4. Falling prices can either increase or decrease equilibrium income. There are two ways in which falling prices can increase income. First, an increase in real money balances shifts the *LM* curve downward, thereby increasing income. Second, the *IS* curve shifts to the right because of the Pigou effect: real money balances are part of household wealth, so an increase in real money balances makes consumers feel wealthier and buy more. This shifts the *IS* curve to the right, also increasing income.

   There are two ways in which falling prices can reduce income. The first is the debt-deflation theory. An unexpected decrease in the price level redistributes wealth from debtors to creditors. If debtors have a higher propensity to consume than creditors, then this redistribution causes debtors to decrease their spending by more than creditors increase theirs. As a result, aggregate consumption falls, shifting the *IS* curve to the left and reducing income. The second way in which falling prices can reduce income is through the effects of expected deflation. Recall that the real interest rate r equals the nominal interest rate i minus the expected inflation rate π^e: $r = i - \pi^e$. If everyone expects the price level to fall in the future (i.e., π^e is negative), then for any given nominal interest rate, the real interest rate is higher. A higher real interest rate depresses investment and shifts the *IS* curve to the left, reducing income.

Problems and Applications

1. a. If the central bank increases the money supply, then the *LM* curve shifts downward, as shown in Figure 11–4. Income increases and the interest rate falls. The increase in disposable income causes consumption to rise; the fall in the interest rate causes investment to rise as well.

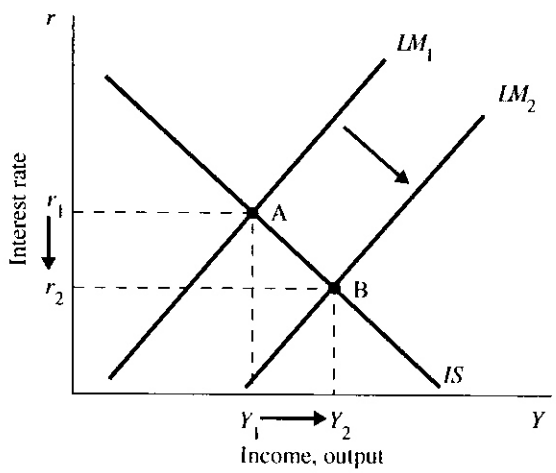


Figure 11–4

b. If government purchases increase, then the government-purchases multiplier tells us that the *IS* curve shifts to the right by an amount equal to $[1/(1 - MPC)]\Delta G$. This is shown in Figure 11–5. Income and the interest rate both increase. The increase in disposable income causes consumption to rise, while the increase in the interest rate causes investment to fall.

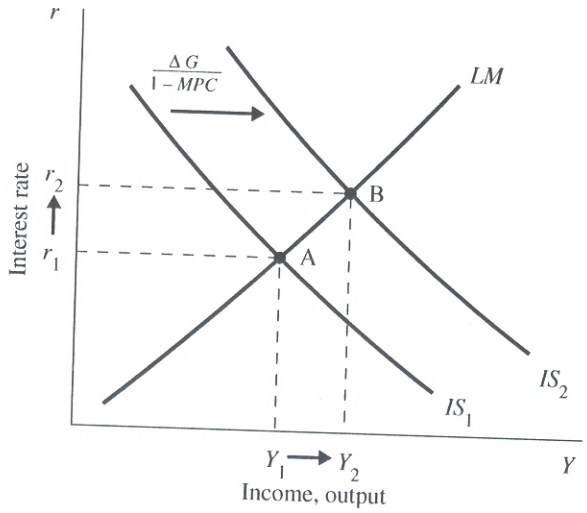


Figure 11–5

c. If the government increases taxes, then the tax multiplier tells us that the *IS* curve shifts to the left by an amount equal to $[-MPC/(1 - MPC)]\Delta T$. This is shown in Figure 11–6. Income and the interest rate both fall. Disposable income falls because income is lower and taxes are higher; this causes consumption to fall. The fall in the interest rate causes investment to rise.

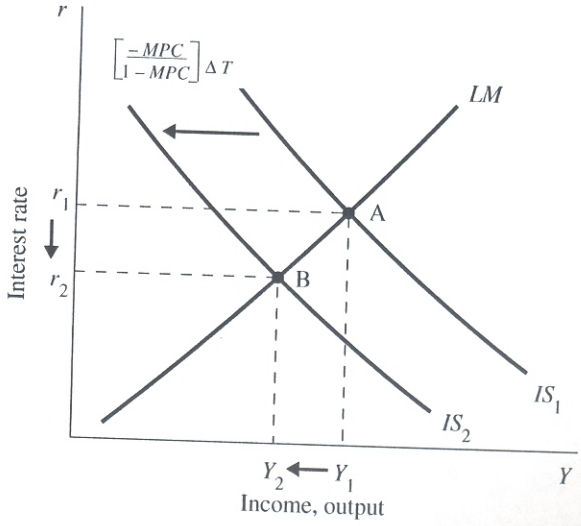


Figure 11–6

We can figure out how much the *IS* curve shifts in response to an equal increase in government purchases and taxes by adding together the two multiplier effects that we used in parts (b) and (c):

$$\Delta Y = [(1/(1 - MPC))]\Delta G] - [(MPC/(1 - MPC))\Delta T]$$

Because government purchases and taxes increase by the same amount, we know that $\Delta G = \Delta T$. Therefore, we can rewrite the above equation as:

$$\Delta Y = [(1/(1 - MPC)) - (MPC/(1 - MPC))]\Delta G$$

$$\Delta Y = \Delta G.$$

This expression tells us how output changes, holding the interest rate constant. It says that an equal increase in government purchases and taxes shifts the *IS* curve to the right by the amount that *G* increases.

This shift is shown in Figure 11–7. Output increases, but by less than the amount that *G* and *T* increase; this means that disposable income $Y - T$ falls. As a result, consumption also falls. The interest rate rises, causing investment to fall.

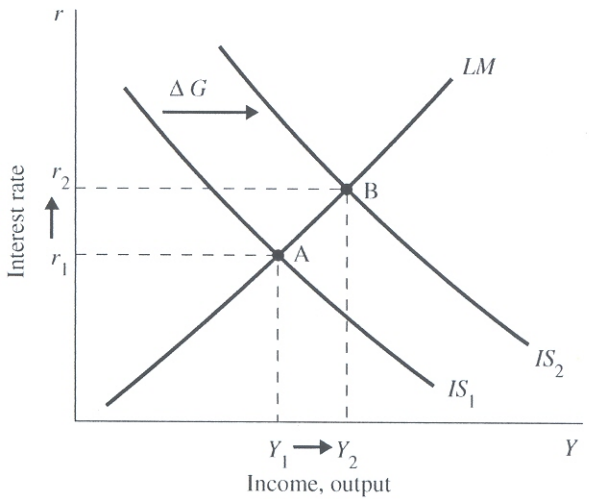


Figure 11–7

2. a. The invention of the new high-speed chip increases investment demand, which shifts the *IS* curve out. That is, at every interest rate, firms want to invest more. The increase in the demand for investment goods shifts the *IS* curve out, raising income and employment. Figure 11–8 shows the effect graphically.

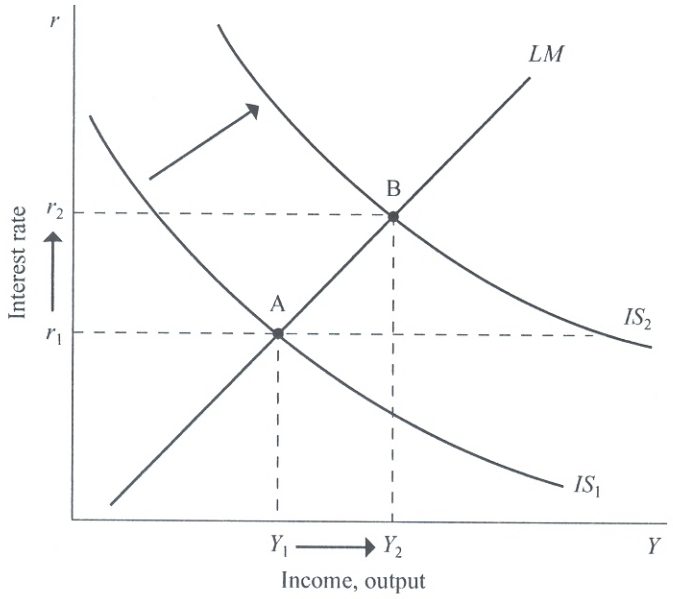


Figure 11–8

The increase in income from the higher investment demand also raises interest rates. This happens because the higher income raises demand for money; since the supply of money does not change, the interest rate must rise in order to restore equilibrium in the money market. The rise in interest rates partially offsets the increase in investment demand, so that output does not rise by the full amount of the rightward shift in the *IS* curve.

Overall, income, interest rates, consumption, and investment all rise.

b. The increased demand for cash shifts the *LM* curve up. This happens because at any given level of income and money supply, the interest rate necessary to equilibrate the money market is higher. Figure 11–9 shows the effect of this *LM* shift graphically.

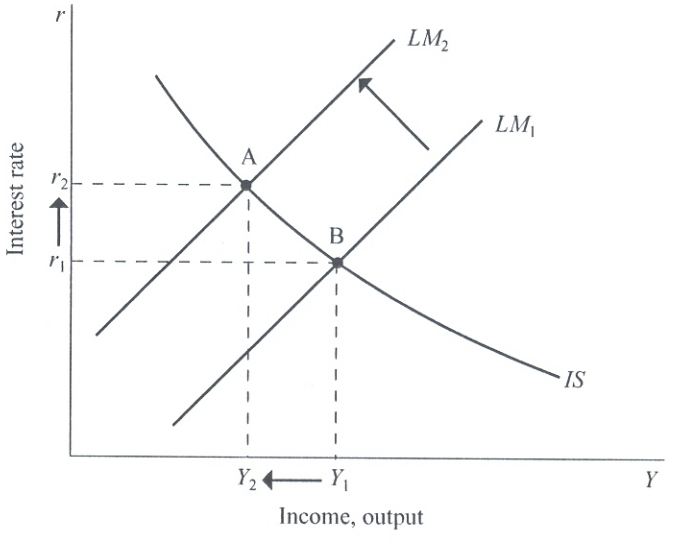


Figure 11–9

The upward shift in the *LM* curve lowers income and raises the interest rate. Consumption falls because income falls, and investment falls because the interest rate rises.

c. At any given level of income, consumers now wish to save more and consume less. Because of this downward shift in the consumption function, the *IS* curve shifts inward. Figure 11–10 shows the effect of this *IS* shift graphically.

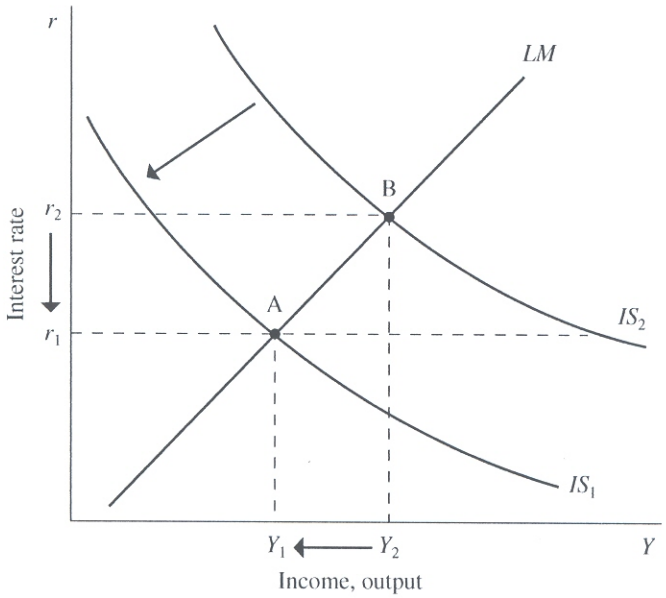


Figure 11–10

Income, interest rates, and consumption all fall, while investment rises. Income falls because at every level of the interest rate, planned expenditure falls. The interest rate falls because the fall in income reduces demand for money; since the supply of money is unchanged, the interest rate must fall to restore money-market equilibrium. Consumption falls both because of the shift in the consumption function and because income falls. Investment rises because of the lower interest rates and partially offsets the effect on output of the fall in consumption.

3. a. The *IS* curve is given by:

$$Y = C(Y - T) + I(r) + G.$$

We can plug in the consumption and investment functions and values for G and T as given in the question and then rearrange to solve for the *IS* curve for this economy:

$$\begin{aligned} Y &= 200 + 0.75(Y - 100) + 200 - 25r + 100 \\ Y - 0.75Y &= 425 - 25r \\ (1 - 0.75)Y &= 425 - 25r \\ Y &= (1/0.25)\,(425 - 25r) \\ Y &= 1{,}700 - 100r. \end{aligned}$$

This *IS* equation is graphed in Figure 11–11 for r ranging from 0 to 8.

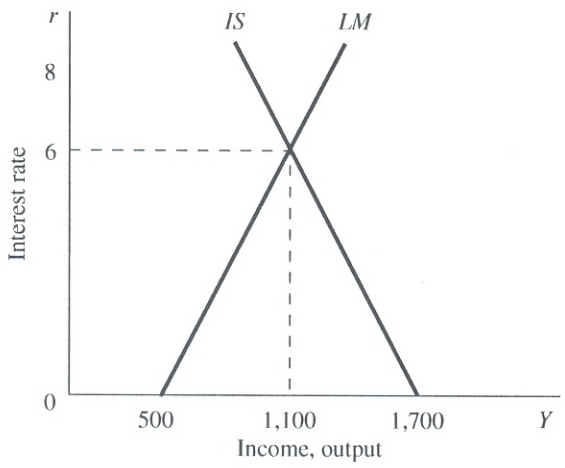


Figure 11–11

b. The *LM* curve is determined by equating the demand for and supply of real money balances. The supply of real balances is 1,000/2 = 500. Setting this equal to money demand, we find:

$$\begin{aligned} 500 &= Y - 100r. \\ Y &= 500 + 100r. \end{aligned}$$

This *LM* curve is graphed in Figure 11–11 for r ranging from 0 to 8.

c. If we take the price level as given, then the *IS* and the *LM* equations give us two equations in two unknowns, Y and r. We found the following equations in parts (a) and (b):

$$\begin{aligned} IS&: Y = 1{,}700 - 100r. \\ LM&: Y = 500 + 100r. \end{aligned}$$

Equating these, we can solve for r:

$$\begin{aligned} 1{,}700 - 100r &= 500 + 100r \\ 1{,}200 &= 200r \\ r &= 6. \end{aligned}$$

Now that we know r, we can solve for Y by substituting it into either the *IS* or the *LM* equation. We find

$$Y = 1{,}100.$$

Therefore, the equilibrium interest rate is 6 percent and the equilibrium level of output is 1,100, as depicted in Figure 11–11.

d. If government purchases increase from 100 to 150, then the *IS* equation becomes:

$$Y = 200 + 0.75(Y - 100) + 200 - 25r + 150.$$

Simplifying, we find:

$$Y = 1{,}900 - 100r.$$

This *IS* curve is graphed as IS_2 in Figure 11–12. We see that the *IS* curve shifts to the right by 200.

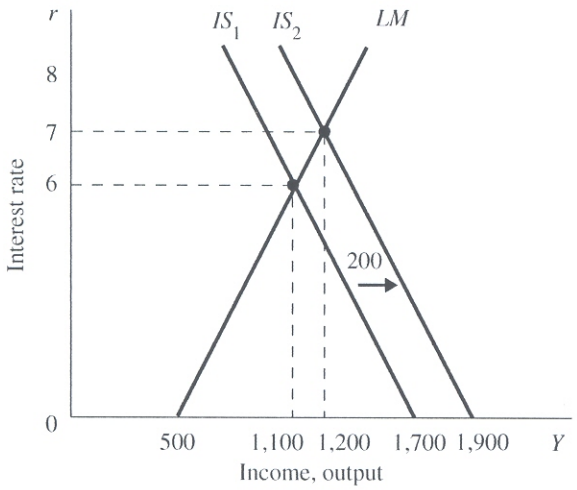


Figure 11–12

By equating the new *IS* curve with the *LM* curve derived in part (b), we can solve for the new equilibrium interest rate:

$$1{,}900 - 100r = 500 + 100r$$
$$1{,}400 = 200r$$
$$7 = r.$$

We can now substitute r into either the *IS* or the *LM* equation to find the new level of output. We find

$$Y = 1{,}200.$$

Therefore, the increase in government purchases causes the equilibrium interest rate to rise from 6 percent to 7 percent, while output increases from 1,100 to 1,200. This is depicted in Figure 11–12.

e. If the money supply increases from 1,000 to 1,200, then the *LM* equation becomes:

$$(1{,}200/2) = Y - 100r,$$

or

$$Y = 600 + 100r.$$

This *LM* curve is graphed as LM_2 in Figure 11–13. We see that the *LM* curve shifts to the right by 100 because of the increase in real money balances.

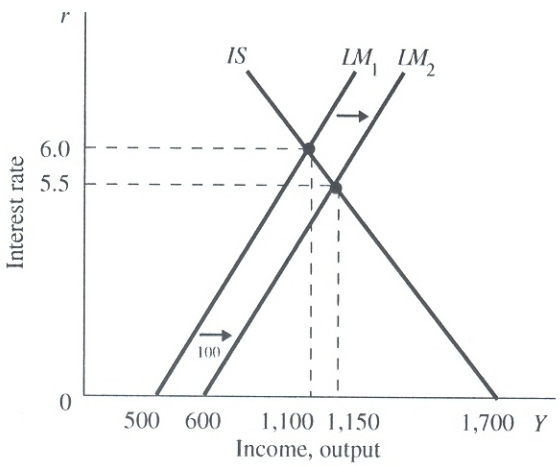


Figure 11–13

To determine the new equilibrium interest rate and level of output, equate the *IS* curve from part (a) with the new *LM* curve derived above:

$$1{,}700 - 100r = 600 + 100r$$
$$1{,}100 = 200r$$
$$5.5 = r.$$

Substituting this into either the *IS* or the *LM* equation, we find

$$Y = 1{,}150.$$

Therefore, the increase in the money supply causes the interest rate to fall from 6 percent to 5.5 percent, while output increases from 1,100 to 1,150. This is depicted in Figure 11–13.

f. If the price level rises from 2 to 4, then real money balances fall from 500 to 1,000/4 = 250. The *LM* equation becomes:

$$Y = 250 + 100r.$$

As shown in Figure 11–14, the *LM* curve shifts to the left by 250 because the increase in the price level reduces real money balances.

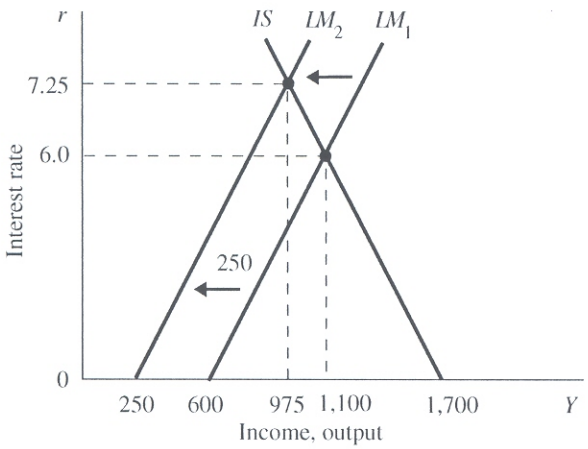


Figure 11–14

To determine the new equilibrium interest rate, equate the *IS* curve from part (a) with the new *LM* curve from above:

$$1{,}700 - 100r = 250 + 100r$$
$$1{,}450 = 200r$$
$$7.25 = r.$$

Substituting this interest rate into either the *IS* or the *LM* equation, we find

$$Y = 975.$$

Therefore, the new equilibrium interest rate is 7.25, and the new equilibrium level of output is 975, as depicted in Figure 11–14.

g. The aggregate demand curve is a relationship between the price level and the level of income. To derive the aggregate demand curve, we want to solve the *IS* and the *LM* equations for Y as a function of P. That is, we want to substitute out for the interest rate. We can do this by solving the *IS* and the *LM* equations for the interest rate:

$$IS: \quad Y = 1{,}700 - 100r$$
$$100r = 1{,}700 - Y.$$
$$LM: \quad (M/P) = Y - 100r$$
$$100r = Y - (M/P).$$

Combining these two equations, we find

$$1{,}700 - Y = Y - (M/P)$$
$$2Y = 1{,}700 + M/P$$
$$Y = 850 + M/2P.$$

Since the nominal money supply M equals 1,000, this becomes

$$Y = 850 + 500/P.$$

This aggregate demand equation is graphed in Figure 11–15.

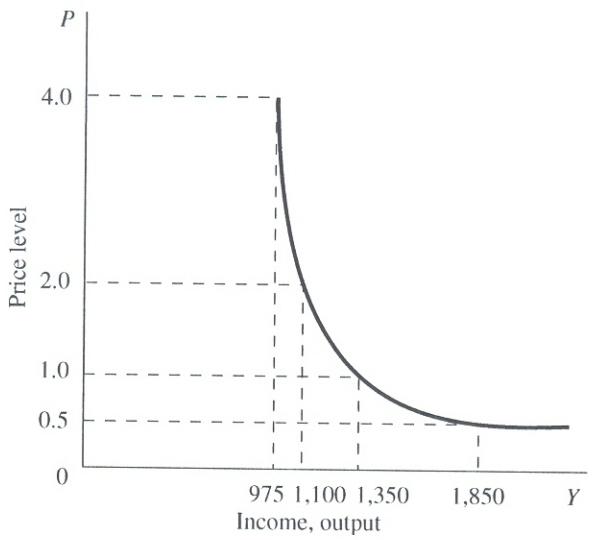


Figure 11–15

How does the increase in fiscal policy of part (d) affect the aggregate demand curve? We can see this by deriving the aggregate demand curve using the *IS* equation from part (d) and the *LM* curve from part (b):

$$IS: \quad Y = 1{,}900 - 100r$$
$$100r = 1{,}900 - Y.$$
$$LM: \quad (1{,}000/P) = Y - 100r$$
$$100r = Y - (1{,}000/P).$$

Combining and solving for Y:

$$1{,}900 - Y = Y - (1{,}000/P),$$

or

$$Y = 950 + 500/P.$$

By comparing this new aggregate demand equation to the one previously derived, we can see that the increase in government purchases by 50 shifts the aggregate demand curve to the right by 100.

How does the increase in the money supply of part (e) affect the aggregate demand curve? Because the *AD* curve is $Y = 850 + M/2P$, the increase in the money supply from 1,000 to 1,200 causes it to become

$$Y = 850 + 600/P.$$

By comparing this new aggregate demand curve to the one originally derived, we see that the increase in the money supply shifts the aggregate demand curve to the right.

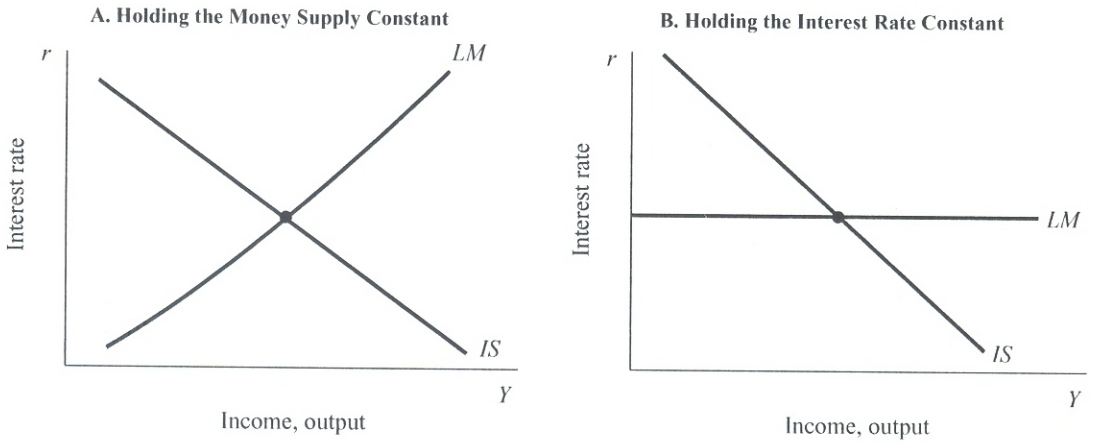
4. a. The *IS* curve represents the relationship between the interest rate and the level of income that arises from equilibrium in the market for goods and services. That is, it describes the combinations of income and the interest rate that satisfy the equation

$$Y = C(Y - T) + I(r) + G.$$

Initially, the *LM* curve is not affected. In the longer run, prices begin to decline because output is below its long-run equilibrium level, and the *LM* curve then shifts to the right because of the increase in real money balances. Interest rates fall even further to r_3 and, thus, further stimulate investment and increase income. In the long run, the economy moves to point C. Output returns to $\bar{Y}$, the price level and the interest rate are lower, and the decrease in consumption has been offset by an equal increases in investment.

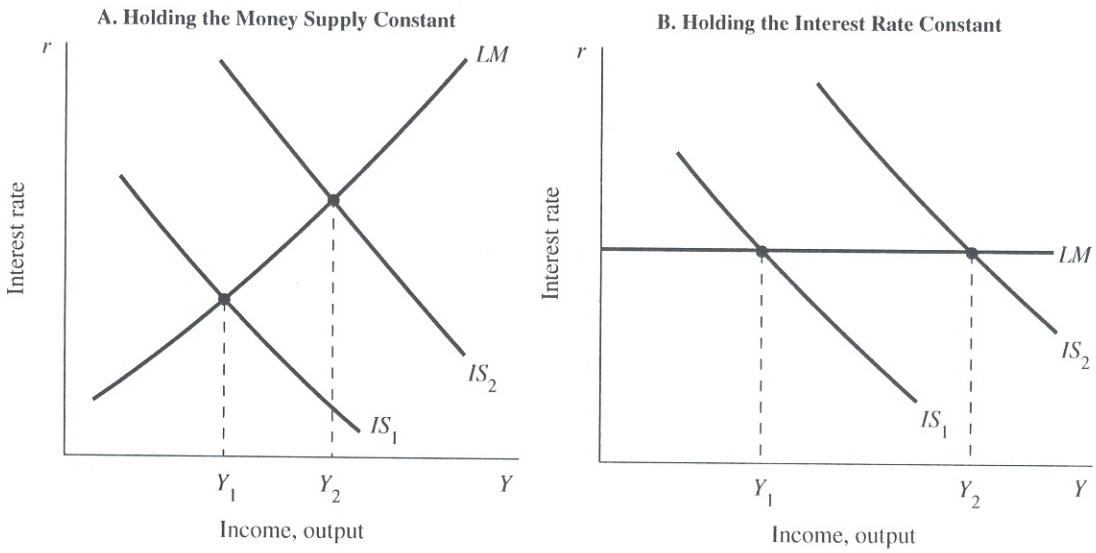
7. Figure 11–25(A) shows what the *IS–LM* model looks like for the case in which the Fed holds the money supply constant. Figure 11–25(B) shows what the model looks like if the Fed adjusts the money supply to hold the interest rate constant; this policy makes the effective *LM* curve horizontal.

Figure 11–25



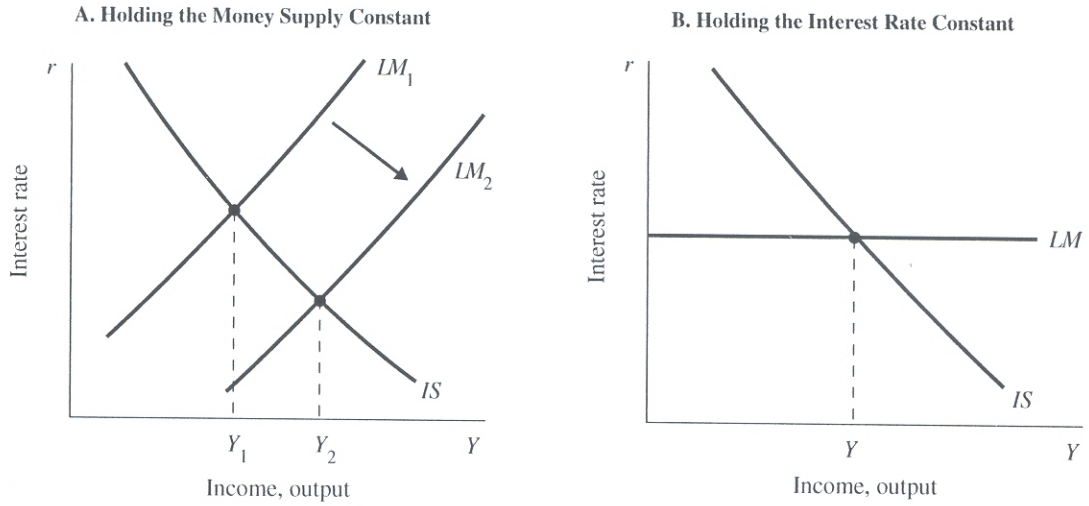
a. If all shocks to the economy arise from exogenous changes in the demand for goods and services, this means that all shocks are to the *IS* curve. Suppose a shock causes the *IS* curve to shift from IS_1 to IS_2. Figures 11–26(A) and (B) show what effect this has on output under the two policies. It is clear that output fluctuates less if the Fed follows a policy of keeping the money supply constant. Thus, if all shocks are to the *IS* curve, then the Fed should follow a policy of keeping the money supply constant.

Figure 11–26



b. If all shocks in the economy arise from exogenous changes in the demand for money, this means that all shocks are to the *LM* curve. If the Fed follows a policy of adjusting the money supply to keep the interest rate constant, then the *LM* curve does not shift in response to these shocks—the Fed immediately adjusts the money supply to keep the money market in equilibrium. Figures 11–27(A) and (B) show the effects of the two policies. It is clear that output fluctuates less if the Fed holds the interest rate constant, as in Figure 11–27(B). If the Fed holds the interest rate constant and offsets shocks to money demand by changing the money supply, then all variability in output is eliminated. Thus, if all shocks are to the *LM* curve, then the Fed should adjust the money supply to hold the interest rate constant, thereby stabilizing output.

Figure 11–27



8. a. The analysis of changes in government purchases is unaffected by making money demand dependent on disposable income instead of total expenditure. An increase in government purchases shifts the *IS* curve to the right, as in the standard case. The *LM* curve is unaffected by this increase. Thus, the analysis is the same as it was before; this is shown in Figure 11–28.