



Money, Interest, and Income

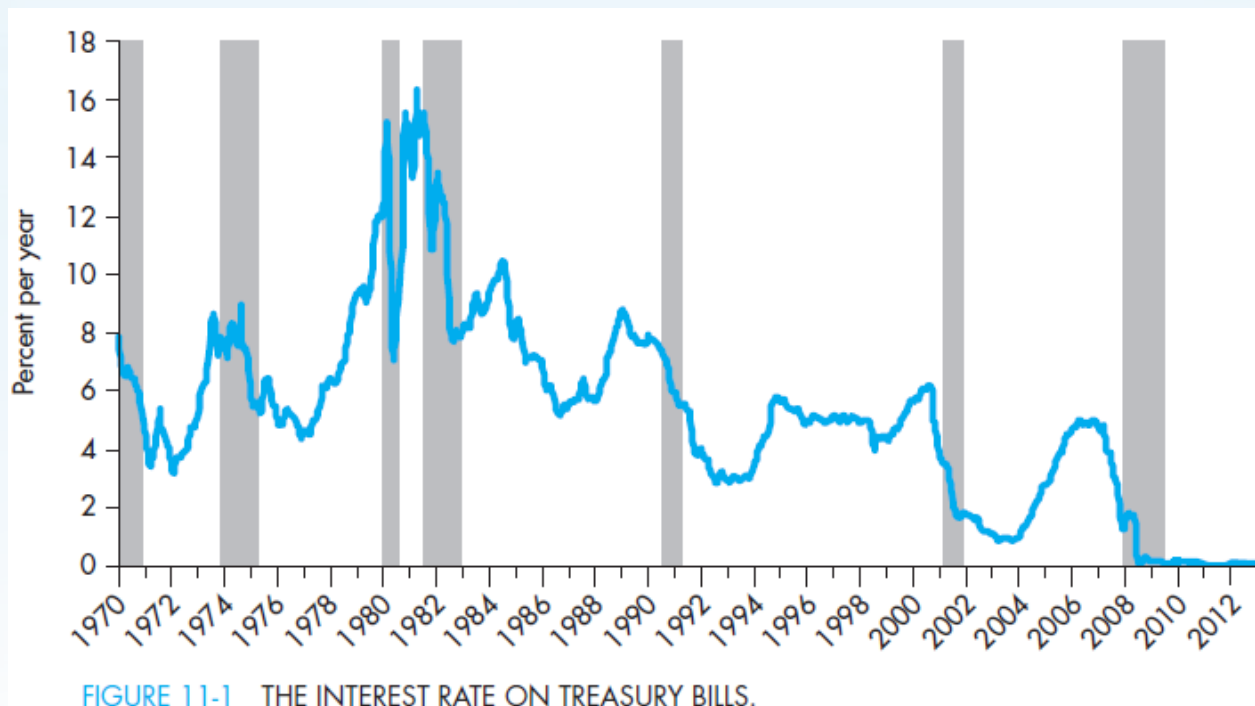
Chapter #11

Introduction

- Money plays a central role in the determination of income and employment
 - Interest rates are a significant determinant of aggregate spending → Fed controls the money supply in the United States
 - The stock of money, interest rates, and the Fed were noticeably absent from the model developed in the last chapter
- This chapter:
 - Introduces money and monetary policy
 - Builds an explicit framework of analysis within which to study the interaction of goods markets and assets market
 - ✓ What determines interest rates?
 - ✓ What is the role of interest rates in the business cycle?

Introduction

- Figure 11-1 shows the interest rate on Treasury bills = the payment received by someone who lends to the U.S. government
 - Ex. At an interest rate of 5%, a \$100 loan to the government will earn \$5 in interest



Introduction

- Interest rates:
 - Are high just before a recession
 - Drop during the recession
 - Rise during the recovery

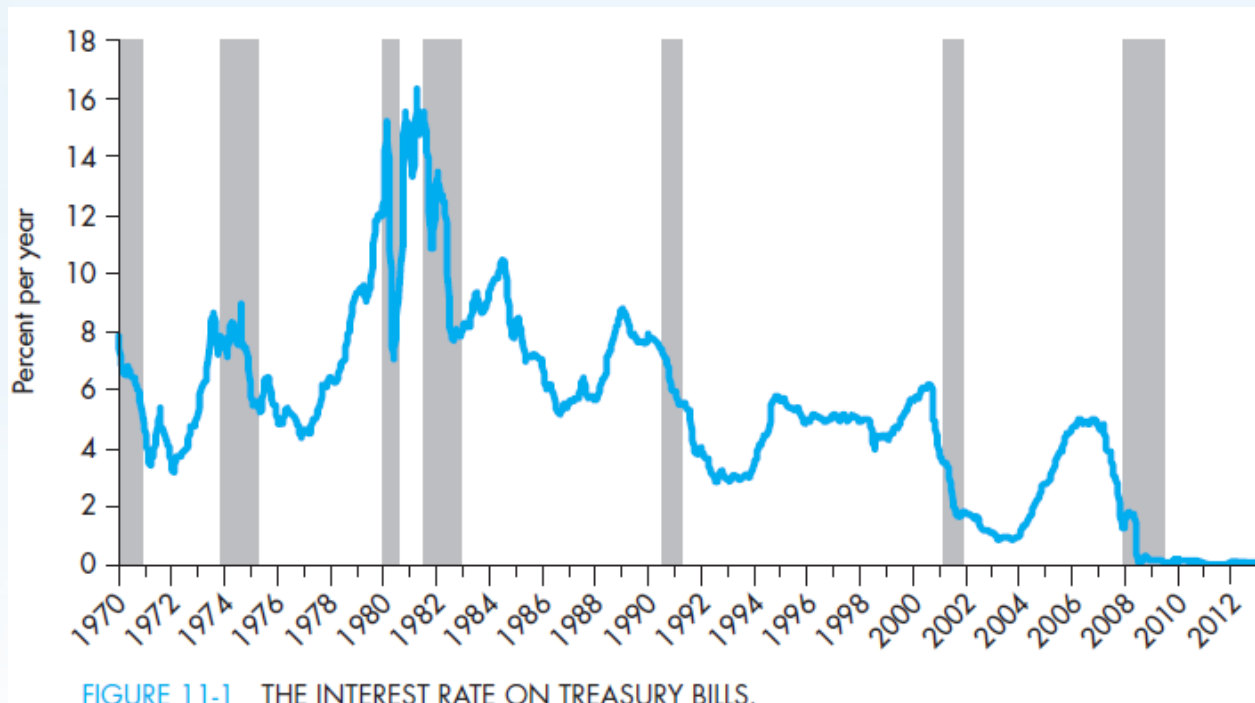


FIGURE 11-1 THE INTEREST RATE ON TREASURY BILLS.

Introduction

- Figure 11-2 shows the strong link between money and output growth
- IS-LM model is the core of short-run macroeconomics
 - Maintains the details of earlier model, but adds the interest rate as an additional determinant of aggregate demand
 - Includes the goods market and the money market, and their link through interest rates and income

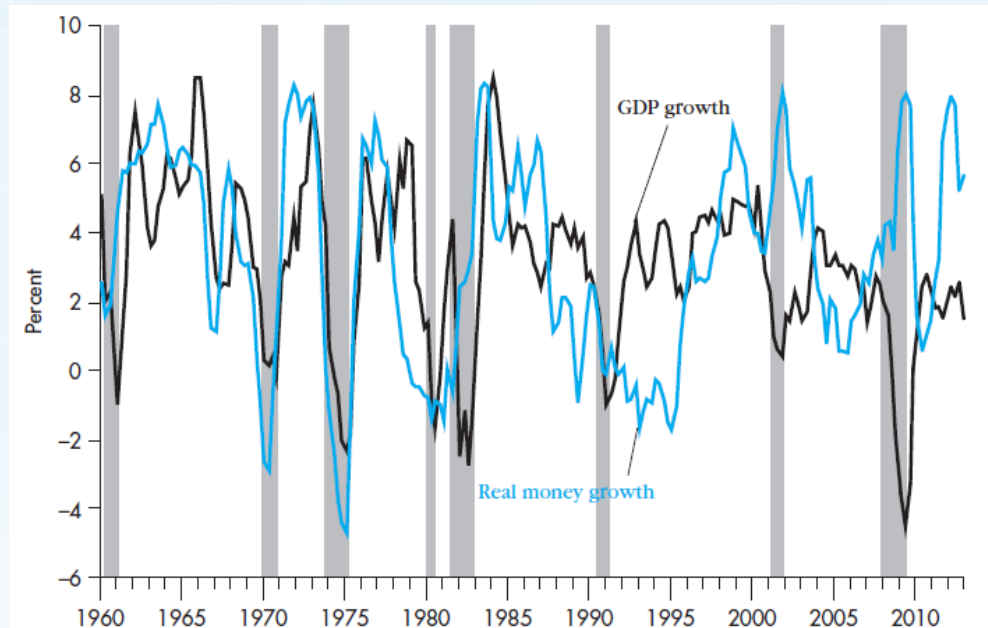
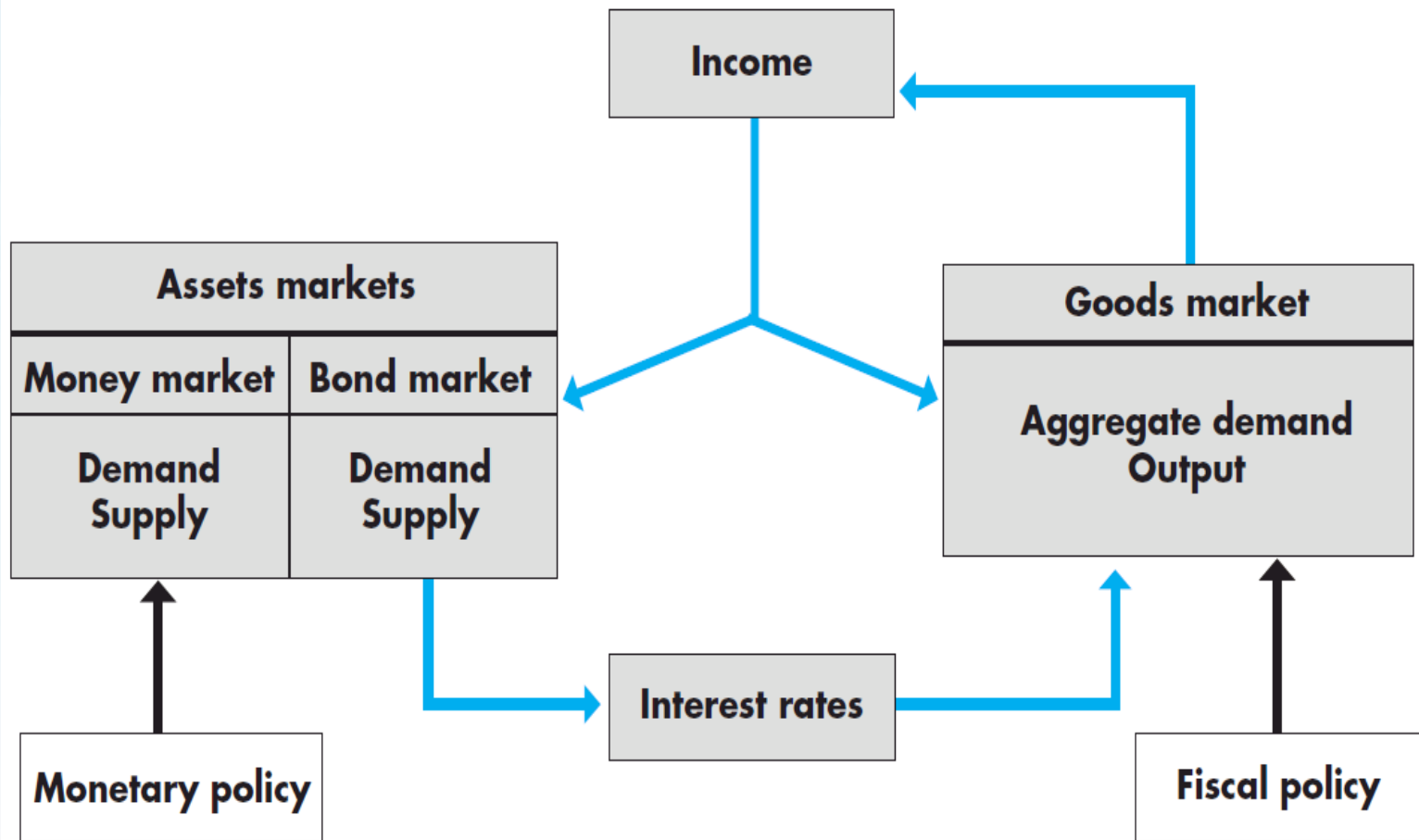


FIGURE 11-2 GDP GROWTH (QUARTERLY) AND REAL MONEY GROWTH (OVER PREVIOUS YEAR).

Structure of the IS-LM Model

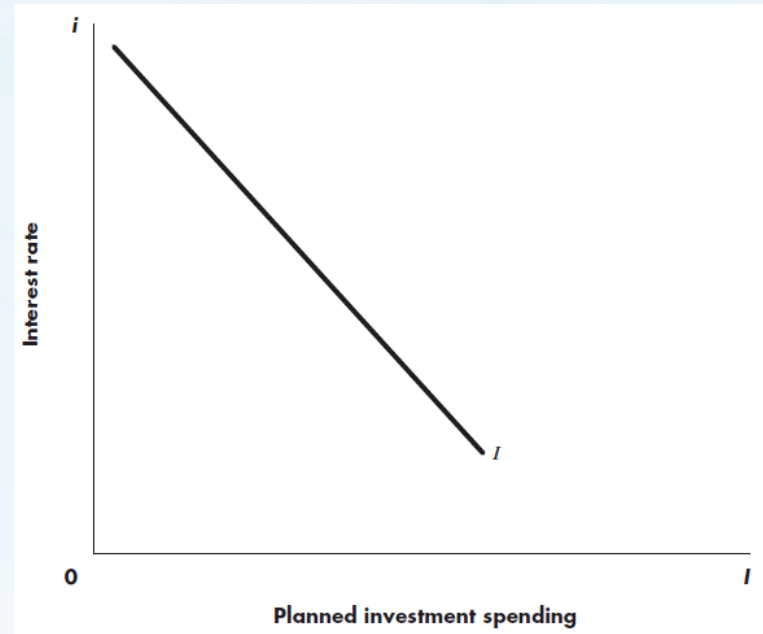


The Goods Market and the IS Curve

- The IS curve shows combinations of interest rates and levels of output such that planned spending equals income
 - Derived in two steps:
 1. Link between interest rates and investment
 2. Link between investment demand and AD
- Investment is no longer treated as exogenous, but dependent upon interest rates (endogenous)
 - Investment demand is lower the higher are interest rates
 - Interest rates are the cost of borrowing money
 - Increased interest rates raise the price to firms of borrowing for capital equipment → reduce the quantity of investment demand

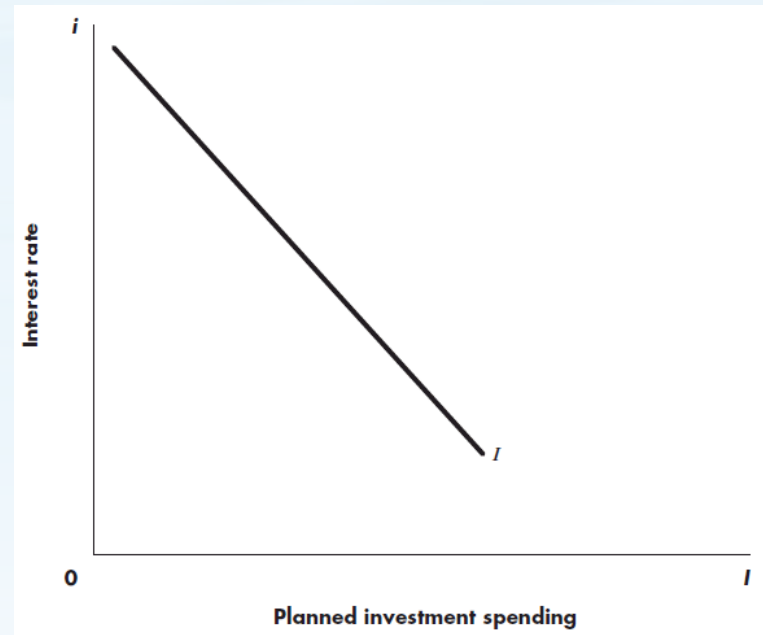
Investment and the Interest Rate

- The investment spending function can be specified as:
 $I = \bar{I} - bi(1)$ where $b > 0$
 - i = rate of interest
 - b = the responsiveness of investment spending to the interest rate
 - \bar{I} = autonomous investment spending



Investment and the Interest Rate

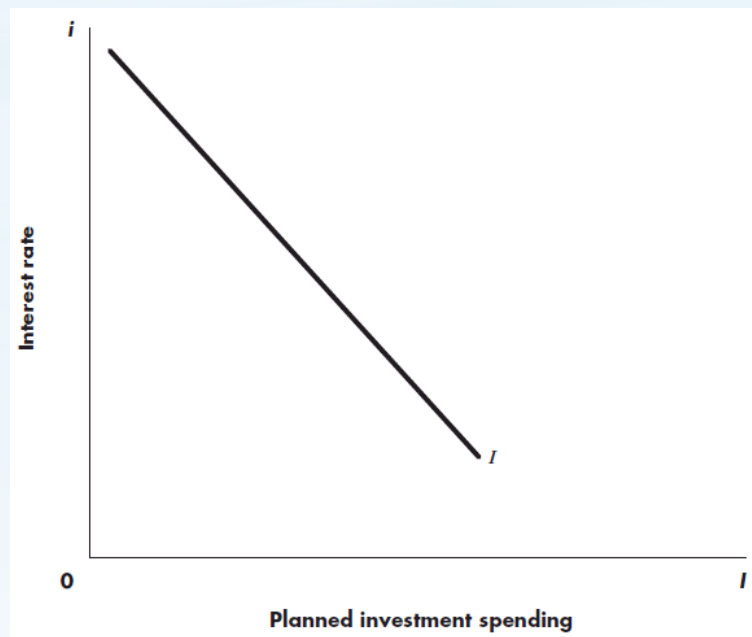
- Figure 11-4 illustrates the investment schedule of equation $I = \bar{I} - bi(1)$
 - Negative slope reflects assumption that a reduction in i increases the quantity of I



Investment and the Interest Rate

$$I = \bar{I} - bi \quad (1)$$

- The position of the I schedule is determined by:
 - The slope, b
 - If investment is highly responsive to i , the investment schedule is almost flat
 - If investment responds little to i , the investment schedule is close to vertical
 - Level of autonomous spending
 - An increase in \bar{I} shifts the investment schedule out
 - A decrease in \bar{I} shifts the investment schedule in



The Interest Rate and AD: The IS Curve

- Need to modify the AD function of the last chapter to reflect the new planned investment spending schedule

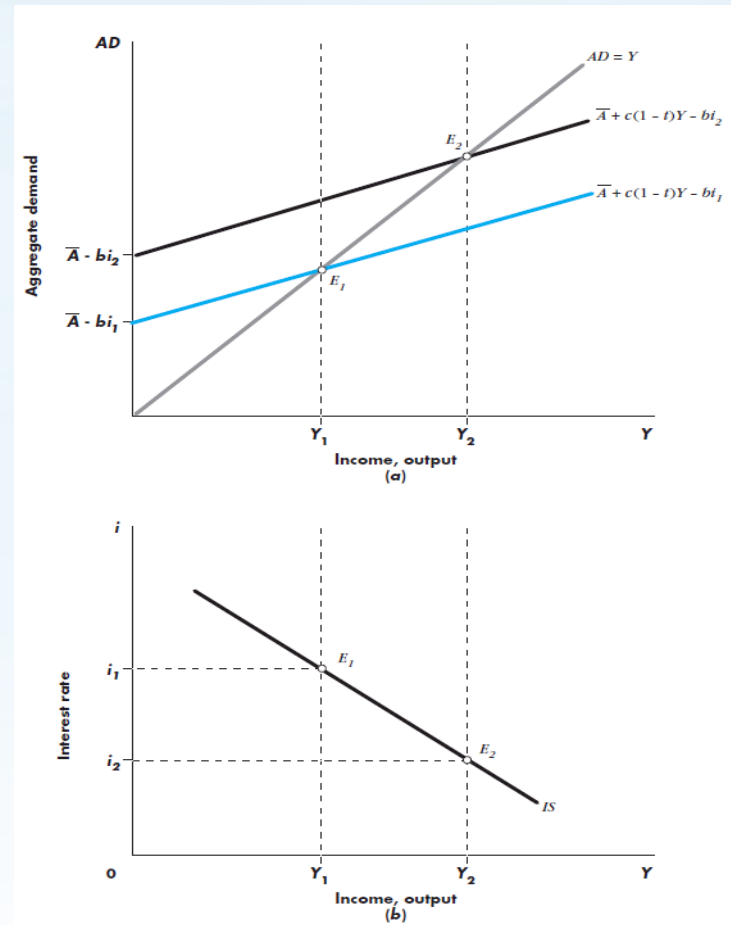
$$\begin{aligned}AD &= C + I + G + NX \\&= [\bar{C} + c\bar{T}\bar{R} + c(1-t)Y] + (\bar{I} - bi) + \bar{G} + \bar{N}\bar{X} \\&= \bar{A} + c(1-t)Y - bi\end{aligned}\tag{2}$$

- An increase in i reduces AD for a given level of income
- At any given level of i , can determine the equilibrium level of income and output as in Chapter 10
- A change in i will change the equilibrium

The Interest Rate and AD: The IS Curve

$$AD = \bar{A} + c(1-t)Y - bi \quad (2)$$

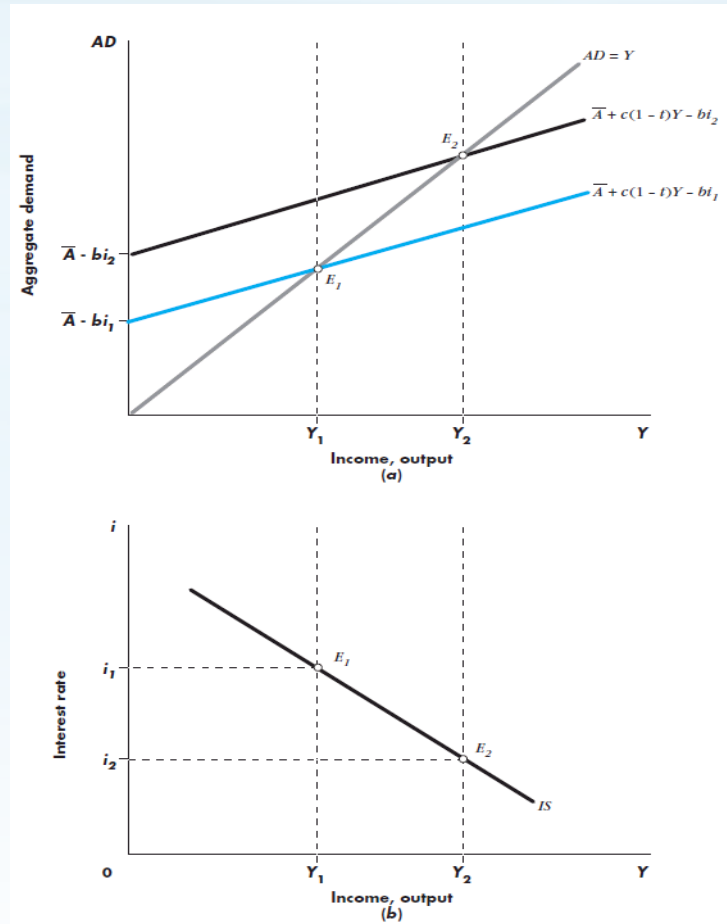
- For a given interest rate, i_1 , the last term in equation (2) is constant \rightarrow can draw the AD function with an intercept of $\bar{A} - bi_1$
 - The equilibrium level of income is Y_1 at point E_1
 - Plot the pair (i_1, Y_1) in the bottom panel as point $E_1 \rightarrow$ a point on the IS curve
 - Combination of i and Y that clears the goods market



The Interest Rate and AD: The IS Curve

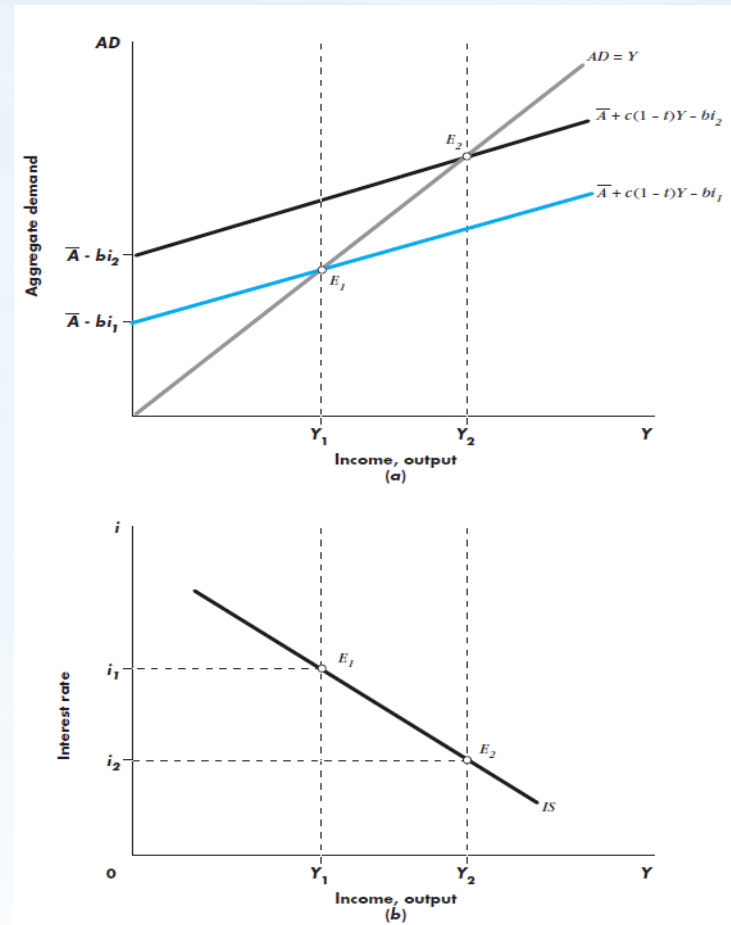
$$AD = \bar{A} + c(1-t)Y - bi \quad (2)$$

- Consider a lower interest rate, i_2
 - Shifts the AD curve upward to AD' with an intercept of $\bar{A} - bi_2$
 - Given the increase in AD, the equilibrium shifts to point E_2 , with an associated income level of Y_2
 - Plot the pair (i_2, Y_2) in panel (b) for another point on the IS curve



The Interest Rate and AD: The IS Curve

- We can apply the same procedure to all levels of i to generate additional points on the IS curve
 - All points on the IS curve represent combinations of i and income at which the goods market clears \rightarrow *goods market equilibrium schedule*
- Figure 11-5 shows the negative relationship between i and Y
 - Downward sloping IS curve



The Interest Rate and AD: The IS Curve

- We can also derive the IS curve using the goods market equilibrium condition:

$$\begin{aligned} Y &= AD = \bar{A} + c(1-t)Y - bi \Rightarrow \\ Y - c(1-t)Y &= \bar{A} - bi \\ Y(1 - c(1-t)) &= \bar{A} - bi \\ Y &= \alpha_G(\bar{A} - bi) \end{aligned} \tag{4}$$

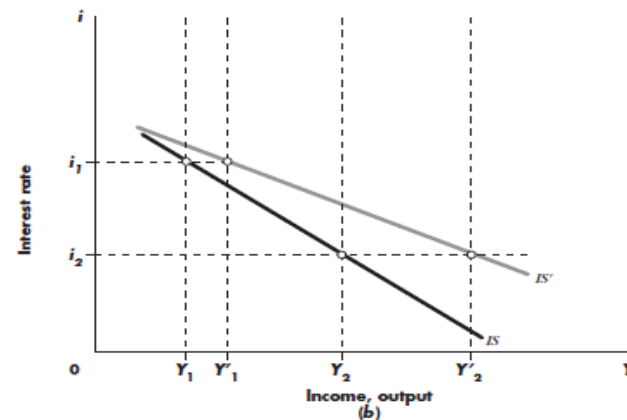
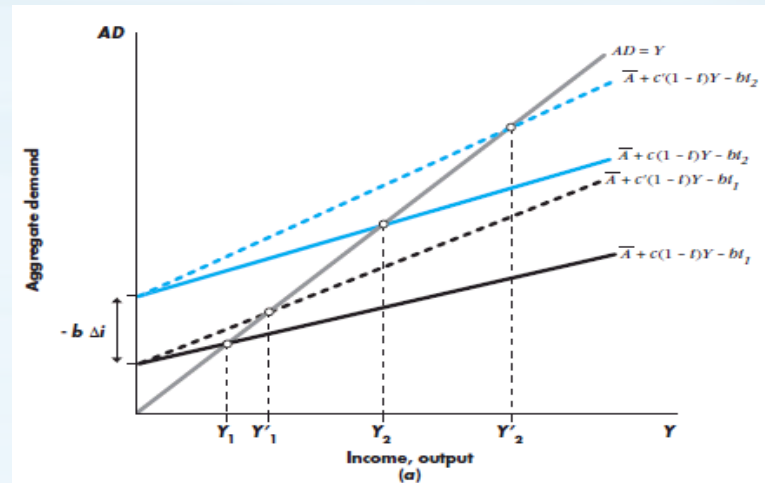
where $\alpha_G = \frac{1}{(1 - c(1-t))}$ (5), the multiplier from Chapter 10

The Slope of the IS Curve

- The steepness of the IS curve depends on:
 - How sensitive investment spending is to changes in i
 - The multiplier, α_G
- Suppose investment spending is very sensitive to $i \rightarrow$ the slope, b , is large
 - A given change in i produces a large change in AD (large shift)
 - A large shift in AD produces a large change in Y
 - A large change in Y resulting from a given change in $i \rightarrow$ IS curve is relatively flat
- If investment spending is not very sensitive to i , the IS curve is relatively steep

The Role of the Multiplier

- Figure 11-6 shows the AD curves corresponding to different multipliers
 - The coefficient c on the solid black AD curve is smaller than that on the dashed AD curve → multiplier larger on the dashed AD curves
- A given reduction in i to i_2 raises the intercept of the AD curves by the same vertical distance
 - Because of the different multipliers, income rises to Y'_2 on the dashed line and Y_2 on the solid line



The Role of the Multiplier

- The smaller the sensitivity of investment spending to the interest rate AND the smaller the multiplier, the steeper the IS curve
 - This can be seen in equation (5): $Y = \alpha_G(\bar{A} - bi)$
- We can solve equation (5) for i : $Y = \alpha_G(\bar{A} - bi)$

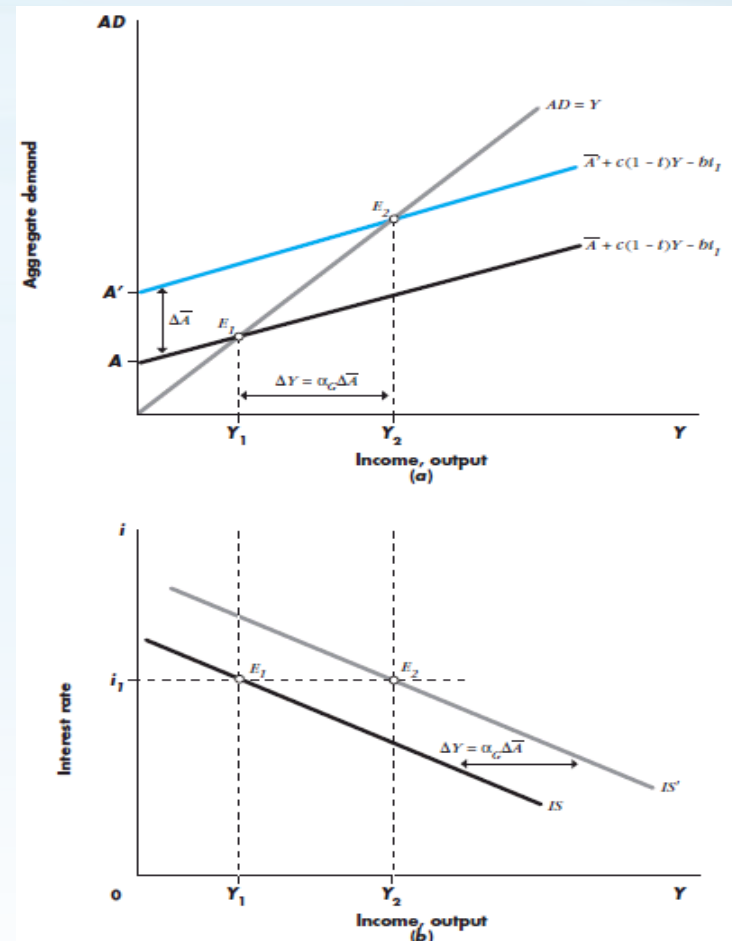
$$Y - \alpha_G \bar{A} = -\alpha_G bi$$

$$i = \frac{Y - \alpha_G \bar{A}}{-\alpha_G b}$$

$$= \frac{\bar{A}}{b} - \frac{Y}{\alpha_G b}$$

The Position of the IS Curve

- Figure 11-7 shows two different IS curves → differ by levels of autonomous spending
 - Initial AD with \bar{A} and i_1 → corresponding point E_1 on IS curve in Figure 11-7 (b)
 - If autonomous spending increases to \bar{A}' , equilibrium level of income increases at i_1 → point E_2 in panel 11-7 (b), shifting out IS
- The change in income as a result from a change in autonomous spending is $\Delta Y = \alpha_G \Delta \bar{A}$



The Money Market and the LM Curve

- The LM curve shows combinations of interest rates and levels of output such that money demand equals money supply → equilibrium in the money market
- The LM curve is derived in two steps:
 1. Explain why money demand depends on interest rates and income
 - Theory of real money balances, rather than nominal
 2. Equate money demand with money supply, and find combinations of income and interest rates that maintain equilibrium in the money market
 - (i, Y) pairs meeting this criteria are points on a given LM curve

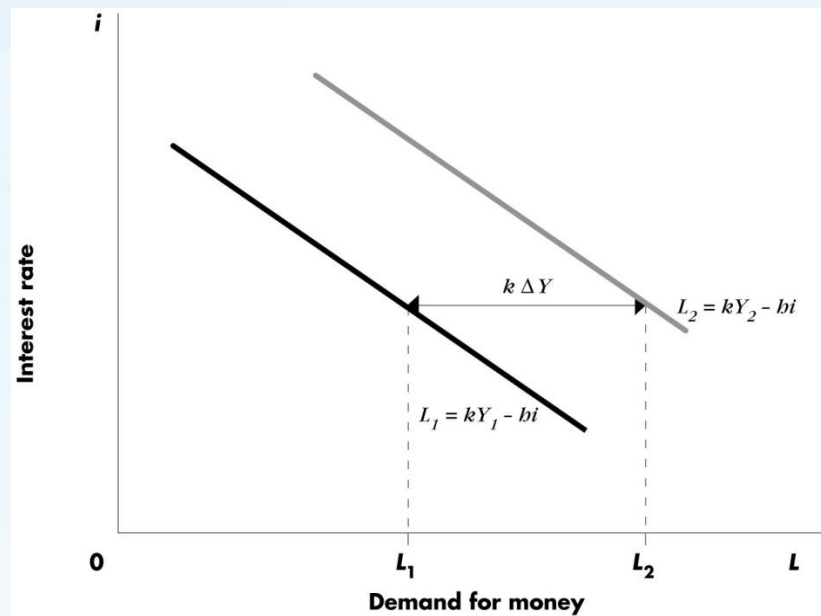
Demand for Money

- The demand for money is a demand for real money balances
 - People are concerned with how much their money can buy, rather than the number of dollars in their pockets
- The demand for real balances depends on:
 - Real income: people hold money to pay for their purchases, which, in turn, depend on income
 - Interest rate: the cost of holding money
- The demand for money is defined as: $L = kY - hi$ (6)

Demand for Money

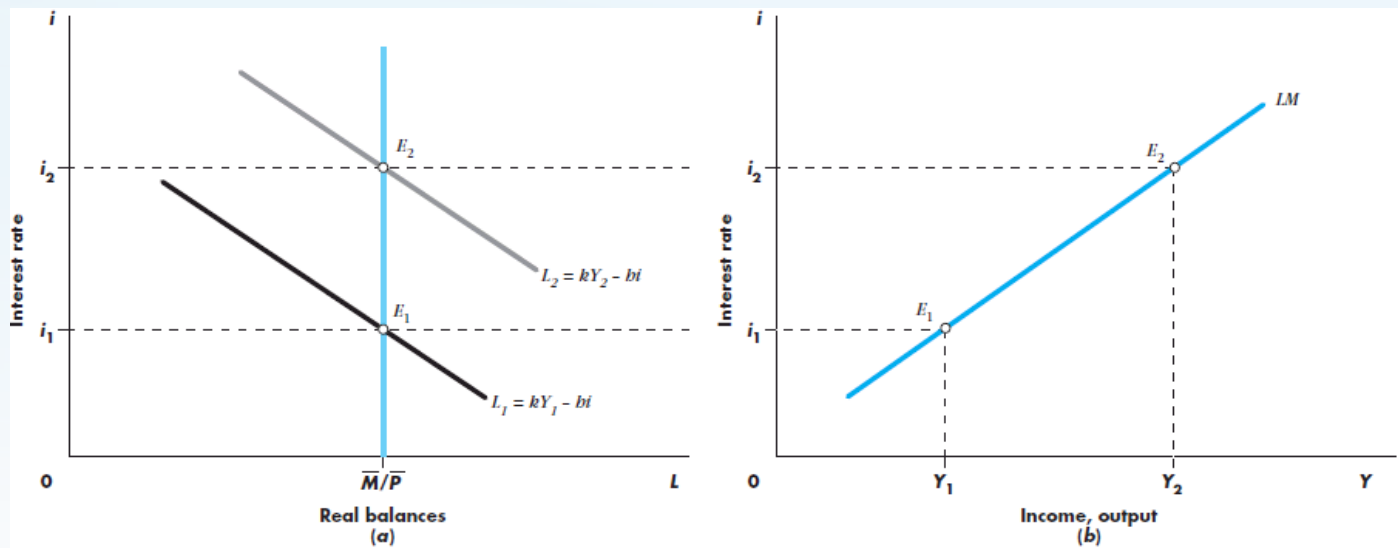
$$L = kY - hi \quad (6)$$

- The parameters k and h reflect the sensitivity of demand for real balances to the level of Y and i
- The demand function for real balances implies that for a given level of income, the quantity demanded is a decreasing function of i
 - Figure 11-8 illustrates the inverse relationship between money demand and $i \rightarrow$ *money demand curve*



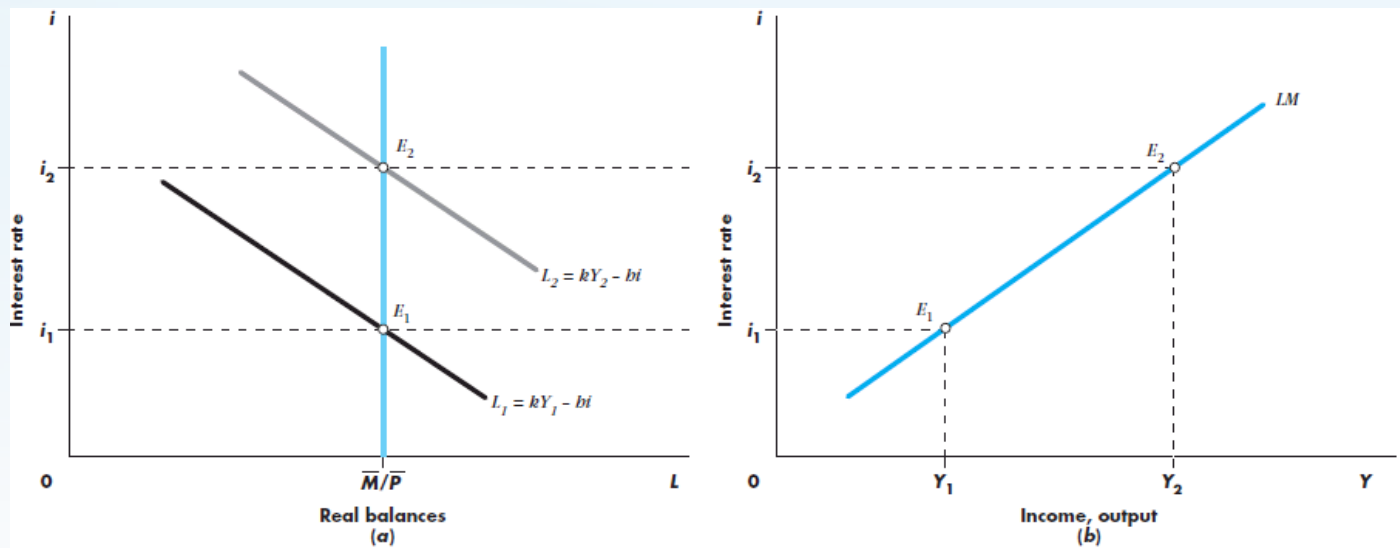
The Supply of Money, Money Market Equilibrium, and the LM Curve

- The nominal quantity of money supplied, M , controlled by central bank
 - Real money supply is $\frac{\bar{M}}{\bar{P}}$, where M and P are assumed fixed
- Figure 11-9 shows combinations of i and Y such that demand for real money balances exactly matches available supply



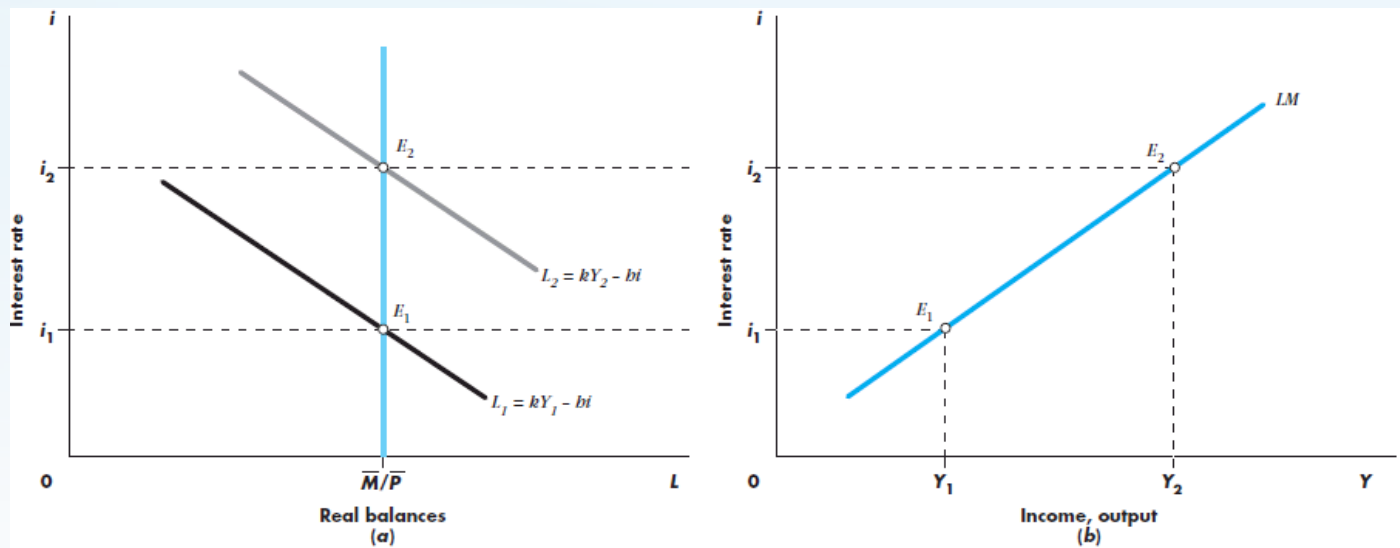
The Supply of Money, Money Market Equilibrium, and the LM Curve

- Starting at Y_1 , the corresponding demand curve for real balances is $L_1 \rightarrow$ shown in panel (a)
 - Point E_1 is the equilibrium point in the money market



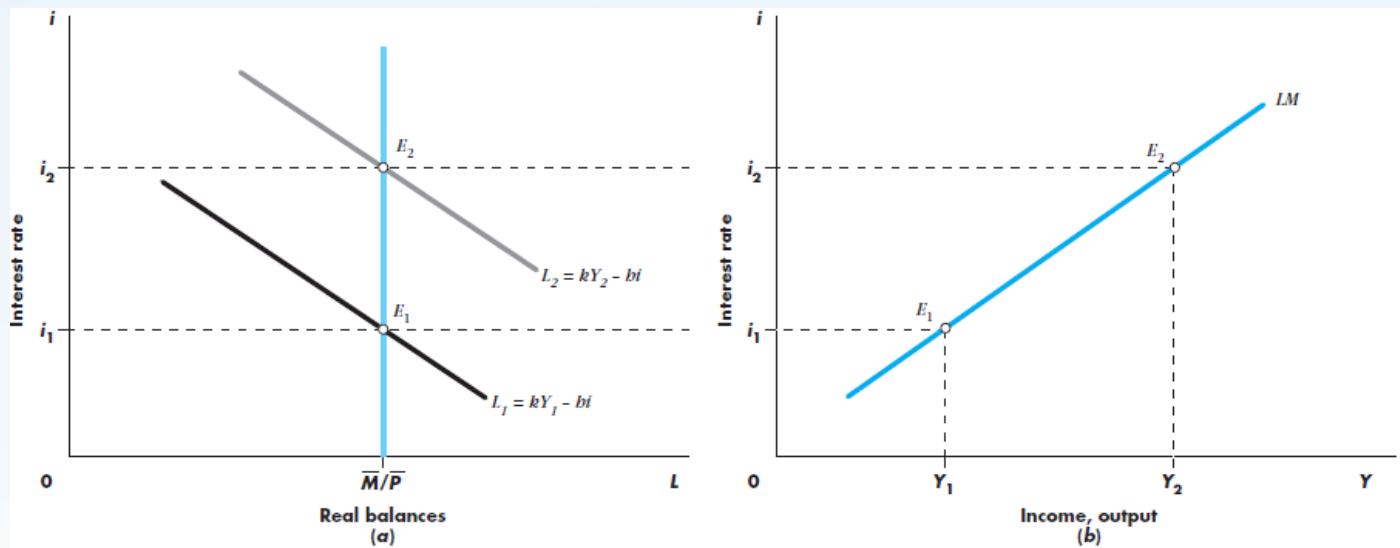
The Supply of Money, Money Market Equilibrium, and the LM Curve

- Point E_1 is recorded in panel (b) as a point on the money market equilibrium schedule, or the LM curve
 - (i_1, Y_1) pair is a point on LM curve



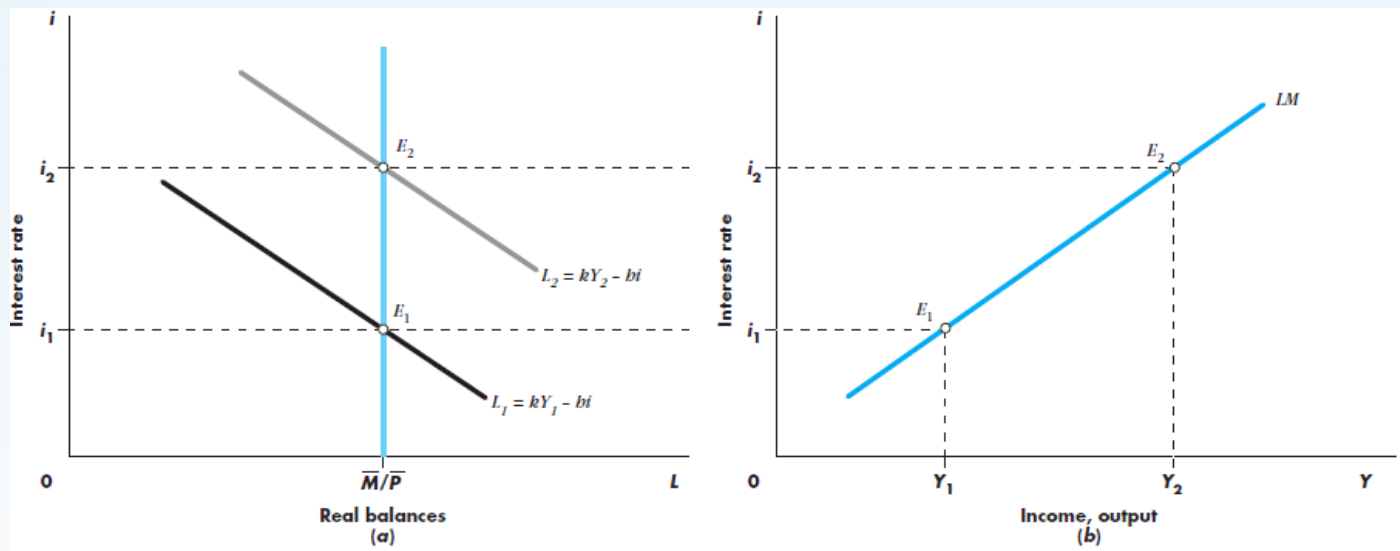
The Supply of Money, Money Market Equilibrium, and the LM Curve

- If income increases to Y_2 , real money balances higher at every level of $i \rightarrow$ money demand shifts to L_2
 - The interest rate increases to i_2 to maintain equilibrium in money market
 - The new equilibrium is at point E_2



The Supply of Money, Money Market Equilibrium, and the LM Curve

- Record E_2 in panel (b) as another point on the LM curve
 - Pair (i_2, Y_2) is higher up the given LM curve



The Supply of Money, Money Market Equilibrium, and the LM Curve

- The LM schedule shows all combinations of interest rates and levels of income such that the demand for real balances is equal to the supply → money market is in equilibrium
 - LM curve is positively sloped:
 - An increase in the interest rate reduces the demand for real balances
 - To maintain the demand for real money balances equal to the fixed supply, the level of income has to rise

Money market equilibrium implies that an increase in the interest rate is accompanied by an increase in the level of income.

The Supply of Money, Money Market Equilibrium, and the LM Curve

- The LM curve can be obtained directly by combining the demand curve for real balances and the fixed supply of real balances
 - For the money market to be in equilibrium, supply must equal demand: $\frac{\bar{M}}{\bar{P}} = kY - hi$ (7)
 - Solving for i : $i = \frac{1}{h} \left(kY - \frac{\bar{M}}{\bar{P}} \right)$ (7a)

The Slope of the LM Curve

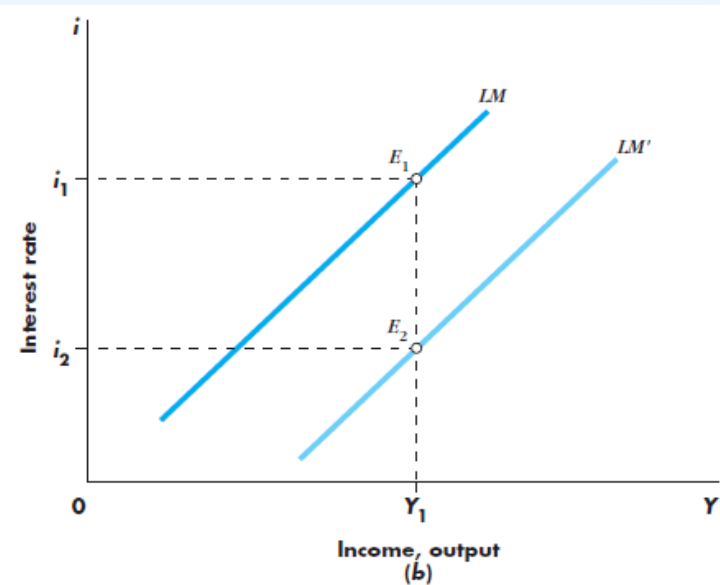
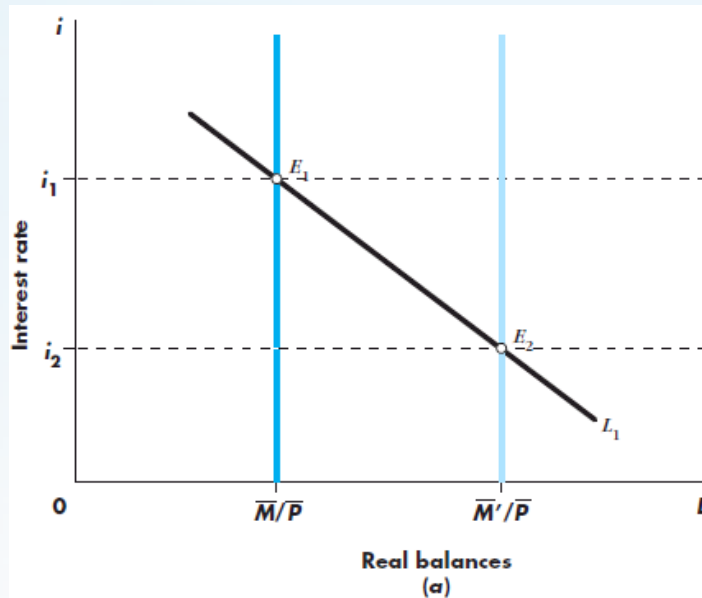
- The steeper the LM curve:
 - The greater the responsiveness of the demand for money to income, as measured by k
 - The lower the responsiveness of the demand for money to the interest rate, h
- These points can be confirmed by experimenting with Figure 11-9 or examining equation (7a),

$$i = \frac{1}{h} \left(kY - \frac{\bar{M}}{\bar{P}} \right)$$

→ A given change in income has a larger effect on i , the larger is k and the smaller is h

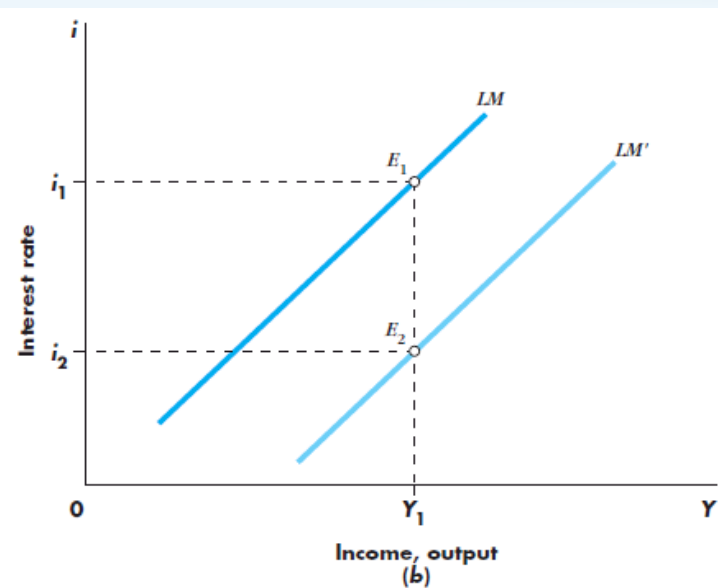
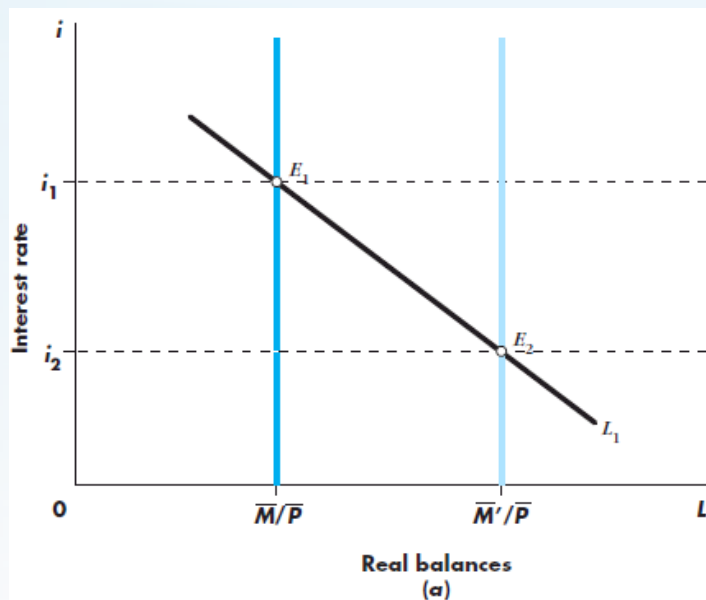
The Position of the LM Curve

- Real money supply constant along the LM curve \rightarrow a change in the real money supply will shift the LM curve
 - Figure 11-10 shows the effect of an increase in money supply
 - Equilibrium occurs at point E_1 with interest rate $i_1 \rightarrow$ corresponding point E_1 on the LM curve



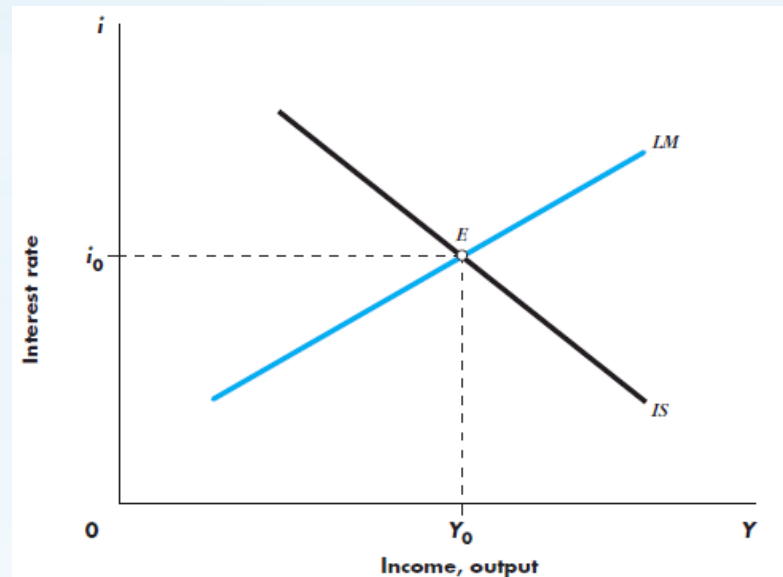
The Position of the LM Curve

- If real money balances increases, money supply curve shifts to the right
 - To restore equilibrium at the income level Y_1 , the i must decrease too
 - In panel (b), the LM curve shifts to the down and to the right



Equilibrium and the Goods and Money Market

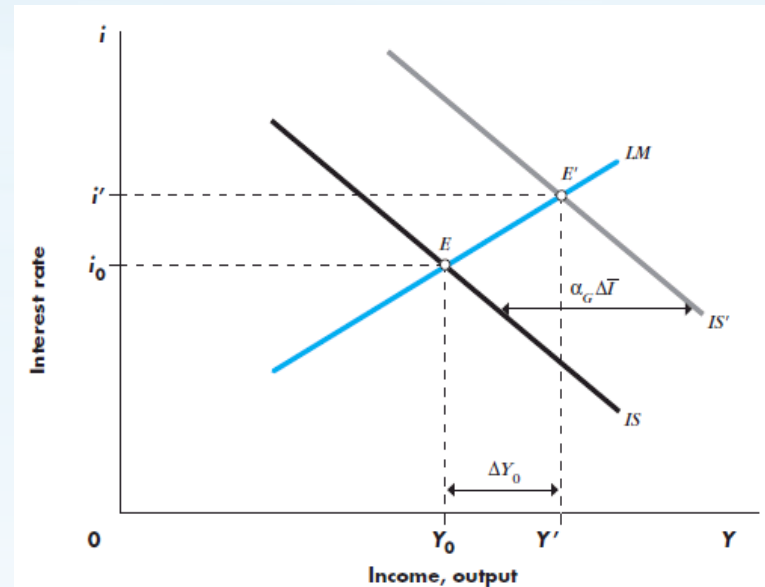
- The IS and LM schedules summarize the conditions that have to be satisfied for the goods and money markets to be in equilibrium
- Assumptions:
 - Price level is constant
 - Firms willing to supply whatever amount of output is demanded at that price level



Flat SRAS curve

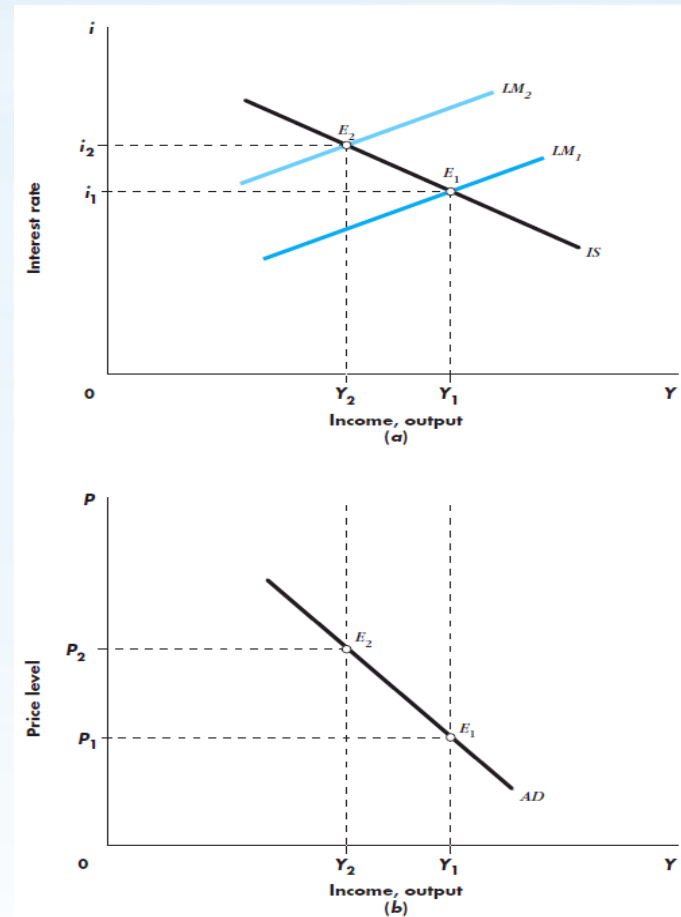
Changes in the Equilibrium Levels of Income and the Interest Rate

- The equilibrium levels of income and the interest rate change when either the IS or the LM curve shifts
- Figure 11-12 shows effects of an increase in autonomous spending
 - Shifts IS curve out by $\alpha_G \Delta I$ if autonomous investment is the source of increased spending
 - The resulting change in Y is smaller than the change in autonomous spending due to slope of LM curve



Deriving the AD Schedule

- The AD schedule maps out the IS-LM equilibrium holding autonomous spending and the nominal money supply constant and allowing prices to vary
- Suppose prices increase from P_1 to P_2
 - M/P decrease from M/P_1 to $M/P_2 \rightarrow$ LM decreases from LM_1 to LM_2
 - Interest rates increase from i_1 to i_2 , and output falls from Y_1 to Y_2
 - Corresponds to lower AD



Deriving the AD Schedule

- Derive the equation for the AD curve using the equations for the IS-LM curves: $IS : Y = \alpha_G(\bar{A} - bi)$

$$LM : i = \frac{1}{h} \left(kY - \frac{\bar{M}}{\bar{P}} \right)$$

- Substituting LM equation into the IS equation:

$$\begin{aligned} Y &= \alpha_G \left[\bar{A} - \frac{b}{h} \left(kY - \frac{\bar{M}}{\bar{P}} \right) \right] \\ &= \frac{h\alpha_G}{h + kb\alpha_G} \bar{A} + \frac{b\alpha_G}{h + kb\alpha_G} \frac{\bar{M}}{\bar{P}} \end{aligned} \quad (8)$$

$$= \gamma \bar{A} + \gamma \frac{b}{h} \frac{\bar{M}}{\bar{P}} \quad (8a)$$

Deriving the AD Schedule

$$Y = \frac{h\alpha_G}{h + k b \alpha_G} \bar{A} + \frac{b\alpha_G}{h + k b \alpha_G} \frac{\bar{M}}{\bar{P}}$$

- Equation (8) shows that AD depends upon:
 1. Autonomous spending
 2. Real money stock
- Equilibrium income is:
 - Higher the higher the level of autonomous spending
 - Higher the higher the stock of real balances

Deriving the AD Schedule

$$Y = \frac{h\alpha_G}{h + k b \alpha_G} \bar{A} + \frac{b\alpha_G}{h + k b \alpha_G} \frac{\bar{M}}{\bar{P}}$$

- Equation (8) is the AD schedule
 - It summarizes the IS-LM relation, relating Y and P for given levels of autonomous spending and nominal balances
 - Since P is in the denominator, AD is downward sloping