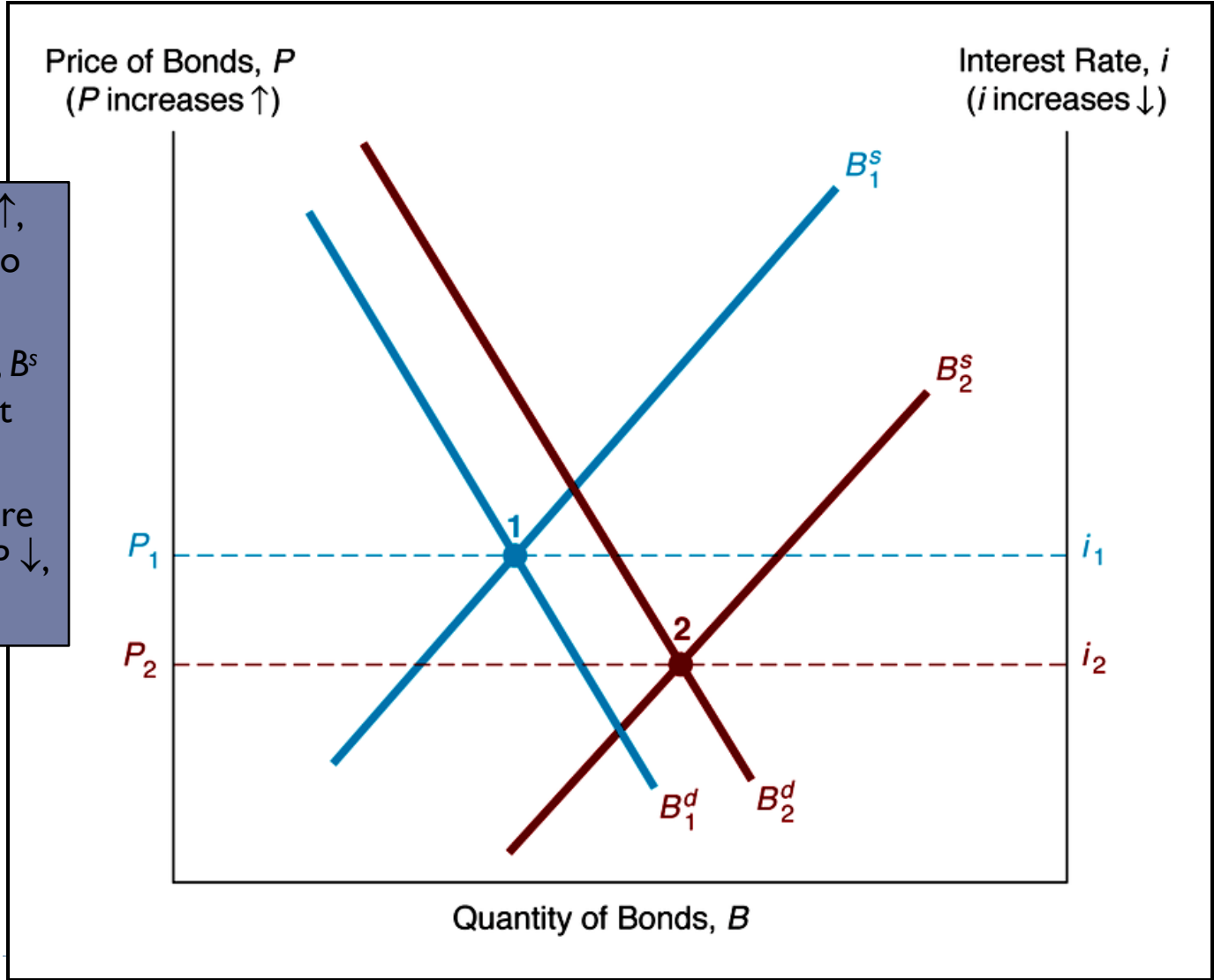
# Evidence on the Fisher Effect in the United States

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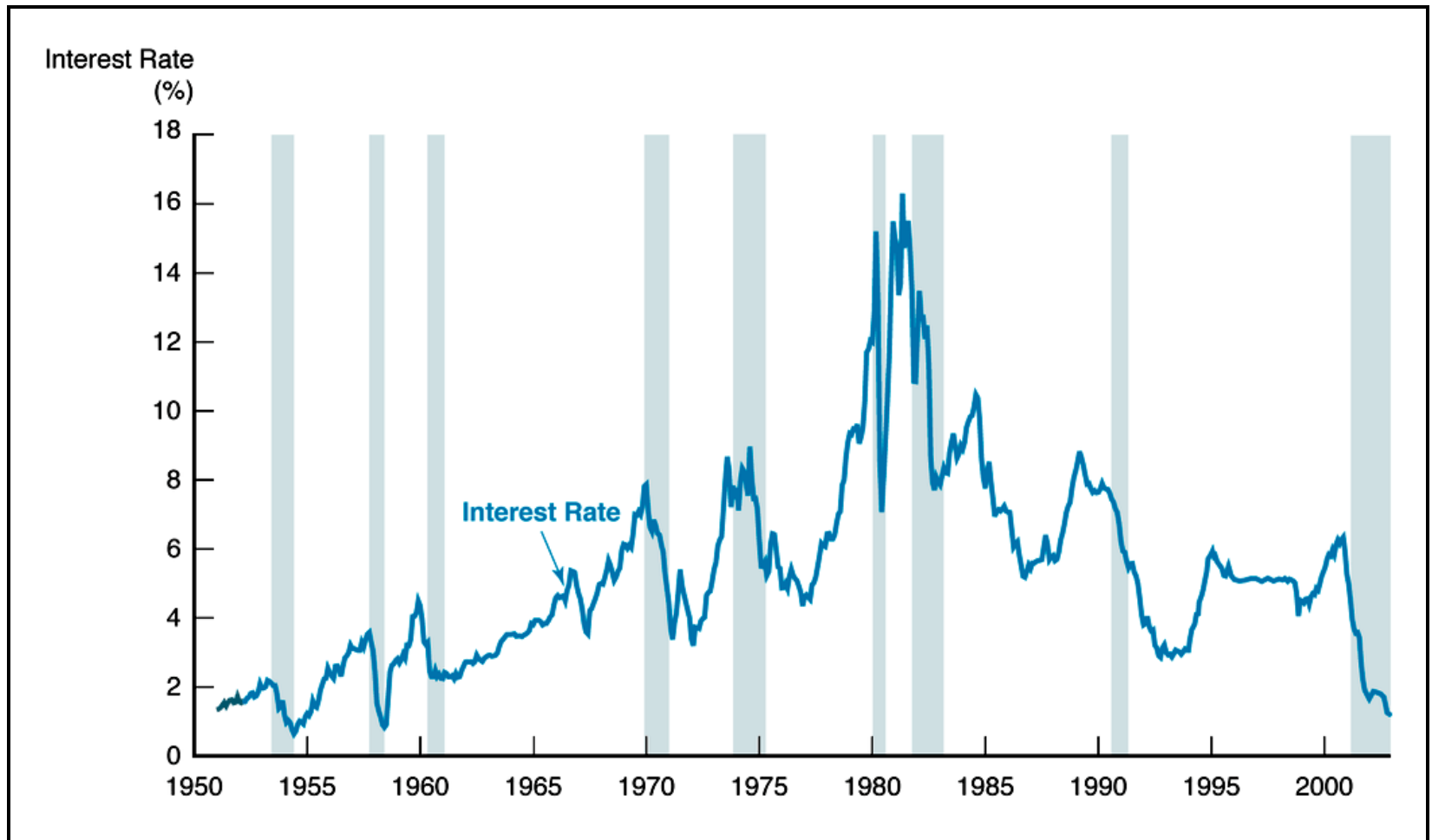
# Case 2: Business Cycle Expansion

- 1. Wealth  $\uparrow$ ,  $B^d \uparrow$ ,  $B^d$  shifts out to right
- 2. Investment  $\uparrow$ ,  $B^s \uparrow$ ,  $B^s$  shifts out to right
- 3. If  $B^s$  shifts more than  $B^d$  then  $P \downarrow$ ,  $i \uparrow$



# Evidence on Business Cycles and Interest Rates

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**II.**

# **Liquidity Preference Theory**



# Relation of Liquidity Preference Framework to Loanable Funds

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**Keynes's Major Assumption: determine equilibrium interest rates in term of S&D for money**

## Two Categories of Assets in Wealth

Money

Bonds

1. Thus:  $M^s + B^s = \text{Wealth}$
2. Budget Constraint:  $B^d + M^d = \text{Wealth}$
3. Therefore:  $M^s + B^s = B^d + M^d$
4. Subtracting  $M^d$  and  $B^s$  from both sides:  
$$M^s - M^d = B^d - B^s$$

## Money Market Equilibrium

5. Occurs when  $M^d = M^s$
6. Then  $M^d - M^s = 0$  which implies that  $B^d - B^s = 0$ , so that  $B^d = B^s$  and bond market is also in equilibrium



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1. Equating supply and demand for bonds as in loanable funds framework is equivalent to equating supply and demand for money as in liquidity preference framework
  2. Two frameworks are closely linked, but differ in practice because liquidity preference assumes only two assets, money and bonds, and ignores effects on interest rates from changes in expected returns on real assets



# Liquidity Preference Analysis

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## Derivation of Demand Curve

1. Keynes assumed money has  $i = 0$
2. As  $i \uparrow$ , relative  $RET^e$  on money  $\downarrow$  (equivalently, opportunity cost of money  $\uparrow$ )  $\Rightarrow M^d \downarrow$
3. Demand curve for money has usual downward slope

## Derivation of Supply curve

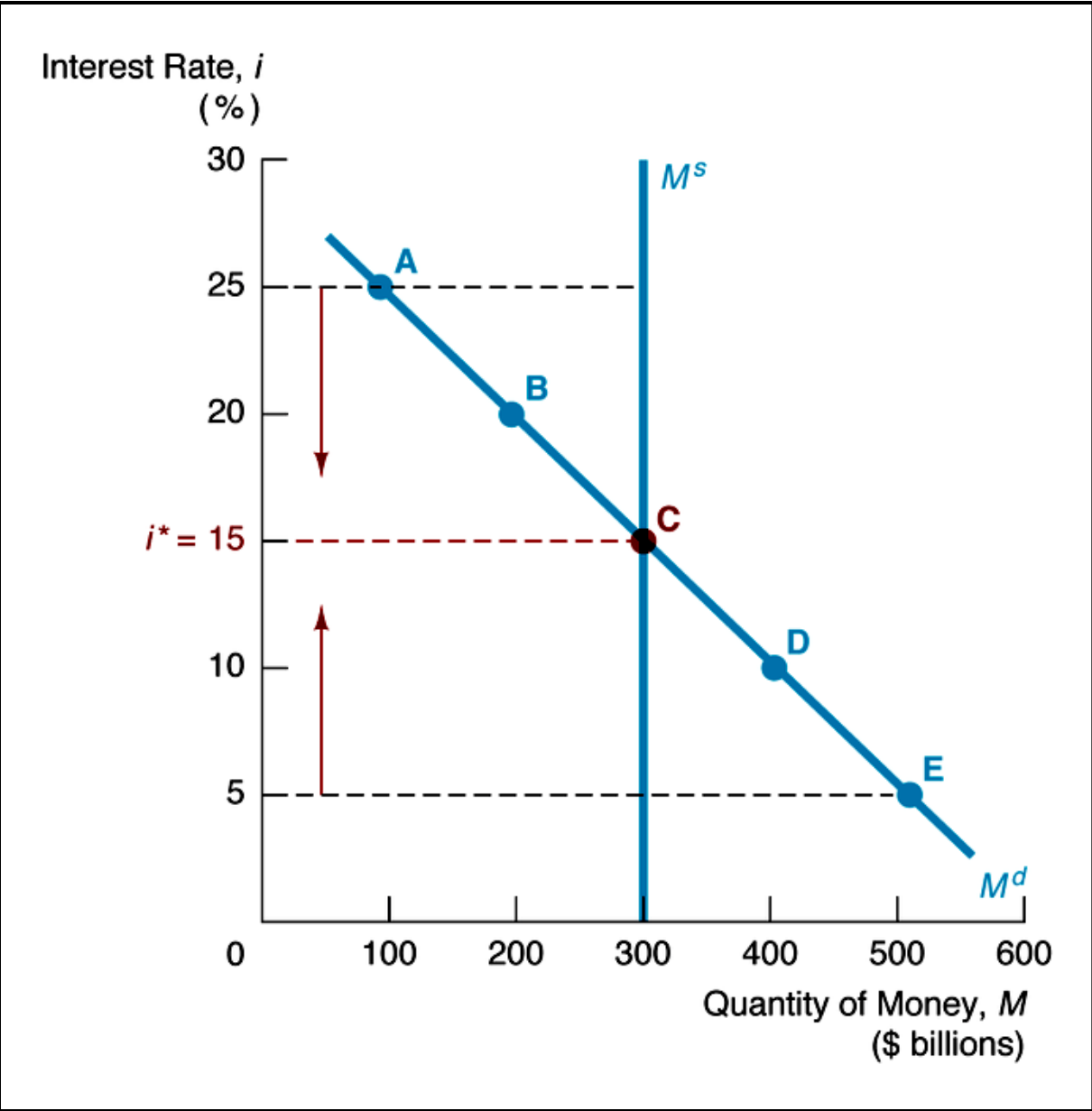
1. Assume that central bank controls  $M^s$  and it is a fixed amount
2.  $M^s$  curve is vertical line

## Market Equilibrium

1. Occurs when  $M^d = M^s$ , at  $i^* = 15\%$
2. If  $i = 25\%$ ,  $M^s > M^d$  (excess supply): Price of bonds  $\uparrow$ ,  $i \downarrow$  to  $i^* = 15\%$
3. If  $i = 5\%$ ,  $M^d > M^s$  (excess demand): Price of bonds  $\downarrow$ ,  $i \uparrow$  to  $i^* = 15\%$



# Money Market Equilibrium



## 2 factors for shift in demand for money

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### ▶ 1. Income effect

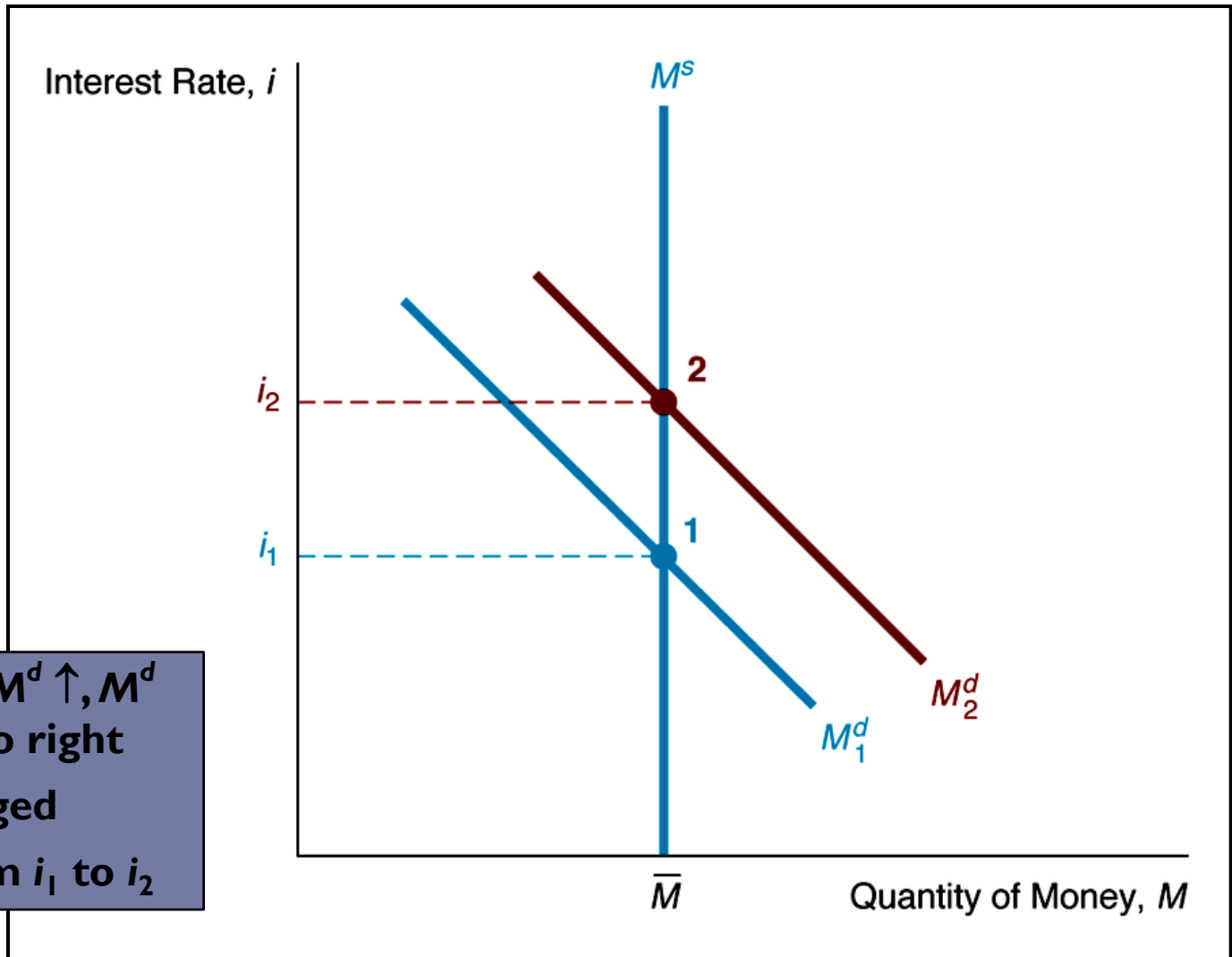
- Economy expand  $\rightarrow$  income  $\uparrow \rightarrow$  wealth  $\uparrow \rightarrow$  demand for money as a store of value  $\uparrow \rightarrow$  D shift right
- Economy expand  $\rightarrow$  income  $\uparrow \rightarrow$  want to carry more transaction using money as a medium of exchange  $\rightarrow$  D shift right

### ▶ 2. Price level effect

- People care about amount of money they hold in real term, i.e., in term of good and service they can buy.
- Price level  $\uparrow \rightarrow$  value of money  $\downarrow \rightarrow$  to consume same amount of goods, we need more money  $\rightarrow$  D shift right

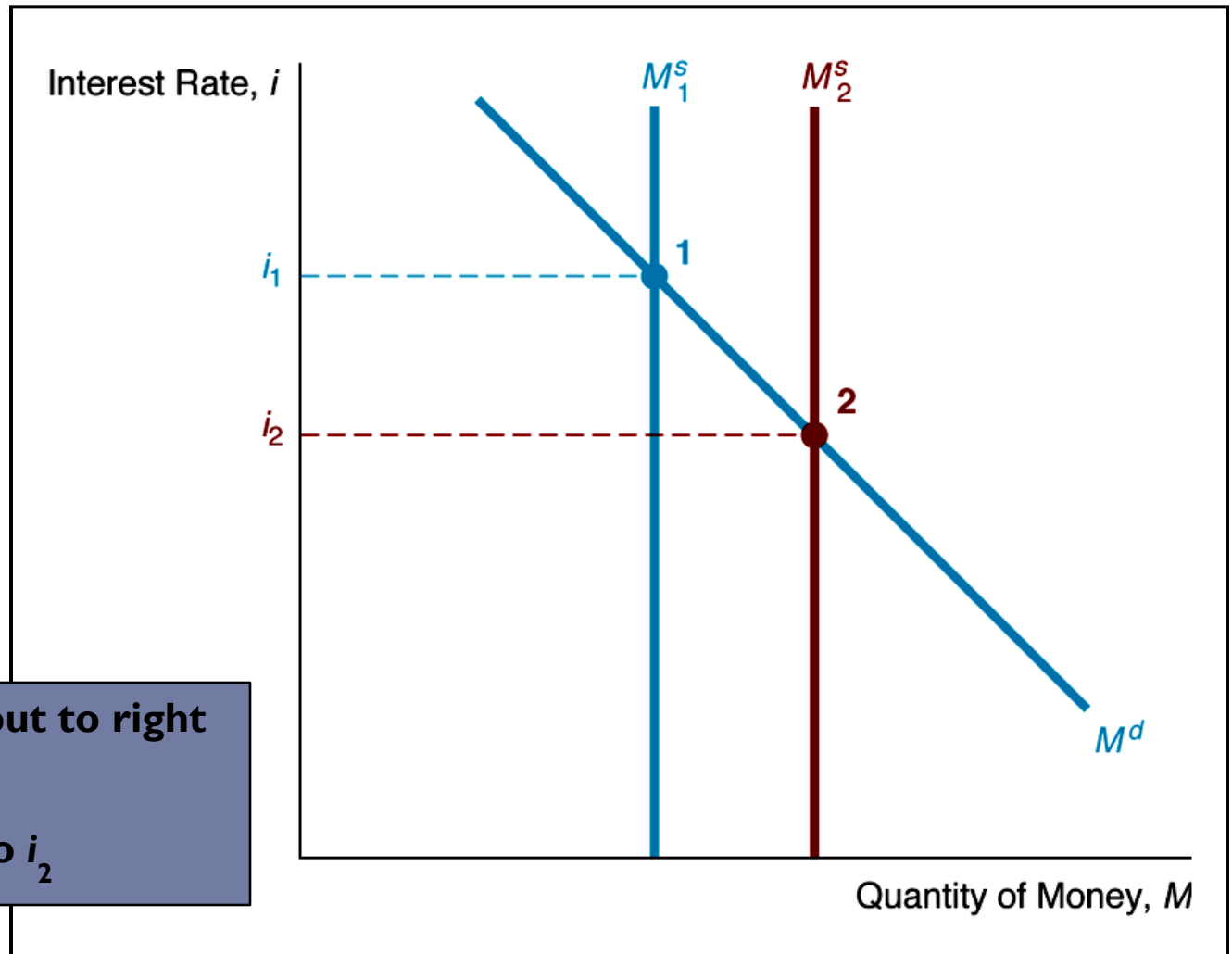


# Rise in Income or the Price Level



- 1. Income  $\uparrow$ ,  $M^d \uparrow$ ,  $M^d$  shifts out to right
- 2.  $M^s$  unchanged
- 3.  $i^*$  rises from  $i_1$  to  $i_2$

# Rise in Money Supply: liquidity effect

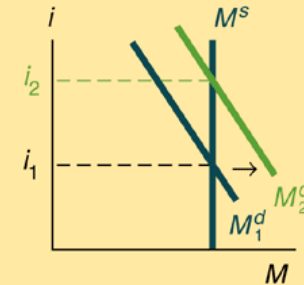


1.  $M^s \uparrow$ ,  $M^s$  shifts out to right
2.  $M^d$  unchanged
3.  $i^*$  falls from  $i_1$  to  $i_2$

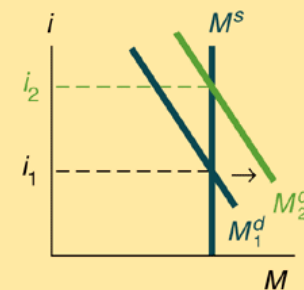
**SUMMARY** Table 4 Factors That Shift the Demand for and Supply of Money

Variable	Change in Variable	Change in Money Demand ( $M^d$ ) or Supply ( $M^s$ )	Change in Interest Rate
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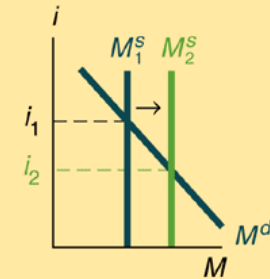
Income	↑	$M^d$ ↑	↑
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Price level	↑	$M^d$ ↑	↑
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Money supply	↑	$M^s$ ↑	↓
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Note: Only increases in the variables are shown. The effect of decreases in the variables on the change in demand would be the opposite of those indicated in the remaining columns.

# Money and Interest Rates

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## Effects of money on interest rates

### 1. Liquidity Effect

$M^s \uparrow$ ,  $M^s$  shifts right,  $i \downarrow$

### 2. Income Effect

$M^s \uparrow$ , Income  $\uparrow$ ,  $M^d \uparrow$ ,  $M^d$  shifts right,  $i \uparrow$

### 3. Price Level Effect

$M^s \uparrow$ , Price level  $\uparrow$ ,  $M^d \uparrow$ ,  $M^d$  shifts right,  $i \uparrow$

### 4. Expected Inflation Effect

$M^s \uparrow$ ,  $\pi^e \uparrow$ ,  $B^d \downarrow$ ,  $B^s \uparrow$ , Fisher effect,  $i \uparrow$

## Effect of higher rate of money growth on interest rates is ambiguous

1. Because income, price level and expected inflation effects work in opposite direction of liquidity effect

# How quickly does each factor take effect?

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- ▶ Which of these effect is largest? How quickly does each take effect?

These are critical factor determining whether interest rate  $\uparrow$  or  $\downarrow$  with respect to  $\uparrow$  money supply growth

- ▶ Liquidity effect: take effect immediately

Money supply  $\uparrow$   $\rightarrow$  interest rate  $\downarrow$  immediately

- ▶ Income and price level effect: take longer time to work

Money supply  $\uparrow$   $\rightarrow$  take time to  $\uparrow$  price level & income

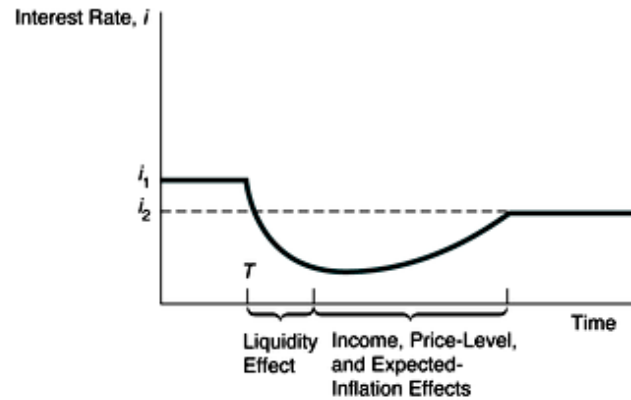
- ▶ Expected inflation effect: can be slow or fast

depend on people adjust their expectation of inflation

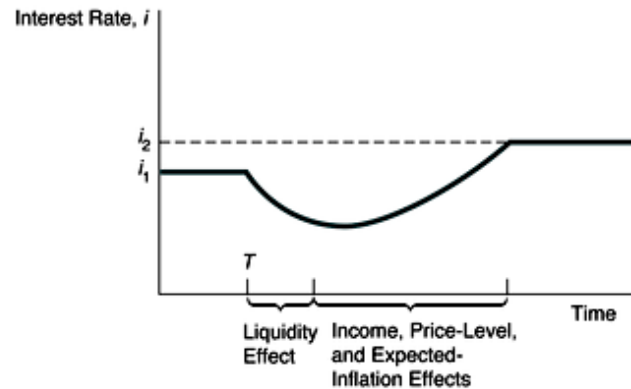
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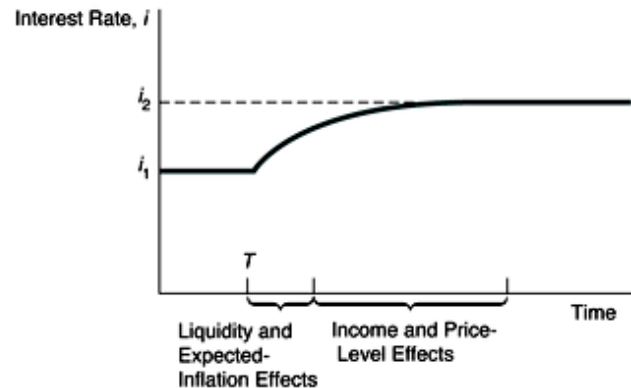
# Does Higher Money Growth Lower Interest Rates?



(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

# Evidence on Money Growth and Interest Rates

