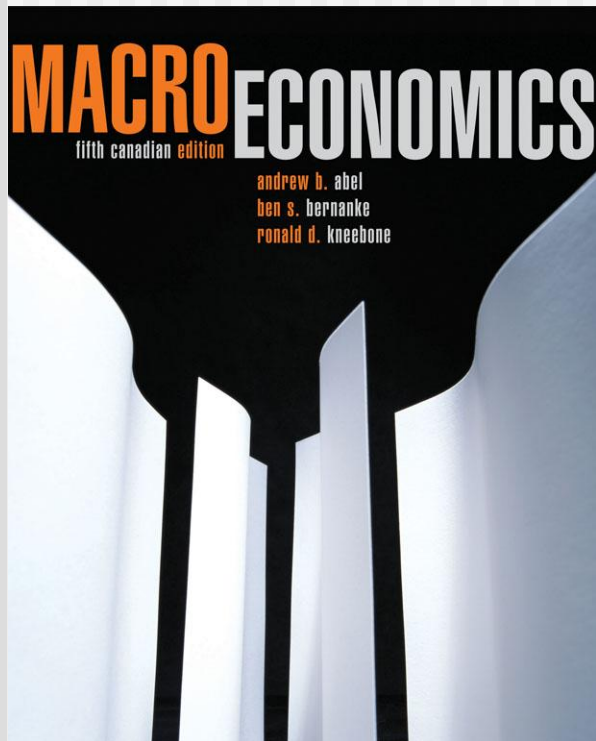




Chapter 9

The *IS–LM/AD–AS* Model: A General Framework for Macroeconomic Analysis

Introduction to the IS-LM Model

- This name originates from its basic equilibrium conditions:
 - investment, I , must equal saving, S ;
 - money demanded, L , must equal money supplied, M .
- The model was first developed by Keynesians but can be used to represent both classical and Keynesian models.
- The classic citation is J R Hicks, "Mr Keynes and the Classics: A suggested Interpretation" *Econometrica*, 1937.

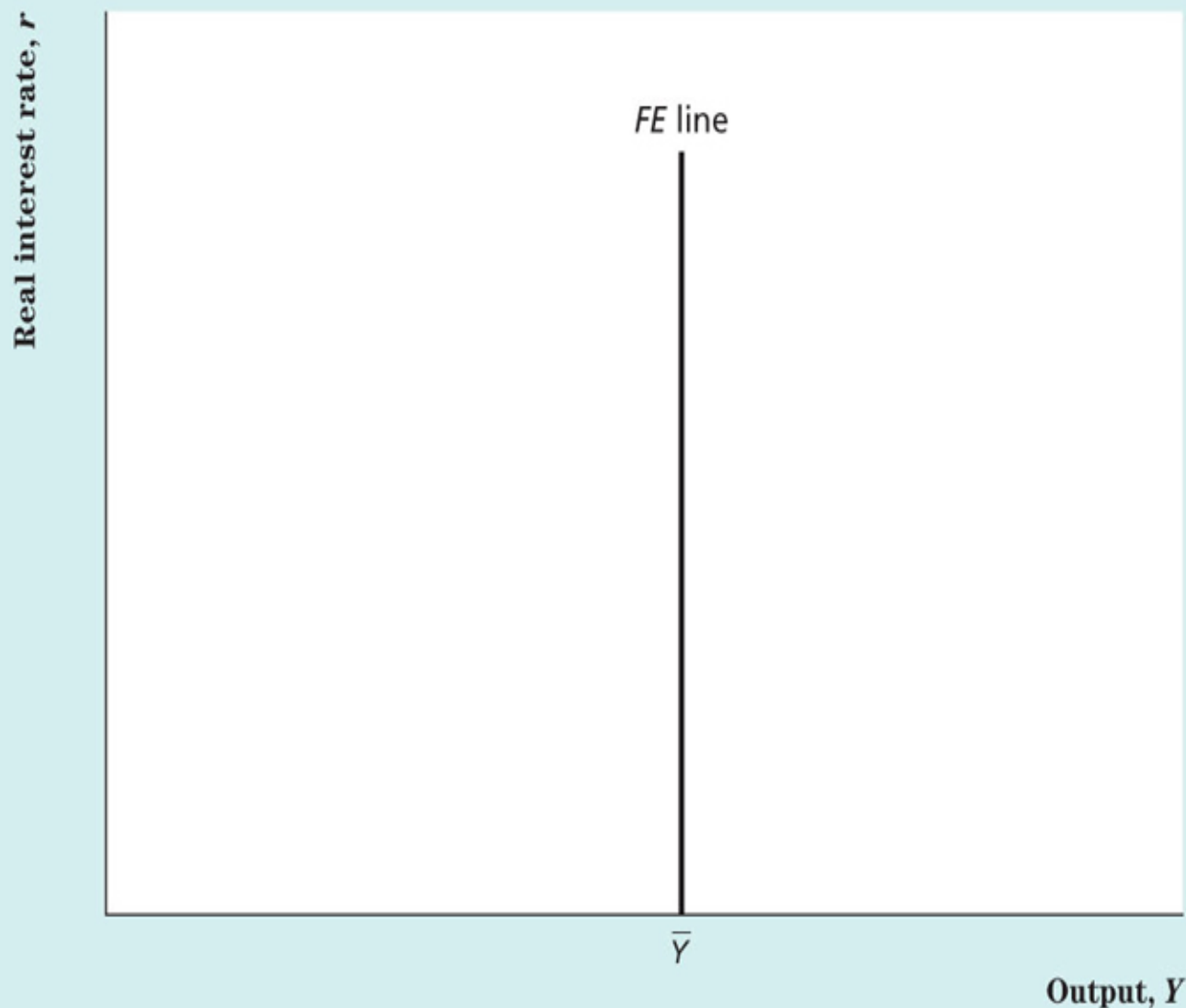
The *FE* Line: Equilibrium in the Labour Market

- Equilibrium in the labour market is represented by **full employment line**, *FE*.
- When the labour market is in equilibrium, output equals its full employment level, regardless of the interest rate (*FE* line is vertical).
- At this point, firms have hired N up to the point where profits are maximised.
- We are assuming that the real interest rate does not affect the current capital stock because the effects take time.

FIGURE 9.1

THE *FE* LINE

The full-employment (*FE*) line represents labour market equilibrium. When the labour market is in equilibrium, employment equals its full-employment level $\bar{N}$ and output equals its full-employment level $\bar{Y}$, regardless of the value of the real interest rate. Thus, the *FE* line is vertical at $Y = \bar{Y}$.



Factors that Shift the *FE* line

- The full-employment level of output, $\bar{Y}$, is determined by the current level of labour, capital and productivity.
- For classical economists the full-employment level of output is affected by government spending -- any increase in spending, assumed to be paid for by higher taxes, shifts the labour supply curve to the right since now labour must work more to maintain their standard of living.

The IS Curve: Equilibrium in the Goods Market

- The *IS curve* shows for any level of output (income), Y , the interest rate, r , at which the goods market is in equilibrium.
- It is important to remember that investment is not a function of Y in our framework.
- To derive the IS curve, we ask what would be the effect of a rise in income on the $S=I$ relationship.
- The *IS* curve slopes downward and to the right.
- At all points on the curve $I=S$ so we have goods market equilibrium.

The IS Curve: Equilibrium in the Goods Market (continued)

- We can use the fact that when $I = S$ we have $AD = AS$ to derive the IS curve.

- Suppose we have:

$$C^d = c_0 + c_y(1-\tau)Y - c_r r \quad \text{and}$$

$$I^d = \lambda_0 - \lambda_r r$$

- The symbols “ c ” and “ λ ” are coefficients and “ τ ” is the income tax rate.
- Since $Y = C^d + I^d + G$ (*i.e.*, $AD = AS$) we have:

$$Y = c_0 + \lambda_0 + c_y(1-\tau)Y - (c_r + \lambda_r)r + G$$

The IS Curve: Equilibrium in the Goods Market (continued)

- We can now derive an expression for the *IS* curve as:

$$r = \{(c_0 + \lambda_0 + G) - (1 - (1-\tau)c_y)Y\}/(c_r + \lambda_r)$$

- This shows that the curve is downward sloping and that increases (decreases) in *G* would shift the curve up (down).
- Changes in $(c_0 + \lambda_0)$ would also shift the curve and these could be because of productivity or confidence effects.

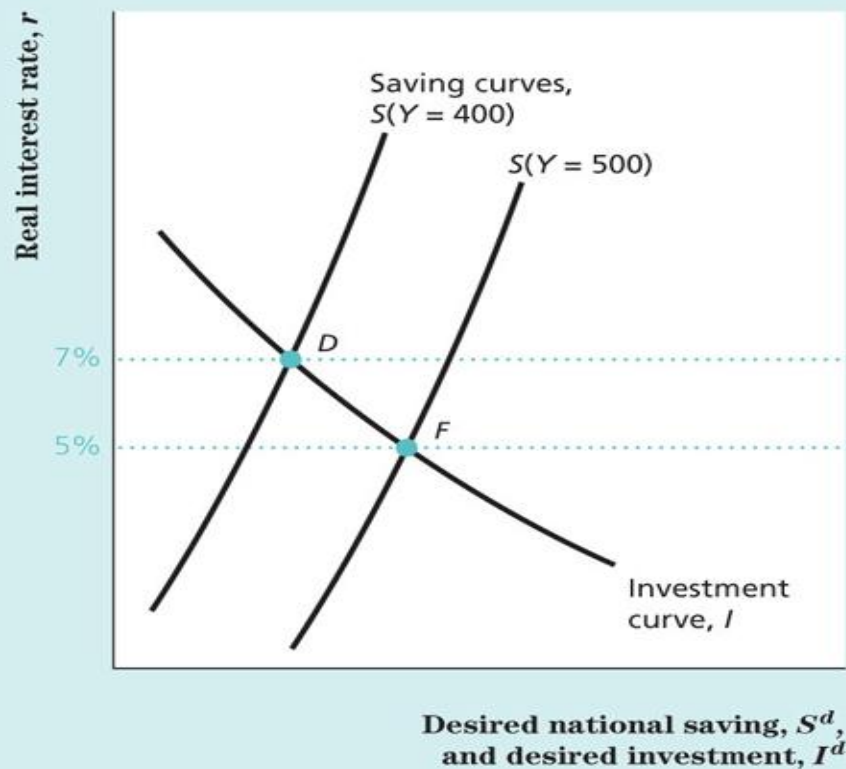
The IS Curve: Equilibrium in the Goods Market (continued)

- The consumption function is as often as not written as:

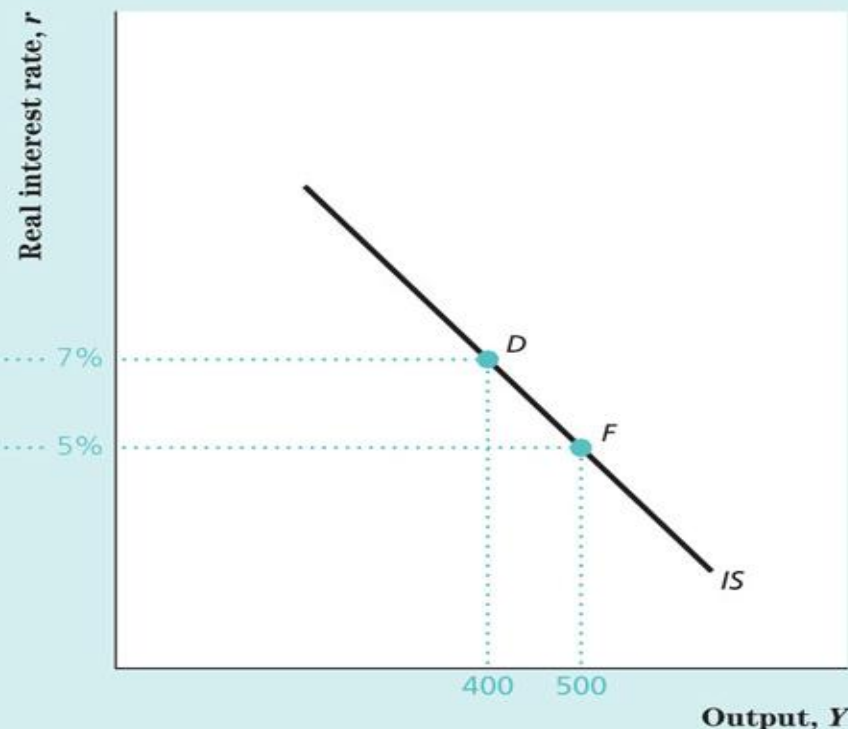
$$C^d = c_0 + c_y(Y - T) - c_r r$$

- Where T is the level of taxation. In this case the IS curve is:

$$r = \{(c_0 + \lambda_0 + G - c_y T) - (1 - c_y)Y\} / (c_r + \lambda_r)$$



(a)



(b)

FIGURE 9.2

DERIVING THE IS CURVE

(a) The graph shows the goods market equilibrium for two different levels of output: 400 and 500 (the output corresponding to each saving curve is indicated in parentheses next to the curve). Higher levels of output (income) increase desired national saving and shift the saving curve to the right. When output is 400, the real interest rate that clears the goods market is 7% (point D). When output is 500, the market-clearing interest rate is 5% (point F).

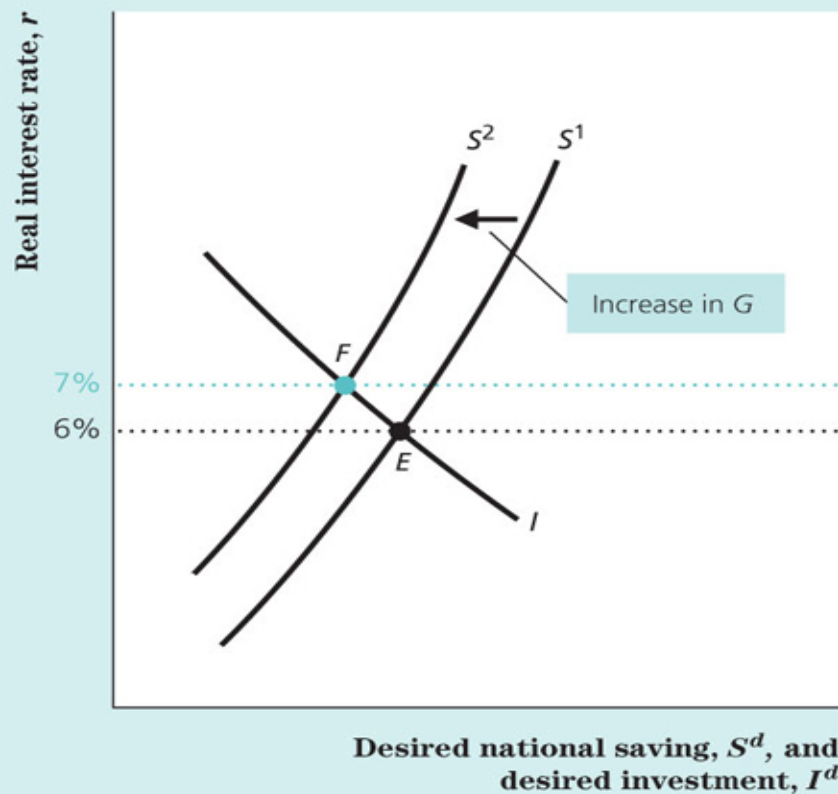
(b) For each level of output the IS curve shows the corresponding real interest rate that clears the goods market. Thus, each point on the IS curve corresponds to an equilibrium point in the goods market. As in (a), when output is 400, the real interest rate that clears the goods market is 7% (point D); when output is 500, the market-clearing interest rate is 5% (point F). Because higher output raises saving and leads to a lower market-clearing interest rate, the IS curve slopes downward.

Factors That Shift the IS Curve

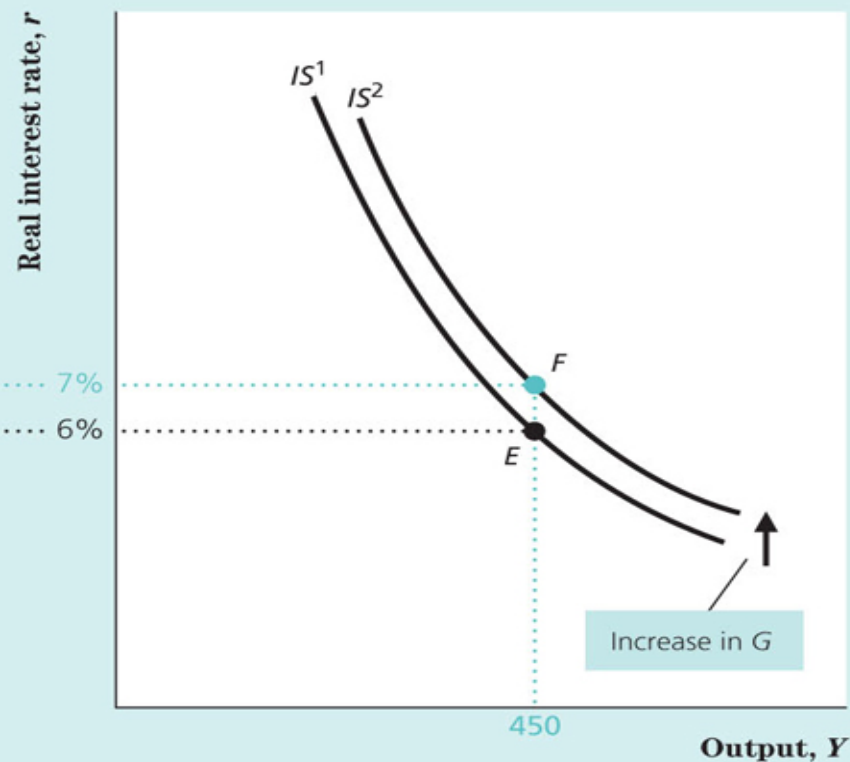
- For **constant output**, any change in the economy that reduces desired national saving relative to desired investment will increase the real interest rate that clears the goods market and shift the IS curve.
- An increase in G , financed by a tax increase, would do this but this is not the only source of a shift in the IS curve.
- The resulting excess demand for goods and services at constant output can only be eliminated by in the real rate of interest.

Factors That Shift the IS Curve (continued)

- The slope of the *IS* curve can also be interpreted in terms of goods equilibrium condition ($AD=AS$) as we know.
- For a **given level of output**, any change that increases (decreases) the aggregate demand for goods shifts the *IS* curve up (down).
- A change in G with output constant, will shift the *IS* curve and interest rates up.



(a)



(b)

FIGURE 9.3

EFFECT ON THE IS CURVE OF A TEMPORARY INCREASE IN GOVERNMENT PURCHASES

(a) The saving–investment diagram shows the effects of a temporary increase in government purchases, G , with output Y constant at 450. The increase in G reduces desired national saving and shifts the saving curve to the left, from S^1 to S^2 . The goods market equilibrium point moves from point E to point F , and the real interest rate rises from 6% to 7%.

(b) The increase in G raises the real interest rate that clears the goods market for any level of output. Thus, the IS curve shifts up and to the right, from IS^1 to IS^2 . In this example, with output held constant at 450, an increase in government purchases raises the real interest rate that clears the goods market from 6% (point E) to 7% (point F).

The Price of a Nonmonetary Asset and the Interest Rate

- Given the promised schedule of repayments of a bond or other nonmonetary asset, the higher the price of the asset, the lower is the **nominal interest rate** of the asset.

- The price of one period bond is:

$$P = \text{coupon}/(1 + i)$$

- As is easily seen, with the coupon unchanged (the stream of payments), P and i (the nominal interest rate) are inversely related.

The Price of a Nonmonetary Asset (continued)

- For a **given rate of inflation** the price of a nonmonetary asset and its **real interest rate** are also inversely related.
- If the price of the bond were to fall, because people were selling them, then the interest rate would rise, given an unchanged stream of payments or coupons.
- This is a key relationship and will be used to explain how equilibrium occurs in the money market.

The Equality of Money Demanded and Supplied

- The real money supply curve (M^s) is a vertical line, it does not depend on the real interest rate but rather on central bank actions.
- The money demand curve (M^d) slopes downward. With higher r the attractiveness of money as an asset decreases.

The Equality of MD and MS (continued)

- Asset market equilibrium occurs at the intersection of the M^s and the M^d curves.
- With M^s unchanged an increase in Y increases M^d .
- When M^d increases people sell nonmonetary assets, their price falls and the interest rate increases.

The LM Curve: Asset Market Equilibrium

- The *LM curve* is a graphical representation of the relationship between output and the real interest rate that clears the asset market.
- The *LM* curve slopes upward.
- At all points of the curve $M^d = M^s$.

The LM Curve: Asset Market Equilibrium (continued)

- As in the case of the *IS* curve, we can demonstrate the slope of the *LM* curve as an equilibrium relationship, this time between real money demand and supply.
- Suppose that real money demand was represented by the following:

$$M^d/P = l_0 + l_y Y - l_r(r + \pi^e)$$

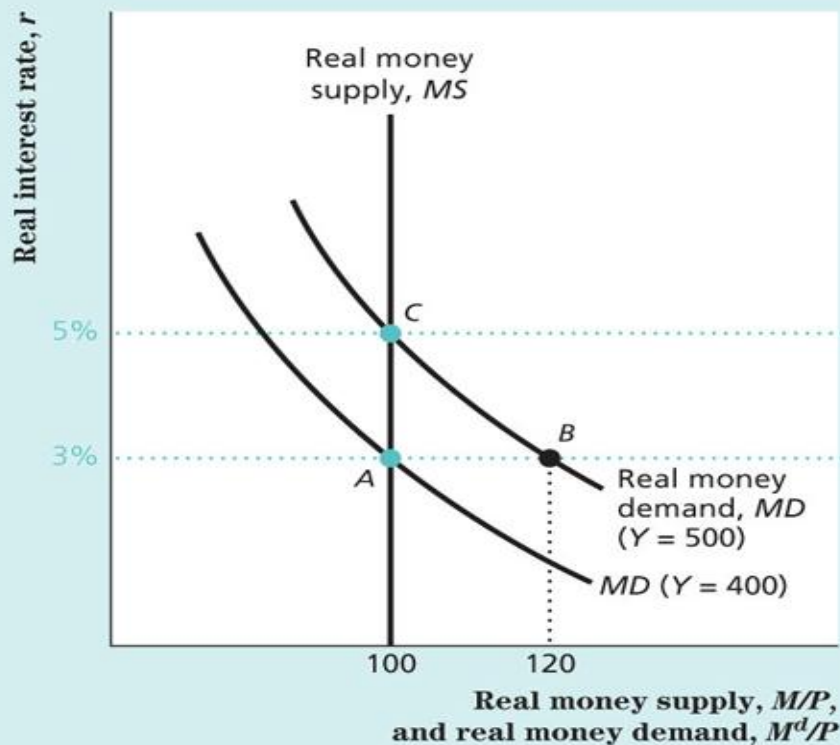
- The symbols “*l*” represent coefficients.

The LM Curve: Asset Market Equilibrium (continued)

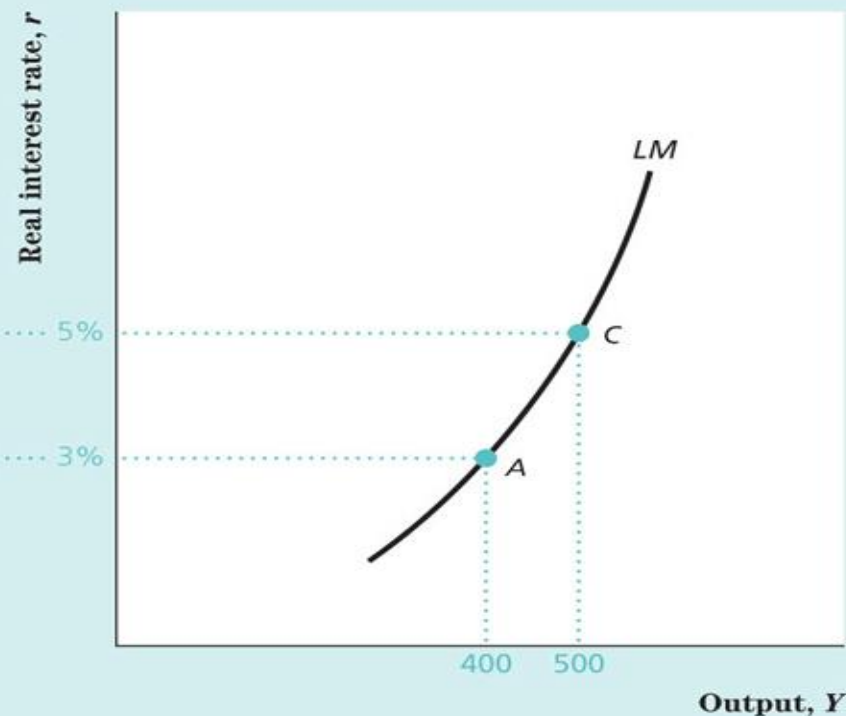
- Then setting $M^d/P = M^s/P$ and solving out for r we get:

$$r = (l_0/l_r) + (l_y/l_r)Y - (1/l_r)(M/P) - \pi^e$$

- The LM clearly slopes upwards in Y . Note that changes in π^e and (M/P) will shift the curve in the same direction.



(a)



(b)

FIGURE 9.4

DERIVING THE LM CURVE

(a) The curves show real money demand and real money supply. Real money supply is fixed at 100. When output is 400, the real money demand curve is MD ($Y = 400$); the real interest rate that clears the asset market is 3% (point A). When output is 500, more money is demanded at the same real interest rate, so the real money demand curve shifts to the right to MD ($Y = 500$). In this case, the real interest rate that clears the asset market is 5% (point C).

(b) The graph shows the corresponding LM curve. For each level of output, the LM curve shows the real interest rate that clears the asset market. Thus, when output is 400, the LM curve shows that the real interest rate that clears the goods market is 3% (point A). When output is 500, the LM curve shows a market-clearing real interest rate of 5% (point C). Because higher output raises money demand, and thus raises the real interest rate that clears the asset market, the LM curve slopes upward.

Factors that Shift the LM Curve

- For constant output, any change that reduces (increases) the real money supply relative to the real demand for money, will increase (decrease) the real interest rate that clears the asset market, and cause the *LM* curve to shift up (down).

Factors that Shift the LM Curve (continued)

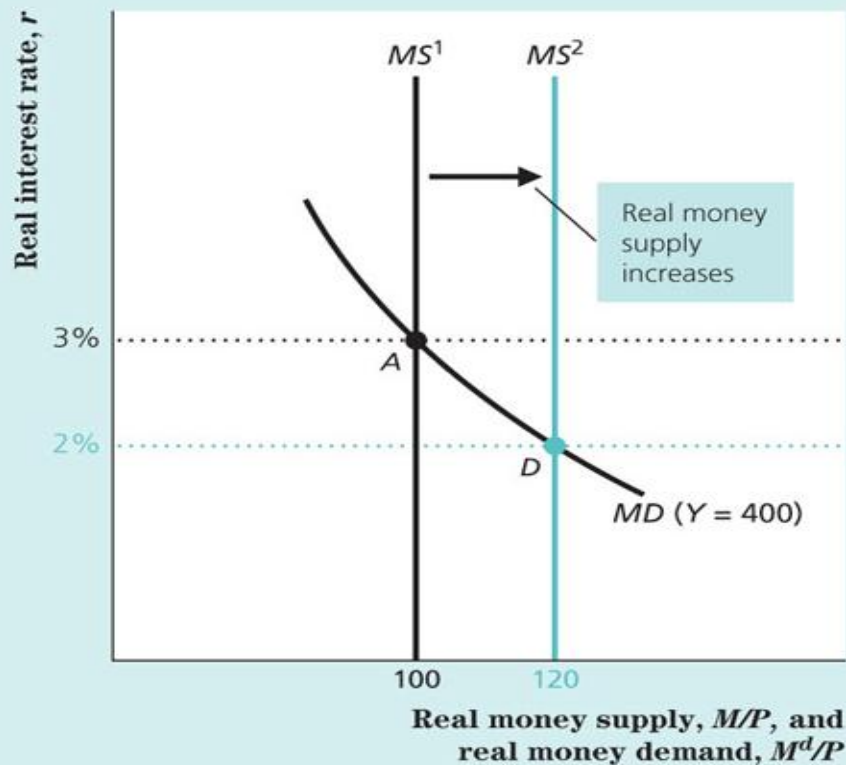
- An increase in expected inflation is a special case and it will also shift the LM curve down and to the right.
- As π^e rises, the demand for money falls (money is expected to be worth less) and people start buying non-monetary assets. This bids down interest rates.
- With output unchanged, the real interest rate, r , must fall and this clears the asset market; i.e., equilibrium is restored.
- This is called the “Mundell-Tobin” effect.

Factors that Shift the LM Curve (continued)

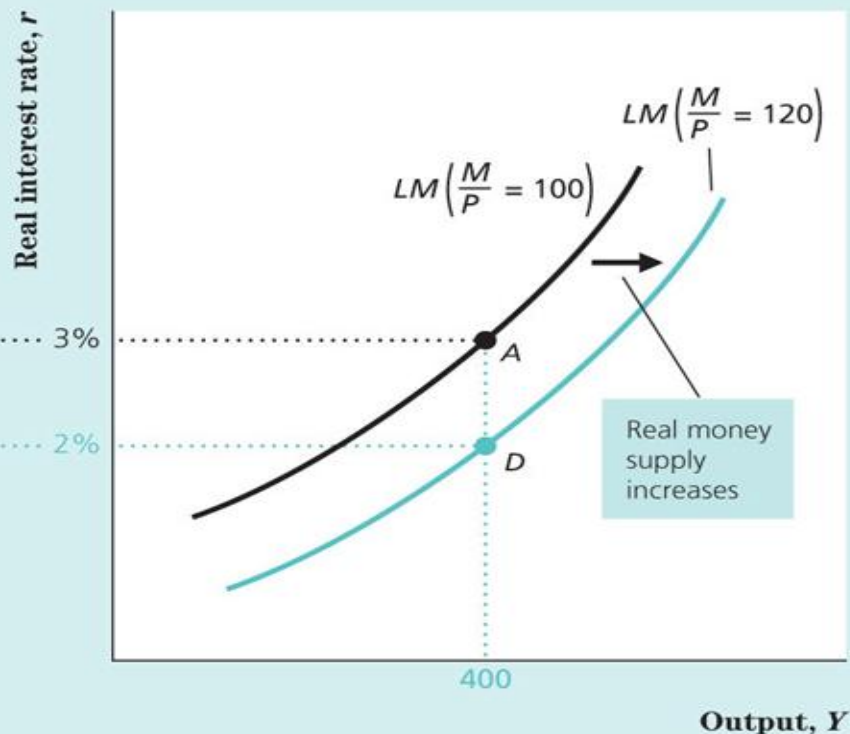
- Other factors that would shift the LM curve include changes in:
 - Return on money
 - Wealth
 - Risk on alternative assets
 - Liquidity of alternative assets
 - Efficiency of payments system

Changes in the Real Money Supply

- From Slide 19, changes in the real money supply, through the term $(1/l_r)(M/P)$, will shift the curve.
- An increase in the real money supply (M/P) will reduce r and shift the LM curve down and to the right.
- Initially there is an excess supply of money which causes holders of wealth try to purchase nonmonetary assets, in turn causing those asset prices to go up and r to go down.
- This process is sometimes called the “monetary transmission mechanism” and it means that changes in monetary are transmitted through the financial markets toward the goods market.



(a)



(b)

FIGURE 9.5

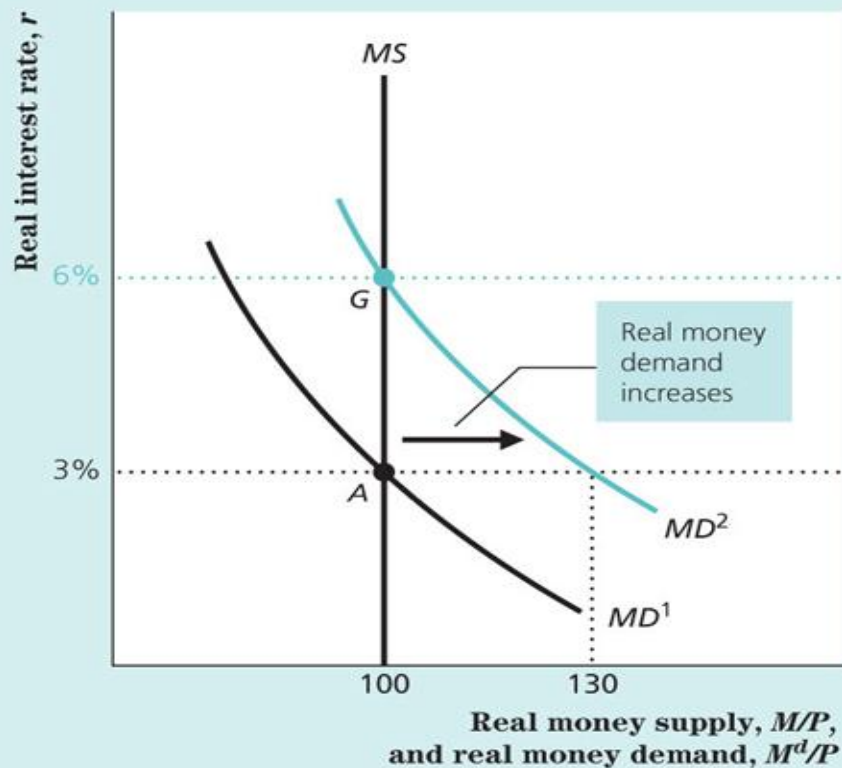
AN INCREASE IN THE REAL MONEY SUPPLY SHIFTS THE LM CURVE DOWN AND TO THE RIGHT

(a) An increase in the real supply of money shifts the money supply curve to the right, from MS^1 to MS^2 . For a constant level of output, the real interest rate that clears the asset market falls. If output is fixed at 400, for example, the money demand curve is $MD (Y = 400)$ and the real interest rate that clears the asset market falls from 3% (point A) to 2% (point D).

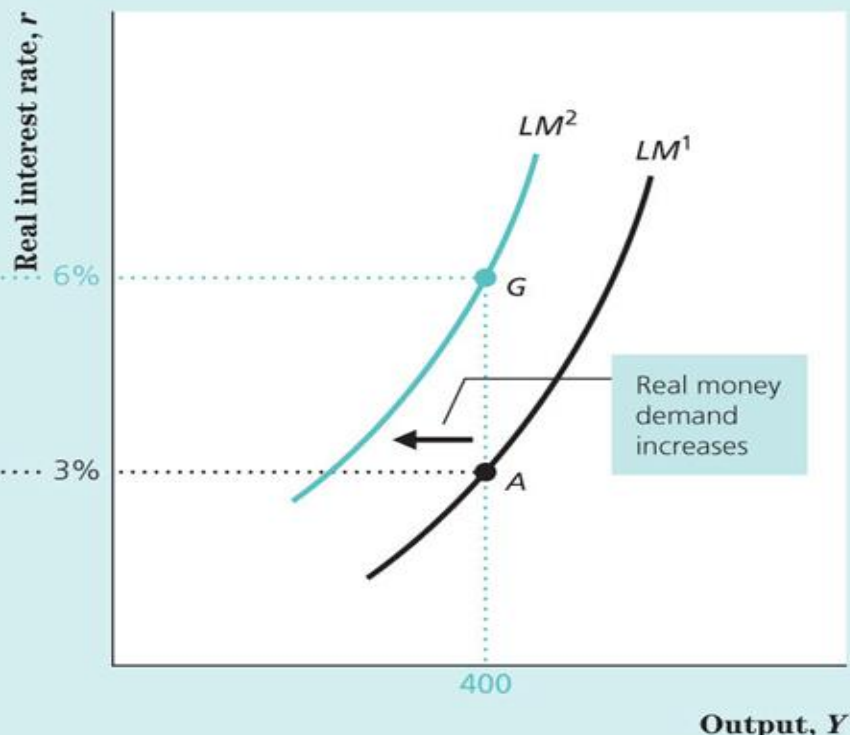
(b) The graph shows the effect of the increase in real money supply on the LM curve. For any level of output, the increase in the real money supply causes the real interest rate that clears the asset market to fall. So, for example, when output is 400, the increase in the real money supply causes the real interest rate that clears the asset market to fall from 3% (point A) to 2% (point D). Thus, the LM curve shifts down and to the right, from LM for $M/P = 100$ to LM for $M/P = 120$.

Changes in the Real Money Demand

- A change in any variable that affects real money demand, other than output or the real interest rate, will also shift the LM curve.
- The process works as before: any excess demand (supply) for money causes wealth holders to sell (buy) non-monetary assets.
- These actions bid down (up) those asset prices and cause the real interest rate to rise (fall).



(a)



(b)

FIGURE 9.6

AN INCREASE IN REAL MONEY DEMAND SHIFTS THE LM CURVE UP AND TO THE LEFT

(a) With output constant at 400 and the real money supply at 100, an increase in the interest rate paid on money raises real money demand. The money demand curve shifts up and to the right, from MD^1 to MD^2 , and the real interest rate that clears the asset market rises from 3% (point A) to 6% (point G).

(b) The graph shows the effect of the increase in real money demand on the LM curve. When output is 400, the increase in real money demand raises the real interest rate that clears the asset market from 3% (point A) to 6% (point G). More generally, for any level of output, the increase in real money demand raises the real interest rate that clears the asset market. Thus, the LM curve shifts up and to the left, from LM^1 to LM^2 .

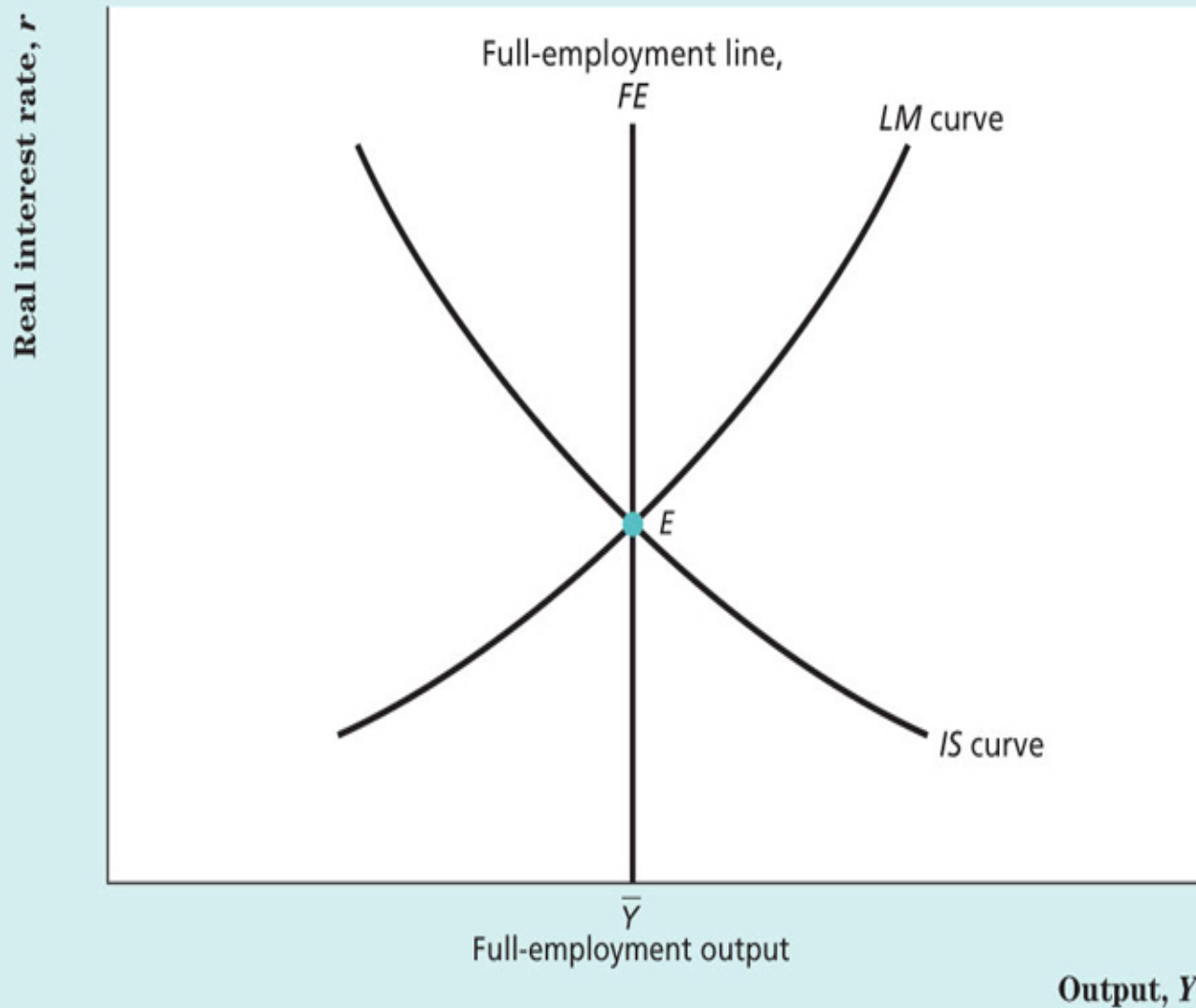
General Equilibrium in the Complete *IS-LM* Model

- When the economy is in general equilibrium:
 - *the FE line, points along which the labour market is in equilibrium;*
 - *the IS curve, points along which the goods market is in equilibrium; and*
 - *the LM curve, points along which the asset market is in equilibrium.*
- The general equilibrium of the economy always occurs at the intersection of the *IS* curve and the *FE* line.
- Adjustments of the price level cause the *LM* curve to shift until it passes through the general equilibrium point.

FIGURE 9.7

GENERAL EQUILIBRIUM IN THE *IS-LM* MODEL

The economy is in general equilibrium when quantities supplied equal quantities demanded in every market. The general equilibrium point, E , lies on the IS curve, the LM curve, and the FE line. Thus, at E , and only at E , the goods market, the asset market, and the labour market are simultaneously in equilibrium.



A Temporary Adverse Supply Shock

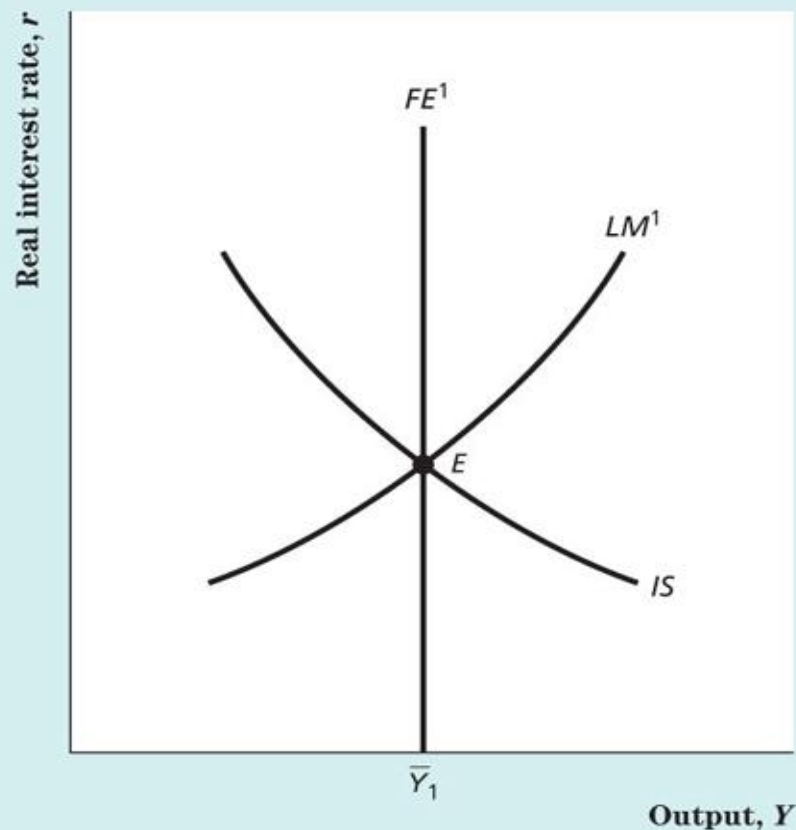
- Suppose the productivity parameter A in the production function drops temporarily.
- It reduces the MPN and shifts the labour demand curve down. The labour supply curve is unaffected.
- Because the shock is temporary, MPK^f is unaffected and accordingly the demand for K remains unchanged.
- The FE line shifts left because of lower N and A .

A Temporary Adverse Supply Shock (continued)

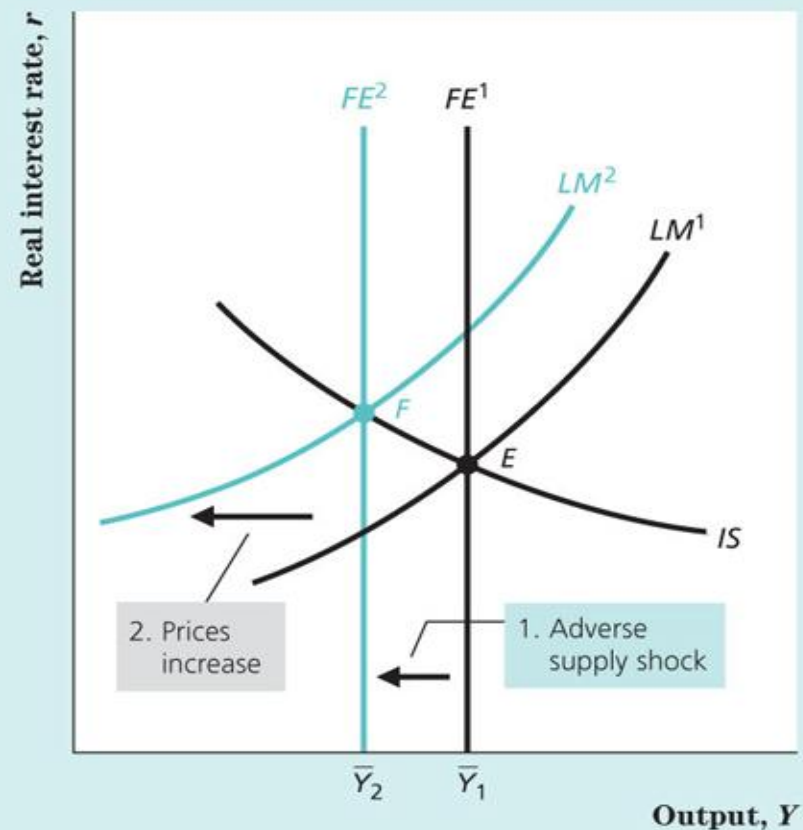
- A temporary adverse supply shock is a movement **along** the *IS* curve, **not a shift** of the *IS* curve.
- A temporary adverse supply shock has no *direct* effect on the demand for, or the supply of money.
- It is the *LM* curve that shifts and it will continue to move until it passes through the intersection of the *FE* line and the *IS* curve.

A Temporary Adverse Supply Shock (continued)

- For that to happen M/P must fall, and with M constant, P has to rise.
- It is firms that will start raising prices since at the temporary equilibrium they are not making profits.
- A temporary supply shock should cause a temporary increase in the rate of inflation during the adjustment process.
- In the new equilibrium, the real rate of interest is higher, output is lower and the price level is higher.
- The process is the reverse for a positive supply shock.



(a)



(b)

FIGURE 9.8

EFFECTS OF A TEMPORARY ADVERSE SUPPLY SHOCK

(a) Initially, the economy is in general equilibrium at point E , with output at its full-employment level $\bar{Y}_1$.

(b) A temporary adverse supply shock reduces full-employment output from $\bar{Y}_1$ to $\bar{Y}_2$ and shifts the FE line to the left from FE^1 to FE^2 . The new general equilibrium is represented by point F , where FE^2 intersects the unchanged IS curve. The price level increases and shifts the LM curve up and to the left, from LM^1 to LM^2 , until it passes through F . At the new general equilibrium point, F , output is lower, the real interest rate is higher, and the price level is higher than at the original general equilibrium point, E .

Attaining General Equilibrium

- We can use the *IS-LM* model to illustrate how the economy moves to a general equilibrium point where the three curves intersect.
- We can also use this model to show some basic differences between the Classical and Keynesian schools.

The Effects of a Monetary Expansion

- Suppose that the central bank decides to raise M .
- In what follows we will assume that asset markets adjust quickly, those for goods and services somewhat more slowly and the labour market the slowest of all.
- P is constant in the short run, so M/P increases.

The Effects of a Monetary Expansion (continued)

- The LM curve will shift down and the real interest rate drops. Neither the IS nor FE curves move.
- Only the asset market and the goods market are in equilibrium, the labour market is not.
- Accordingly, the economy is not in a general equilibrium and this is illustrated by not having a general intersection of the curves.

The Effects of a Monetary Expansion (continued)

- After the increase in M , wealth holders have too much money compared with what they want to hold (an excess supply) and they start to buy non-monetary assets, bidding up their prices and lowering the real interest rate.
- So far we are holding the price level constant because we are in a short period equilibrium.

The Effects of a Monetary Expansion (continued)

- After the interest falls, the aggregate demand for goods rises (we move along the *IS* curve).
- Assume that firms respond by increasing production leading to a higher level of output in the new short-run equilibrium.
- A short-period equilibrium is one where the *IS* and *LM* curves intersect.
- Importantly at this point, the labour market is still not in equilibrium.

The Adjustment of the Price Level

- In meeting the higher level of aggregate demand, firms are producing more output than they want to given their costs – they are on their SRAS curves.
- Note that at this point, firms are not maximizing their profits since aggregate demand is greater than $\bar{Y}$. Recall that positions on the *FE* curve represent points where firms have hired *N* up to the point that profits are maximised.
- At some point firms begin to raise their prices and the economy's price level rises – that is, firms are moving to their LRAS curves.

The Adjustment of the Price Level (continued)

- As the price level rises the real money supply M/P becomes lower and the LM curve shifts up.
- The LM curve keeps shifting until it returns to its initial position, where the aggregate quantity of goods demanded equals full-employment output.
- Thus, the change in the nominal money supply causes the price level to change proportionally; that is, by the same percentage.

The Adjustment of the Price Level (continued)

- The return of the economy to general equilibrium requires adjustment of nominal wages as well as adjustment of the price of goods.
- However, real output, the real interest rate and employment are all unaffected in equilibrium – this is what we mean when we say **money is neutral**.
- Note that we have started from a position of full employment.

The Adjustment of the Price Level (continued)

- In practice the money supply increases constantly and the price level increases accordingly.
- Thus, when we talk about an increase in the money supply, we will mean an increase relative to the expected (or trend) rate of money growth.
- The same can be said for inflation.

Attaining General Equilibrium with the Equations

- Let's use the *IS* and *LM* curves from Slides 8 and 19 respectively and simplify them by collecting terms as follows:

- *IS curve* $r = \alpha_{IS} - \beta_{IS}Y$ (eq 1)

- *LM curve* $r = \alpha_{LM} + \beta_{LM}Y - (1/l_r)(M/P)$ (eq 2)

where: $\alpha_{IS} = (c_0 + \lambda_0 + G)/(c_r + \lambda_r)$

$$\alpha_{LM} = (l_0/l_r) - \pi^e$$

$$\beta_{IS} = (1 - (1-\tau)c_y)/(c_r + \lambda_r)$$

$$\beta_{LM} = (l_y/l_r)$$

The “ α 's” are constant terms while the “ β 's” are slopes.

Attaining General Equilibrium with the Equations

- **Note** that when the consumption function is written as:

$$C^d = c_0 + c_y(Y - T) - c_r r$$

- And the resulting IS curve is:

$$r = \{(c_0 + \lambda_0 + G - c_y T) - (1 - c_y)Y\} / (c_r + \lambda_r)$$

- Then:

$$\alpha'_{IS} = (c_0 + \lambda_0 + G - c_y T) / (c_r + \lambda_r)$$

$$\beta'_{IS} = (1 - c_y) / (c_r + \lambda_r)$$

Attaining General Equilibrium with the Equations (continued)

- In the short period equilibrium, we can use eq 1 and 2 to solve for r and Y . Representing the higher level of money as M' and the original price level as P_0 , then:

$$Y = \{(\alpha_{IS} - \alpha_{LM}) + (1/l_r)(M'/P_0)\}/(\beta_{IS} + \beta_{LM}) \quad (eq\ 3)$$

- This is the short period level of real output that results from the new higher level of M' with an initial unchanged level of prices P_0 .

Attaining General Equilibrium with the Equations (continued)

- We know that this is a temporary equilibrium and that the economy will go back to its long-run equilibrium level of output ($\hat{Y}$) as firms start to raise prices to meet the excess demand.
- The interest rate in the long-run equilibrium is given by eq 1 as:

$$r = \alpha_{IS} - \beta_{IS} \hat{Y} \quad (\text{eq 3})$$

- We can use this relationship in the money market equilibrium equation to get the price level as:

$$P = M' / [l_0 + l_y \hat{Y} - l_r (\alpha_{IS} - \beta_{IS} \hat{Y} + \pi^e)] \quad (\text{eq 4})$$

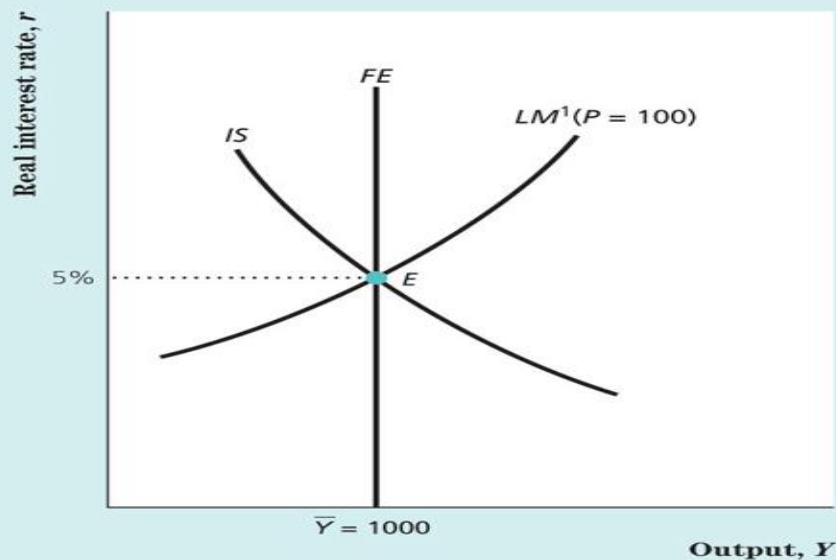
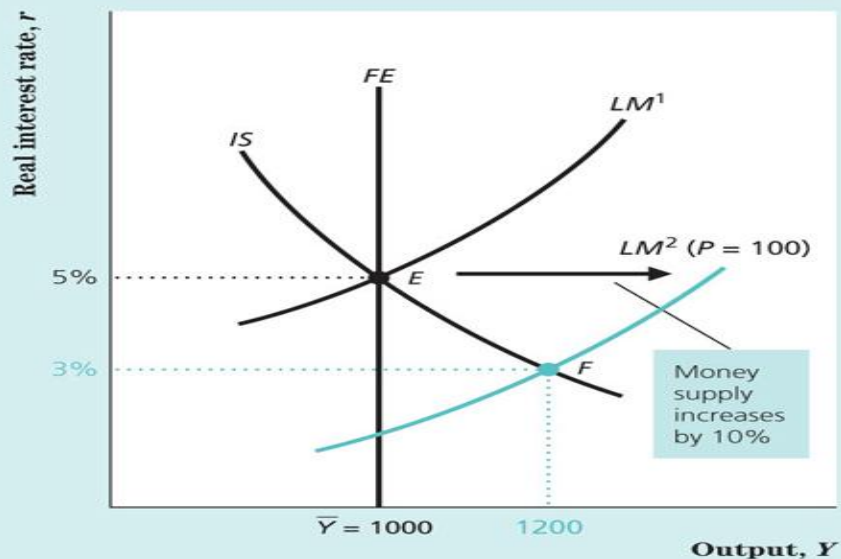
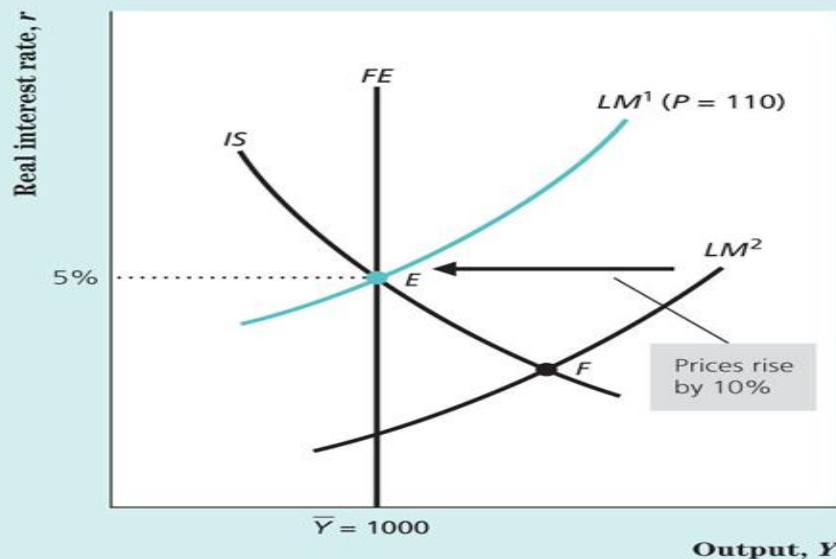
- The equilibrium price level is proportional to M and with Y back at $\hat{Y}$, P rises by the amount that M rose.

FIGURE 9.9**EFFECTS OF A MONETARY EXPANSION**

(a) The economy is in general equilibrium at point E . Output equals the full-employment level of 1000, the real interest rate is 5%, and the price level is 100.

(b) With the price level fixed, a 10% increase in the nominal money supply M raises the real money supply M/P and shifts the LM curve down and to the right, from LM^1 to LM^2 . At point F , the intersection of the IS curve and the new LM curve, LM^2 , the real interest rate has fallen to 3%, which raises the aggregate demand for goods. If firms produce extra output to meet the increase in aggregate demand, output rises to 1200 (higher than full-employment output of 1000).

(c) Because aggregate demand exceeds full-employment output at point F , firms raise prices. A 10% rise in P , from 100 to 110, restores the real money supply to its original level and shifts the LM curve back to its original position at LM^1 . This returns the economy to point E , where output again is at its full-employment level of 1000, but the price level has risen 10%, from 100 to 110.

**(a)****(b)****(c)**

The Debate Between Classical and Keynesian Economists

- Two questions central to the debate:
 - How rapidly does the economy reach general equilibrium?
 - What are the effects of monetary policy on the economy?
- We looked at this question in Chapter 8 using the *AD* and *AS* model.

Price Adjustment

- After an initial LM curve shift, the price level adjusts and shifts the LM curve back to the general equilibrium.
- There is little controversy about the fact that the price level will adjust and restore general equilibrium.
- The *classical view* is that prices are flexible and the adjustment process is rapid.

Price Adjustment (continued)

- According to the *Keynesian view*, sluggish adjustment of prices might prevent general equilibrium from being attained for a much longer period of time.
- The economy is not in general equilibrium and the labour market is not in equilibrium for an extended period.

Stabilization Policy

- Unexpected shifts in the *IS*, *LM* and the *FE* curves are the sources of business cycles.
- **Stabilization policy** is the use of fiscal and monetary policy to shift the position of the *IS* and *LM* curves so as to offset the effects of such shocks.

Monetary Neutrality

- There is **monetary neutrality** if a change in the nominal money supply changes the price level proportionately but has no effect on real variables in the long run.
- We have already shown that this is a feature of the model presented here.
- Keynesians believe in monetary neutrality in the long-run but not in the short-run.
- The classical view is the opposite.

The *AD-AS* Model

- The *AD-AS* and the *IS-LM* models are equivalent.
- Each version can be used to focus on either r or P .
- The *IS-LM* model relates the real interest rate to output.
- The *AD-AS* model relates the price level to output.

The Aggregate Demand Curve

- The **aggregate demand curve** shows the relation between the aggregate quantity of goods demanded ($C^d + I^d + G$) and the price level, P .
- The AD curve slopes downward because an increase in the price level will shift the LM curve up and to the left.
- The reduction in the real money supply will raise the real interest rate and lower aggregate demand.

The Aggregate Demand Curve (continued)

- We can use the equations from Slides 8 and 19 above to derive an equation for it.
- Recall the expression for the *IS* and *LM* curves:

$$r = (c_0 + \lambda_0)/(c_r + \lambda_r) - (1 - (1-\tau)c_y)/(c_r + \lambda_r)Y + G/(c_r + \lambda_r)$$

$$r = (l_0/l_r) + (l_y/l_r)Y - \pi^e - (1/l_r)(M/P)$$

- To get the *AD* curve we set each equal to eliminate *r* which then gives us an expression in *P* and *Y*.

The Aggregate Demand Curve (continued)

- As before we will simplify these equations by defining:

$$\alpha_{IS} = (c_0 + \lambda_0 + G)/(c_r + \lambda_r) \text{ and } \beta_{IS} = (1 - (1-\tau)c_y)/(c_r + \lambda_r)$$

$$\alpha_{LM} = (l_0/l_r) - \pi^e \text{ and } \beta_{LM} = (l_y/l_r)$$

- Then setting the two equations in Slide 54 equal to each other (in effect eliminating r), we get the downward sloping AD curve:

$$Y = [\alpha_{IS} - \alpha_{LM} + (1/l_r)(M/P)]/(\beta_{IS} + \beta_{LM})$$

- We can re-write this in terms of the price level as;

$$P = M/\{l_r[\alpha_{LM} - \alpha_{IS} + (\beta_{IS} + \beta_{LM})Y]\}$$

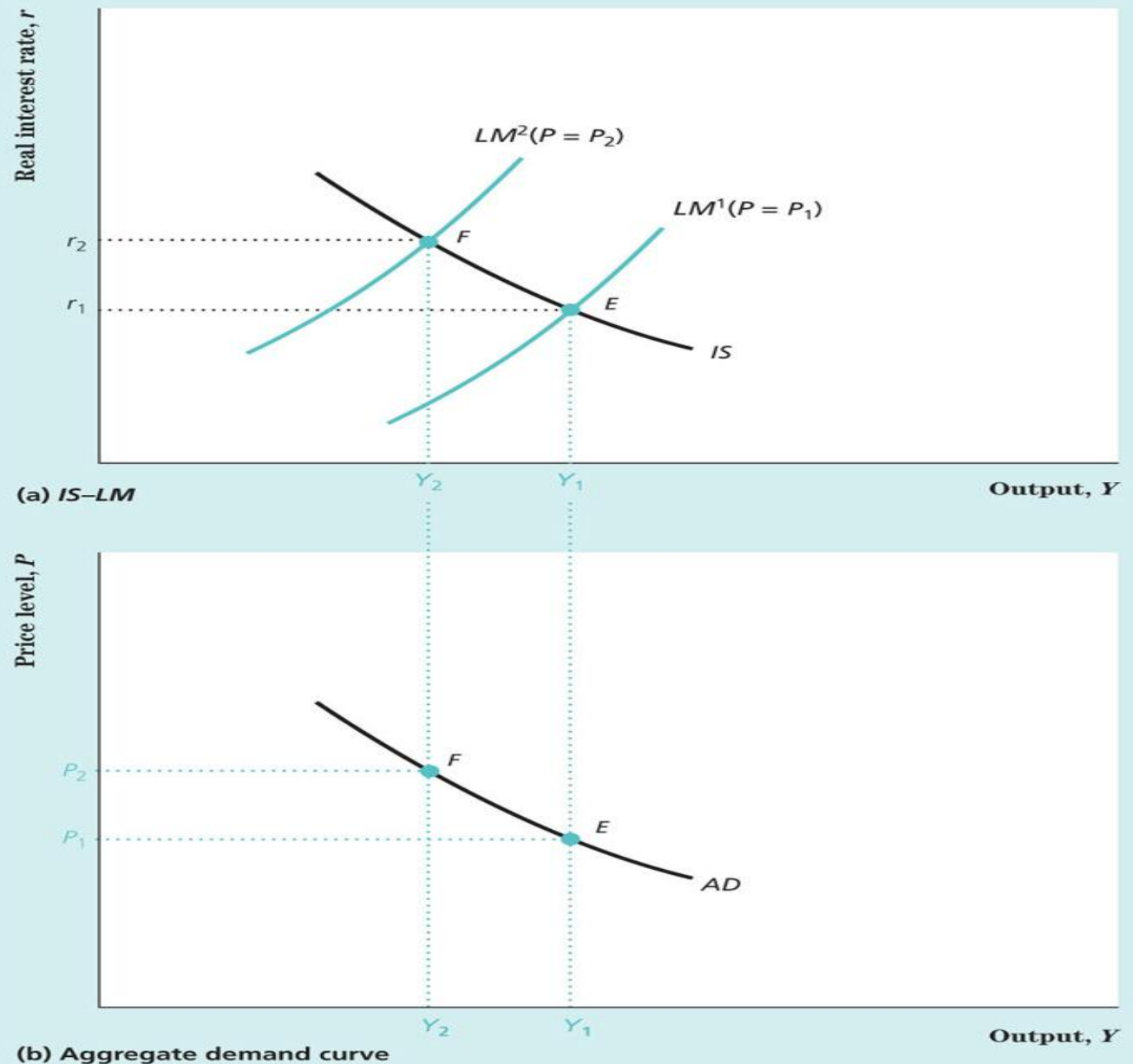
- To get the long-run price level we replace Y with $\bar{Y}$.
- In Appendix 9.B, this should be equation (9.B.28) – there is an error in the text.

FIGURE 9.10**DERIVATION OF THE
AGGREGATE DEMAND
CURVE**

For a given price level, the aggregate quantity of output demanded is determined where the IS and LM curves intersect. If the price level, P , is P_1 and the initial LM curve is LM^1 , the initial aggregate quantity of output demanded is Y_1 , corresponding to point E in both (a) and (b). To derive the aggregate demand curve, we examine what happens to the quantity of output demanded when the price level changes.

(a) An increase in the price level from P_1 to P_2 reduces the real money supply and shifts the LM curve up and to the left, from LM^1 to LM^2 . Therefore, the aggregate quantity of output demanded, represented by the intersection of the IS and LM curves, falls from Y_1 to Y_2 .

(b) The increase in the price level from P_1 to P_2 reduces the aggregate quantity of output demanded from Y_1 to Y_2 , so the aggregate demand curve slopes downward.



Factors That Shift the *AD* Curve

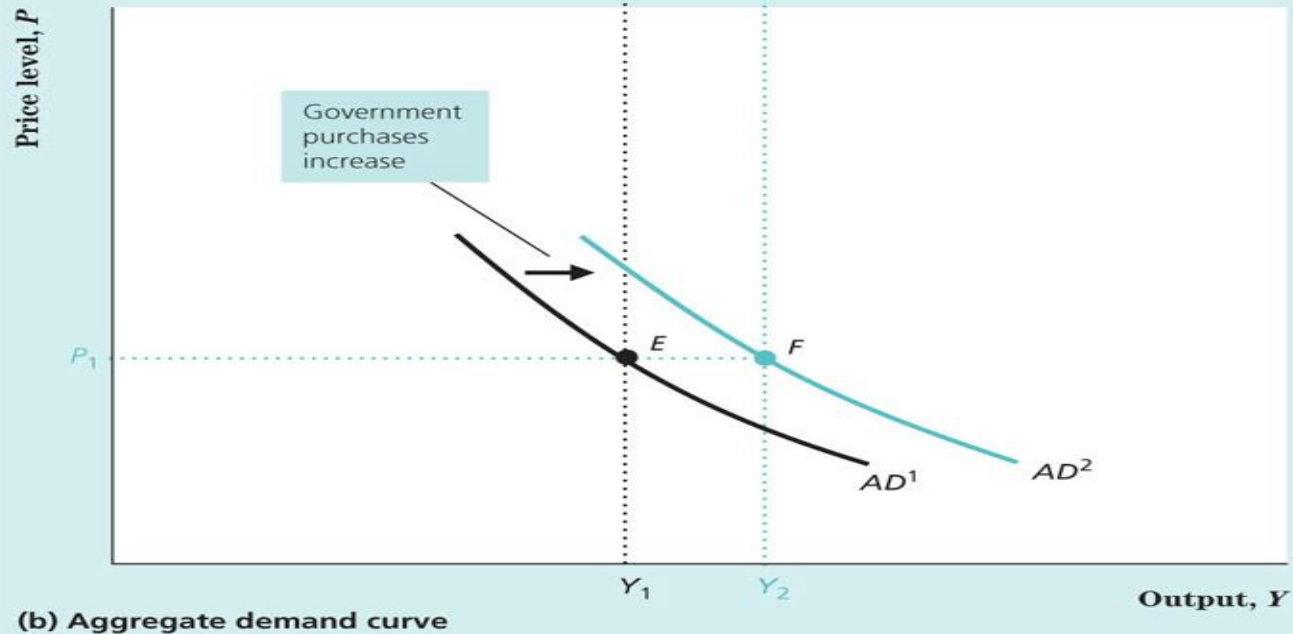
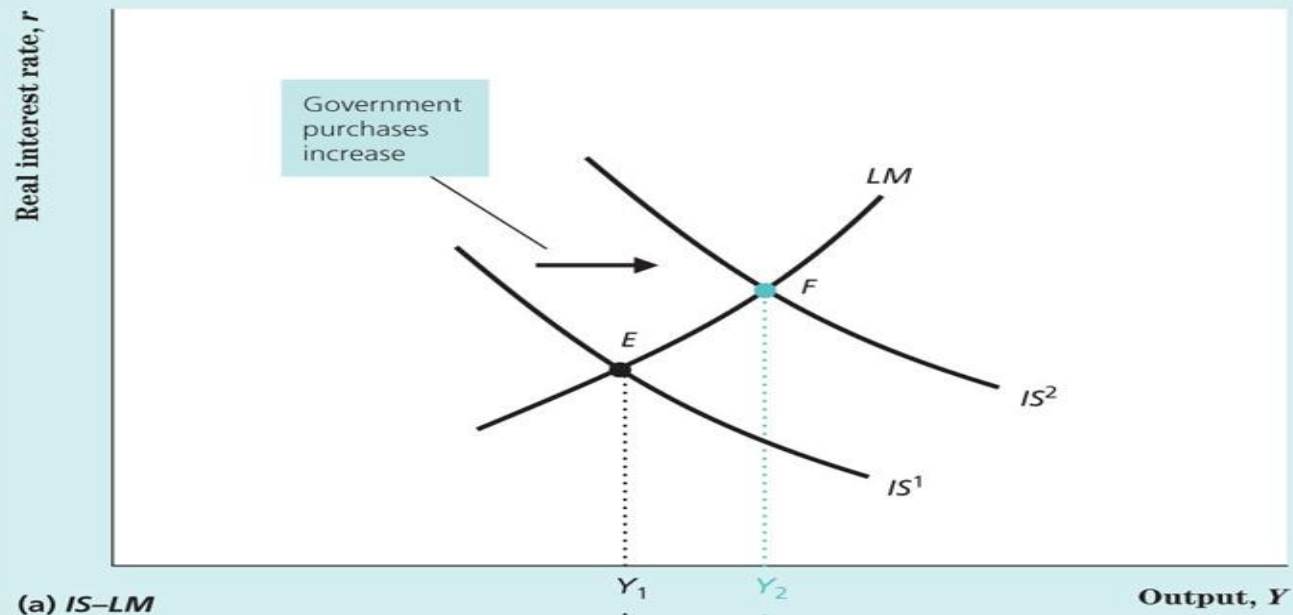
- For a constant price level:
 - any factor that changes the aggregate demand for output will cause the *AD* curve to shift;
 - any factor that causes the intersection of the *IS* and the *LM* curves to shift will cause the *AD* to shift.

FIGURE 9.11

THE EFFECT OF AN INCREASE IN GOVERNMENT PURCHASES ON THE AGGREGATE DEMAND CURVE

(a) An increase in government purchases shifts the IS curve up and to the right, from IS^1 to IS^2 . At price level P_1 , the aggregate quantity of output demanded increases from Y_1 to Y_2 , as shown by the shift of the IS – LM intersection from point E to point F .

(b) Because the aggregate quantity of output demanded rises at any price level, the AD curve shifts to the right. Points E and F in part (b) correspond to points E and F in part (a).



The Aggregate Supply Curve

- The **aggregate supply curve** shows the relation between the price level and the aggregate amount of output that firms supply.
- The prices remain fixed in the short run and the **short-run aggregate supply curve (SRAS)** is a horizontal line.

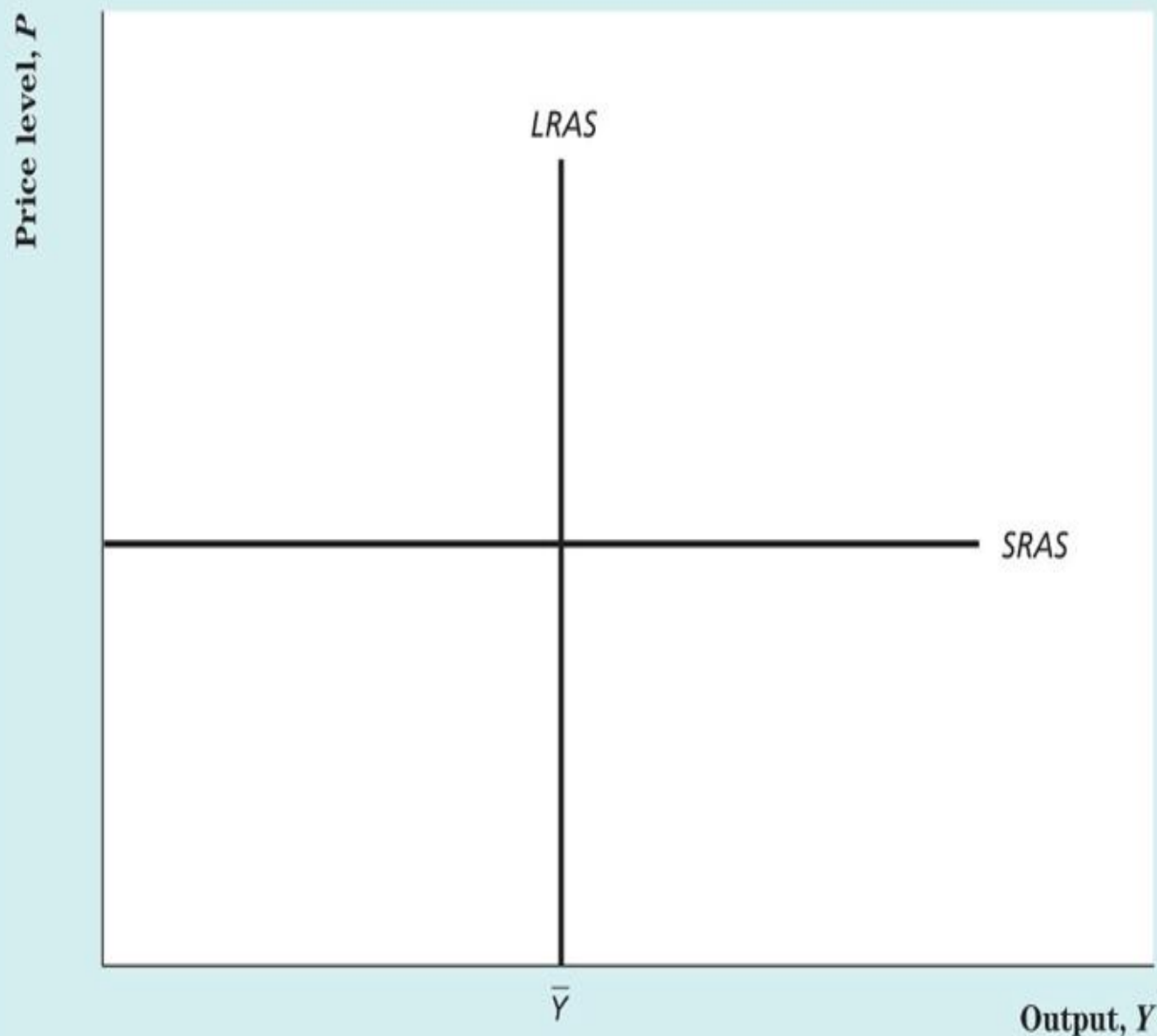
The Aggregate Supply Curve (continued)

- Prices adjust to clear all the markets in the long-run, employment equals $\bar{N}$ and output supplied is the full-employment output $\bar{Y}$.
- The long-run aggregate supply curve (*LRAS*) is a vertical line.

FIGURE 9.12

THE SHORT-RUN AND LONG-RUN AGGREGATE SUPPLY CURVES

In the short run, firms supply the amount of output demanded at the fixed price, so the short-run aggregate supply (*SRAS*) curve is a horizontal line. In the long run, when the labour market clears, firms supply the full-employment level of output, $\bar{Y}$, regardless of the price level. Thus, the long-run aggregate supply (*LRAS*) curve is a vertical line at $Y = \bar{Y}$.



Factors That Shift the *AS* Curve

- Any factor that changes the full-employment level of output, $\bar{Y}$, shifts the *LRAS*.
- The *SRAS* curve shifts whenever firms change their prices in the short-run (e.g. due to costs changes).

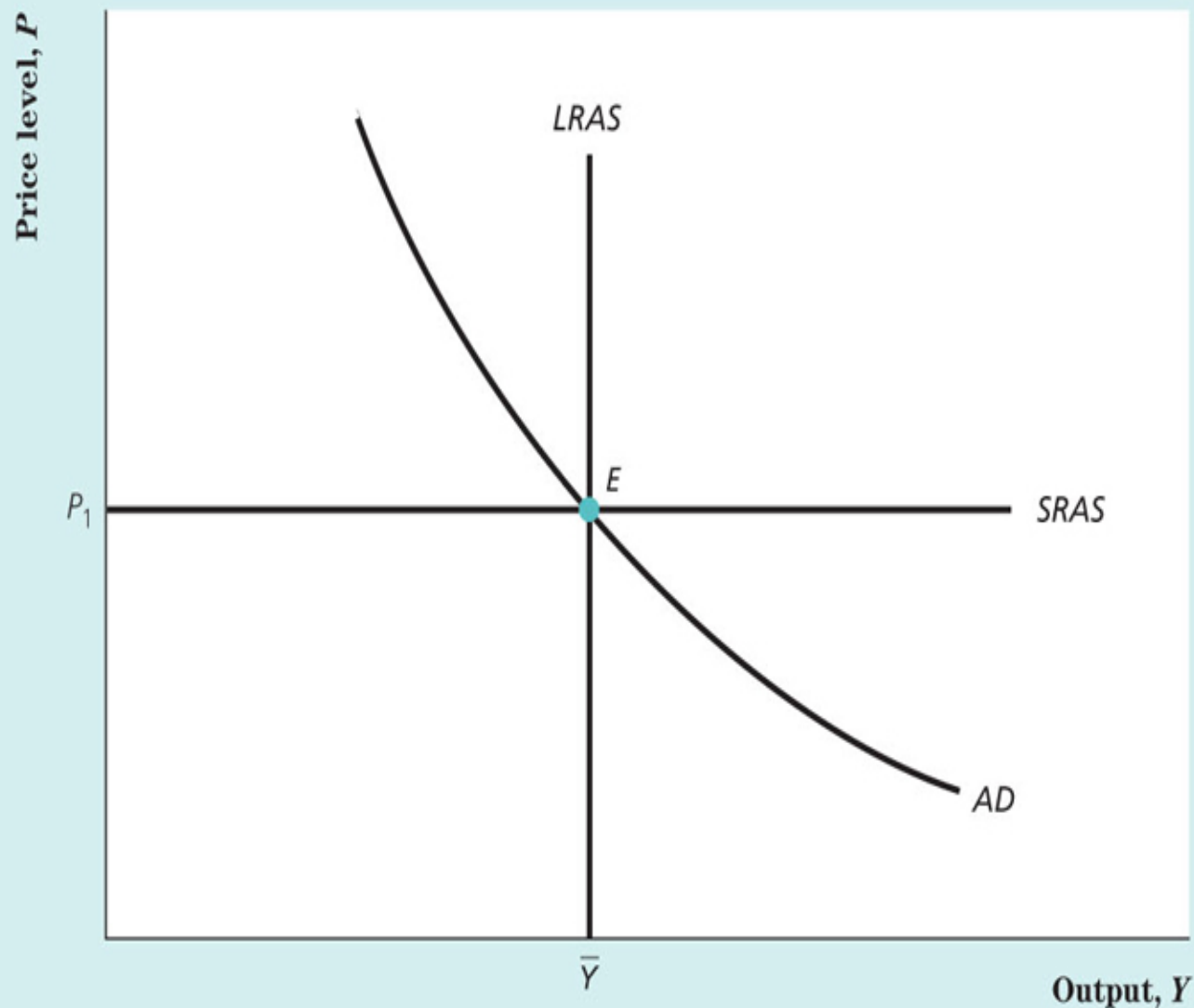
Equilibrium in the *AD-AS* Model

- Long-run equilibrium is the same as general equilibrium because in long-run equilibrium, all markets clear.
- In general equilibrium, or long-run equilibrium, *AD*, *SRAS* and *LRAS* curves intersect at a common point.

FIGURE 9.13

EQUILIBRIUM IN THE *AD-AS* MODEL

Short-run equilibrium is represented by the intersection of the *AD* and *SRAS* curves at point *E*. At short-run equilibrium, prices are fixed and firms meet demand at those prices. Long-run equilibrium, which occurs after prices have fully adjusted, is represented by the intersection of the *AD* and *LRAS* curves, also at point *E*. Long-run equilibrium is the same as general equilibrium because in long-run equilibrium all markets clear.



Monetary Neutrality in the *AD-AS* Model

- An increase in M shifts the AD curve up and to the right.
- In the short run the price level remains fixed and $SRAS$ does not change.
- In the long run the price level rises, the $SRAS$ shifts up to the point where the AD and the $LRAS$ curves intersect.
- We conclude (once again) that money is neutral in the long-run.

FIGURE 9.14

MONETARY NEUTRALITY IN
THE AD-AS FRAMEWORK

If we start from general equilibrium at point E , a 10% increase in the nominal money supply shifts the AD curve up by 10% at each level of output, from AD^1 to AD^2 . The AD curve shifts up by 10% because at any given level of output, a 10% increase in the price level is needed to keep the real money supply, and, thus, the aggregate quantity of output demanded, unchanged. In the new short-run equilibrium at point F , the price level is unchanged, and output is higher than its full-employment level. In the new long-run equilibrium at point H , output is unchanged at $\bar{Y}$, and the price level P_2 is 10% higher than the initial price level P_1 . Thus, money is neutral in the long run.

