Problem Set 4 Answers

Chapter 10 #1, 2, and 3 (on pages 308-309)

1. a. Interest-bearing checking accounts make holding money more attractive. This increases the demand for money.

b. The increase in money demand is equivalent to a decrease in the velocity of money. Recall the quantity equation

\[ \frac{M}{P} = kY, \]

where \( k = 1/V \). For this equation to hold, an increase in real money balances for a given amount of output means that \( k \) must increase; that is, velocity falls. Because interest on checking accounts encourages people to hold money, dollars circulate less frequently.

c. If the Fed keeps the money supply the same, the decrease in velocity shifts the aggregate demand curve downward, as in Figure 10-6. In the short run when prices are sticky, the economy moves from the initial equilibrium, point A, to the short-run equilibrium, point B. The drop in aggregate demand reduces the output of the economy below the natural rate.

Over time, the low level of aggregate demand causes prices and wages to fall. As prices fall, output gradually rises until it reaches the natural-rate level of output at point C.

d. The decrease in velocity causes the aggregate demand curve to shift downward. The Fed could increase the money supply to offset this decrease and thereby return the economy to its original equilibrium at point A, as in Figure 10-7.
To the extent that the Fed can accurately measure changes in velocity, it has the ability to reduce or even eliminate the impact of such a demand shock on output. In particular, when a regulatory change causes money demand to change in a predictable way, the Fed should make the money supply respond to that change in order to prevent it from disrupting the economy.

e. The decrease in velocity shifts the aggregate demand curve down and to the left. In the short run, the price level remains the same and the level of output falls below the natural rate. If the Fed wants to stabilize output and return it to the natural rate, they should increase the money supply. Note that increasing the money supply in this case will stabilize both output and the price level so that the answer here is the same as in part (d).

2. a. If the Fed reduces the money supply, then the aggregate demand curve shifts down, as in Figure 10-8. This result is based on the quantity equation $MV = PY$, which tells us that a decrease in money $M$ leads to a proportionate decrease in nominal output $PY$ (assuming that velocity $V$ is fixed). For any given price level $P$, the level of output $Y$ is lower, and for any given $Y$, $P$ is lower.
b. In the short run, we assume that the price level is fixed and that the aggregate supply curve is flat. As Figure 10-9 shows, in the short run, the leftward shift in the aggregate demand curve leads to a movement from point A to point B—output falls but the price level doesn’t change. In the long run, prices are flexible. As prices fall, the economy returns to full employment at point C.

If we assume that velocity is constant, we can quantify the effect of the 5-percent reduction in the money supply. Recall from Chapter 5 that we can express the quantity equation in terms of percentage changes:

$$\frac{\% \Delta M}{\% \Delta V} = \frac{\% \Delta P}{\% \Delta Y}$$

If we assume that velocity is constant, then the \(\% \Delta V = 0\). Therefore,

$$\% \Delta M = \% \Delta P + \% \Delta Y.$$  

We know that in the short run, the price level is fixed. This implies that the \(\% \Delta P = 0\).

Therefore,

$$\% \Delta M = \% \Delta Y.$$  

Based on this equation, we conclude that in the short run a 5-percent reduction in the money supply leads to a 5-percent reduction in output. This is shown in Figure 10-9.

In the long run, we know that prices are flexible and the economy returns to its natural rate of output. This implies that in the long run, the \(\% \Delta Y = 0\). Therefore,

$$\% \Delta M = \% \Delta P.$$  

Based on this equation, we conclude that in the long run a 5-percent reduction in the money supply leads to a 5-percent reduction in the price level, as shown in Figure 10-9.

c. Okun’s law refers to the negative relationship that exists between unemployment and real GDP. Okun’s law can be summarized by the equation

$$\% \Delta \text{ Real GDP} = 3\% - 2 \times [\Delta \text{ Unemployment Rate}].$$

That is, output moves in the opposite direction from unemployment, with a ratio of 2 to 1. In the short run, when output falls, unemployment rises. Quantitatively, if velocity is constant, we found that output falls 5 percentage points relative to full employment in the short run. Okun’s law states
that output growth equals the full employment growth rate of 3 percent minus two times the change in the unemployment rate. Therefore, if output falls 5 percentage points relative to full-employment growth, then actual output growth is –2 percent. Using Okun’s law, we find that the change in the unemployment rate equals 2.5 percentage points:

\[-2 = 3 - 2 \times [\Delta \text{ in Unemployment Rate}]\]

\[-2 - 3]/[-2] = [\Delta \text{ in Unemployment Rate}]\]

\[2.5 = [\Delta \text{ in Unemployment Rate}]\].

In the long run, both output and unemployment return to their natural rate levels. Thus, there is no long-run change in unemployment.

d. The national income accounts identity tells us that saving \( S = Y - C - G \). Thus, when \( Y \) falls, \( S \) falls (assuming the marginal propensity to consume is less than one). Figure 10-10 shows that this causes the real interest rate to rise. When \( Y \) returns to its original equilibrium level, so does the real interest rate.

3. a. An exogenous decrease in the velocity of money causes the aggregate demand curve to shift downward, as in Figure 10-11. In the short run, prices are fixed, so output falls.
If the Fed wants to keep output and employment at their natural-rate levels, it must increase aggregate demand to offset the decrease in velocity. By increasing the money supply, the Fed can shift the aggregate demand curve upward, restoring the economy to its original equilibrium at point A. Both the price level and output remain constant.

If the Fed wants to keep prices stable, then it wants to avoid the long-run adjustment to a lower price level at point C in Figure 10-11. Therefore, it should increase the money supply and shift the aggregate demand curve upward, again restoring the original equilibrium at point A.

Thus, for both scenarios, the Fed makes the same choice of policy in response to this demand shock.

b. An exogenous increase in the price of oil is an adverse supply shock that causes the short-run aggregate supply curve to shift upward, as in Figure 10-12.

If the Fed cares about keeping output and employment at their natural-rate levels, then it should increase aggregate demand by increasing the money supply. This policy response shifts the aggregate demand curve upwards, as shown in the shift from \( AD_1 \) to \( AD_2 \) in Figure 10-12. In this case, the economy immediately reaches a new equilibrium at point C. The price level at point C is permanently higher, but there is no loss in output associated with the adverse supply shock.

If the Fed cares about keeping prices stable, then there is no policy response it can implement. In the short run, the price level stays at the higher level \( P_2 \). If the Fed increases aggregate demand, then the economy ends up with a permanently higher price level. Hence, the Fed must simply wait, holding aggregate demand constant. Eventually, prices fall to restore full employment at the old price level \( P_1 \). But the cost of this process is a prolonged recession.

Thus, for both scenarios, the Fed makes a different policy choice in response to a supply shock.

Chapter 11 #1, 2, 3, 4, 5, and 6 (on pages 335-36)

1. a. The Keynesian cross illustrates an economy’s planned expenditure function, \( PE = C(Y - T) + I + G \), and the equilibrium condition that actual expenditure equals planned expenditure, \( Y = PE \), as shown in Figure 11-6.
An increase in government purchases from $G_1$ to $G_2$ shifts the planned expenditure function upward. The new equilibrium is at point B. The change in equilibrium GDP, $Y$, equals the product of the government-purchases multiplier and the change in government spending: $\Delta Y = \frac{1}{1 - MPC} \Delta G$. Because we know that the marginal propensity to consume $MPC$ is less than one, this expression tells us that a one-dollar increase in $G$ leads to an increase in $Y$ that is greater than one dollar.

b. An increase in taxes $T$ reduces disposable income $Y - T$ by $\Delta T$ and, therefore, reduces consumption by $MPC \times \Delta T$. For any given level of income $Y$, planned expenditure falls. In the Keynesian cross, the tax increase shifts the planned-expenditure function down by $MPC \times \Delta T$, as in Figure 11-7.
The amount by which equilibrium GDP falls is given by the product of the tax multiplier and the increase in taxes:

\[ \Delta Y = \left( -\frac{MPC}{1 - MPC} \right) \Delta T. \]

c. We can calculate the effect of an equal increase in government expenditure and taxes by adding the two multiplier effects that we used in parts (a) and (b):

\[ \Delta Y = \left\{ \left[ \frac{1}{1 - MPC} \right] \Delta G \right\} - \left\{ \left[ \frac{MPC}{1 - MPC} \right] \Delta T \right\}. \]

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

\[ \Delta Y = \left\{ \left[ \frac{1}{1 - MPC} \right] - \left[ \frac{MPC}{1 - MPC} \right] \right\} \Delta G = \Delta G. \]

This expression tells us that an equal increase in government purchases and taxes increases \( Y \) by the amount that \( G \) increases. That is, the balanced-budget multiplier is exactly 1.

2. a. Total planned expenditure is

\[ PE = C(Y - T) + I + G. \]

Plugging in the consumption function and the values for investment \( I \), government purchases \( G \), and taxes \( T \) given in the question, total planned expenditure \( PE \) is

\[ PE = 120 + 0.80(Y - 400) + 200 + 400 \]
\[ = 0.80Y + 400. \]

This equation is graphed in Figure 11-8.
b. To find the equilibrium level of income, combine the planned-expenditure equation derived in part (a) with the equilibrium condition $Y = PE$:

$$Y = 0.80Y + 400$$
$$Y = 2,000.$$

The equilibrium level of income is 2,000, as indicated in Figure 11-8.

c. If government purchases increase to 420, then planned expenditure changes to $PE = 0.80Y + 420$. Equilibrium income increases to $Y = 2,100$. Therefore, an increase in government purchases of 20 (i.e., $420 - 400 = 20$) increases income by 100. This is what we expect to find, because the formula for the government-purchases multiplier is $1/(1 - MPC)$, the $MPC$ is 0.80, and the government-purchases multiplier therefore has a numerical value of 5.

d. An income level of 2,400 represents an increase of 400 over the original level of income. The government-purchases multiplier is $1/(1 - MPC)$: the $MPC$ in this example equals 0.80, so the government-purchases multiplier is 5. This means that government purchases must increase by 80 (to a level of 480) for income to increase by 400.

e. An income level of 2,400 represents an increase of 400 over the original level of income. The tax multiplier is $-MPC/(1 - MPC)$: the $MPC$ in this example equals 0.80, so the tax multiplier is 4. This means that taxes must decrease by 100 (to a level of 300) for income to increase by 400.

3. a. When taxes do not depend on income, a one-dollar increase in income means that disposable income increases by one dollar. Consumption increases by the marginal propensity to consume $MPC$. When taxes do depend on income, a one-dollar increase in income means that disposable income increases by only $(1 - t)$ dollars. Consumption increases by the product of the $MPC$ and the change in disposable income, or $(1 - t)MPC$. This is less than the $MPC$. The key point is that disposable income changes by less than total income, so the effect on consumption is smaller.

b. When taxes are fixed, we know that $\Delta Y/\Delta G = 1/(1 - MPC)$. We found this by considering an increase in government purchases of $\Delta G$; the initial effect of this change is to increase income by $\Delta G$. This in turn increases consumption by an amount equal to the marginal propensity to consume times the change in income, $MPC \times \Delta G$. This increase in consumption raises expenditure and income even further. The process continues indefinitely, and we derive the multiplier above.
When taxes depend on income, we know that the increase of $\Delta G$ increases total income by $\Delta G$; disposable income, however, increases by only $(1 - t)\Delta G$. Consumption then increases by an amount $(1 - t)\text{MPC} \times \Delta G$. Expenditure and income increase by this amount, which in turn causes consumption to increase even more. The process continues, and the total change in output is

$$\Delta Y = \Delta G \left\{ 1 + (1 - t)\text{MPC} + [(1 - t)\text{MPC}]^2 + [(1 - t)\text{MPC}]^3 + \ldots \right\}$$

$$= \Delta G \left\{ 1/[1 - (1 - t)\text{MPC}] \right\}.$$ 

Thus, the government-purchases multiplier becomes $1/[1 - (1 - t)\text{MPC}]$ rather than $1/(1 - \text{MPC})$. This means a much smaller multiplier. For example, if the marginal propensity to consume $\text{MPC}$ is $3/4$ and the tax rate $t$ is $1/3$, then the multiplier falls from $1/(1 - 3/4)$, or 4, to $1/[1 - (1 - 1/3)(3/4)]$, or 2.

c. In this chapter, we derived the IS curve algebraically and used it to gain insight into the relationship between the interest rate and output. To determine how this tax system alters the slope of the IS curve, we can derive the IS curve for the case in which taxes depend on income. Begin with the national income accounts identity:

$$Y = C + I + G.$$ 

The consumption function is

$$C = a + b(Y - T - tY).$$ 

Note that in this consumption function taxes are a function of income. The investment function is the same as in the chapter:

$$I = c - dr.$$ 

Substitute the consumption and investment functions into the national income accounts identity to obtain

$$Y = [a + b(Y - T - tY)] + c - dr + G.$$ 

Solving for $r$:

$$r = \frac{a - bT + c + G}{d} + Y \left\{ \frac{b(1-t)-1}{d} \right\}.$$ 

The slope of the IS curve is therefore

$$\frac{\Delta r}{\Delta y} = \frac{b(1-t)-1}{d}.$$ 

Recall that $t$ is a number that is less than 1. As $t$ becomes a bigger number, the slope of the IS curve increases in absolute value terms and the curve becomes steeper. Suppose, for example, that $b$ is 0.80, $t$ is 0.1, and $d$ is 0.5. The slope of the IS curve is $-0.56$. If the tax rate increases to 0.2, then the slope becomes $-0.72$. Intuitively, if the tax rate is higher, then any given reduction in the interest rate has a smaller effect on real output $Y$ because the multiplier will be smaller.

4. a. If society becomes more thrifty—meaning that for any given level of income people save more and consume less—then the planned-expenditure function shifts downward, as in Figure 11-9 (note that $C_2 < C_1$). Equilibrium income falls from $Y_1$ to $Y_2$. 
b. Equilibrium saving remains unchanged. The national accounts identity tells us that saving equals investment, or $S = I$. In the Keynesian-cross model, we assumed that desired investment is fixed. This assumption implies that investment is the same in the new equilibrium as it was in the old. We can conclude that saving is exactly the same in both equilibria.

c. The paradox of thrift is that even though thriftiness increases, saving is unaffected. Increased thriftiness leads only to a fall in income. For an individual, we usually consider thriftiness a virtue. From the perspective of the entire economy as represented by the Keynesian-cross model, however, thriftiness is a vice.

d. In the classical model of Chapter 3, the paradox of thrift does not arise. In that model, output is fixed by the factors of production and the production technology, and the interest rate adjusts to equilibrate saving and investment, where investment depends on the interest rate. An increase in thriftiness decreases consumption and increases saving for any level of output; since output is fixed, the saving schedule shifts to the right, as in Figure 11-10. At the new equilibrium, the interest rate is lower, and investment and saving are higher.

Thus, in the classical model, the paradox of thrift does not exist.

5. a. The downward sloping line in Figure 11–11 represents the money demand function $(M/P)^d = 800 - 50r$. With $M = 2,000$ and $P = 5$, the real money supply $(M/P)^s = 400$. The real money supply is independent of the interest rate and is, therefore, represented by the vertical line in Figure 11-11.
b. We can solve for the equilibrium interest rate by setting the supply and demand for real balances equal to each other:

\[ 400 = 800 - 50r \]
\[ r = 8. \]

Therefore, the equilibrium real interest rate equals 8 percent.

c. If the price level remains fixed at 5 and the supply of money is reduced from 2,000 to 1,500, then the new supply of real balances \((M/P)^s\) equals 300. We can solve for the new equilibrium interest rate by setting the new \((M/P)^s\) equal to \((M/P)^d\):

\[ 300 = 800 - 50r \]
\[ 50r = 500 \]
\[ r = 10. \]

Thus, decreasing the money supply from 2,000 to 1,500 causes the equilibrium interest rate to rise from 8 percent to 10 percent.

d. To determine at what level the Fed should set the money supply to reduce the interest rate to 4 percent, set \((M/P)^s\) equal to \((M/P)^d\):

\[ M/P = 800 - 50r. \]

Setting the price level at 5 and substituting \(r = 4\), we find:

\[ M/5 = 800 - 50 \times 4 \]
\[ M^f = 3,000. \]

For the Fed to reduce the interest rate from 8 percent to 4 percent, it must increase the nominal money supply from 2,000 to 3,000.

6. a. The variable \(Y\) represents real output or real income. From Chapter 2, we know that the value of the produced goods and services (real output) has to be equal to the value of the income earned in producing the goods and services (real income). The variable \(C\) represents the consumption of goods and services. The variable \(I\) represents investment by the firms. When firms purchase new capital goods, it counts as investment. When firms experience a change in their inventories, it also
counts in the investment category of GDP. The variable \( G \) represents the government’s spending on newly produced goods and services. The variable \( T \) represents lump sum taxes, and \( Y - T \) represents disposable income. The variable \( M \) represents the nominal money supply, \( P \) is the price level, and \( M/P \) is the real money supply. The variable \( r \) is the real interest rate. The variable \((M/P)\) represents real money demand. Consumption depends positively on disposable income, investment depends negatively on the real interest rate, and real money demand depends positively on real income and negatively on the real interest rate.

b. The IS curve represents all combinations of the real interest rate \( r \) and real output \( Y \) such that the goods market is in equilibrium. The equation for the IS curve can be derived as follows:

\[
Y = C + I + G
\]
\[
Y = [50 + 0.75(Y - T)] + (150 - 10r) + 250
\]
\[
Y = (50 + 0.75(Y - 200)) + (150 - 10r) + 250
\]
\[
Y = 300 + 0.75Y - 10r
\]
\[
0.25Y = 300 - 10r
\]
\[
Y = 1,200 - 40r
\]

The IS curve is illustrated in Figure 11-12.

![Image of IS and LM curves](image.png)

c. The LM curve represents all combinations of the real interest rate \( r \) and real output \( Y \) such that the money market is in equilibrium. The equation for the LM curve can be derived as follows:

\[
\left( \frac{M}{P} \right)^d = \frac{M}{P}
\]
\[
Y - 50r = \frac{3,000}{4}
\]
\[
Y = 750 + 50r.
\]

The LM curve is illustrated in Figure 11-12.

d. To find the equilibrium levels of the interest rate and output (or income), set the equation for the IS curve equal to the equation for the LM curve and solve for the interest rate \( r \) to get 5. Now substitute the interest rate of 5 back into either equation to solve for \( Y \) equal to 1,000.
Chapter 12 #1, 3, 4, 6, and 8 (on pages 362-65)

1. a. If the central bank increases the money supply, then the $LM$ curve shifts downward, as shown in Figure 12-4. 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 12-4](image)

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 $\frac{1}{1 - MPC} \Delta G$. This is shown in Figure 12-5. 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 12-5](image)

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 $\frac{-MPC}{1 - MPC} \Delta T$. This is shown in Figure 12-6. 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.
d. 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):

\[ \Delta Y = \left( \frac{1}{1 - \text{MPC}} \right) \Delta G - \left[ \frac{\text{MPC}}{1 - \text{MPC}} \right] \Delta T \]

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:

\[ \Delta Y = \left( \frac{1}{1 - \text{MPC}} \right) - \left( \frac{\text{MPC}}{1 - \text{MPC}} \right) \Delta G \]

\[ \Delta Y = \Delta G. \]

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 12-7. 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.
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:

\[
\begin{align*}
Y &= 300 + 0.60(Y - 500) + 700 - 80r + 500 \\
Y - 0.60Y &= 1,200 - 80r \\
(1 - 0.60)Y &= 1,200 - 80r \\
Y &= (1/0.40)(1,200 - 80r) \\
Y &= 3,000 - 200r.
\end{align*}
\]

This IS equation is graphed in Figure 12-12 for \( r \) ranging from 0 to 8.

b. The LM curve is determined by equating the demand for and supply of real money balances. The supply of real balances is \( 3,000/3 = 1,000 \). Setting this equal to money demand, we find:
1,000 = Y – 200r.
Y = 1,000 + 200r.

This LM curve is graphed in Figure 12-12 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):

\[ IS: \ Y = 3,000 - 200r. \]
\[ LM: \ Y = 1,000 + 200r. \]

Equating these, we can solve for r:

\[
3,000 - 200r = 1,000 + 200r
\]
\[
2,000 = 400r
\]
\[
r = 5.
\]

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

\[ Y = 2,000. \]

Therefore, the equilibrium interest rate is 5 percent and the equilibrium level of output is 2,000, as depicted in Figure 12-12.

d. If government purchases increase from 500 to 700, then the IS equation becomes:

\[ Y = 300 + 0.60(Y - 500) + 700 - 80r + 700. \]

Simplifying, we find:

\[ Y = 3,500 - 200r. \]

This IS curve is graphed as IS\textsubscript{2} in Figure 12-13. We see that the IS curve shifts to the right by 500.

![Figure 12-13](image-url)

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

\[ \begin{align*}
3,500 - 200r &= 1,000 + 200r \\
2,500 &= 400r \\
6.25 &= r.
\end{align*} \]

We can now substitute \( r \) into either the IS or the LM equation to find the new level of output. We find:

\[ Y = 2,250. \]

Therefore, the increase in government purchases causes the equilibrium interest rate to rise from 5 percent to 6.25 percent, while output increases from 2,000 to 2,250. This is depicted in Figure 12-13.

e. If the money supply increases from 3,000 to 4,500, then the LM equation becomes:

\[ (4,500/3) = Y - 200r, \]

or

\[ Y = 1,500 + 200r. \]

This LM curve is graphed as \( LM_2 \) in Figure 12-14. We see that the LM curve shifts to the right by 500 because of the increase in real money balances.

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:

\[ \begin{align*}
3,000 - 200r &= 1,500 + 200r \\
1,500 &= 400r \\
3.75 &= r.
\end{align*} \]

Substituting this into either the IS or the LM equation, we find...
Therefore, the increase in the money supply causes the interest rate to fall from 5 percent to 3.75 percent, while output increases from 2,000 to 2,250. This is depicted in Figure 12–14.

f. If the price level rises from 3 to 5, then real money balances fall from 1,000 to 3,000/5 = 600. The LM equation becomes:

\[ Y = 600 + 200r. \]

As shown in Figure 12-15, the LM curve shifts to the left by 400 because the increase in the price level reduces real money balances.

\[ 3,000 - 200r = 600 + 200r \]
\[ 2,400 = 400r \]
\[ 6 = r. \]

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

\[ Y = 1,800. \]

Therefore, the new equilibrium interest rate is 6, and the new equilibrium level of output is 1,800, as depicted in Figure 12-15.

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:

\[
\begin{align*}
IS: & \quad Y = 3,000 - 200r \\
& \quad 200r = 3,000 - Y. \\
LM: & \quad (M/P) = Y - 200r \\
& \quad 200r = Y - (M/P).
\end{align*}
\]

Combining these two equations, we find:

\[ 3,000 - Y = Y - (M/P) \]
\[ 2Y = 3,000 + M/P \]
\[ Y = 1,500 + M/2P. \]

Since the nominal money supply \( M \) equals 3,000, this becomes:

\[ Y = 1,500 + 1,500/P. \]

This aggregate demand equation is graphed in Figure 12-16.

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:** \[ Y = 3,500 - 200r \]
\[ 200r = 3,500 - Y. \]

**LM:** \[ (3,000/P) = Y - 200r \]
\[ 200r = Y - (3,000/P). \]

Combining and solving for \( Y \):

\[ 3,500 - Y = Y - (3,000/P), \]

or:

\[ Y = 1,750 + 1,500/P. \]

By comparing this new aggregate demand equation to the one previously derived, we can see that the increase in government purchases by 200 shifts the aggregate demand curve to the right by 250.

How does the increase in the money supply of part (e) affect the aggregate demand curve? Because the \( AD \) curve is \( Y = 1,500 + M/2P \); the increase in the money supply from 3,000 to 4,500 causes it to become

\[ Y = 1,500 + 2,250/P. \]

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 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:

\[
\begin{align*}
    Y &= 500 + 0.75(Y - 1,000) + 1,000 - 50r + 1,000 \\
    Y &= 0.75Y = 1,750 - 50r \\
    (1 - 0.75)Y &= 1,750 - 50r \\
    Y &= (1/0.25) (1,750 - 50r) \\
    Y &= 7,000 - 200r.
\end{align*}
\]

The LM curve is determined by equating the demand for and supply of real money balances. The supply of real balances is \( 6,000 / 2 = 3,000 \). Setting this equal to money demand, we find:

\[
\begin{align*}
    3,000 &= Y - 200r \\
    Y &= 3,000 + 200r.
\end{align*}
\]

Equating the IS and LM equations, we can solve for \( r \):

\[
\begin{align*}
    7,000 - 200r &= 3,000 + 200r \\
    4,000 &= 400r \\
    r &= 10.
\end{align*}
\]

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

\[ Y = 5,000. \]

Therefore, the equilibrium interest rate is 10 percent and the equilibrium level of output is 5,000. This is labeled as point a in Figure 12-17 in part e below.

b. If taxes fall by 20% then taxes are now equal to 800 and we can recalculate the IS curve equation:

\[
\begin{align*}
    Y &= 500 + 0.75(Y - 800) + 1,000 - 50r + 1,000 \\
    Y &= 0.75Y = 1,900 - 50r \\
    (1 - 0.75)Y &= 1,900 - 50r \\
    Y &= (1/0.25) (1,900 - 50r) \\
    Y &= 7,600 - 200r.
\end{align*}
\]

Equating the new IS and old LM equations, we can solve for \( r \):

\[
\begin{align*}
    7,600 - 200r &= 3,000 + 200r \\
    4,600 &= 400r \\
    r &= 11.5.
\end{align*}
\]

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

\[ Y = 5,300. \]

Therefore, the equilibrium interest rate is 11.5 percent and the equilibrium level of output is 5,300. The decrease in taxes will shift the IS curve to the right. The new equilibrium point is labeled as point b in Figure 12-17 in part e below. The tax multiplier measures the change in equilibrium output divided by the change in taxes, or \( 300/-200 = -1.5 \).

c. To find the value of the money supply that will keep the interest rate at the original level of 10 percent after the tax cut, rewrite the LM curve equation so that it is a function of \( M \):
\[ \frac{M}{2} = Y - 200r \]
\[ Y = \frac{M}{2} + 200r. \]

Now we can equate this new equation for the LM curve with the new IS curve, plug in the value of 10 for the interest rate \( r \) and solve for the money supply \( M \):

\[ 7,600 - 200r = \frac{M}{2} + 200r \]
\[ 7,600 - 200(10) = \frac{M}{2} + 200(10) \]
\[ M = 7,200. \]

If the money supply has a value of 7,200 then the level of output is 5,600. The increase in the money supply will shift the LM curve to the right. This new equilibrium point is illustrated as point c in Figure 12-17 in part e below. The tax multiplier measures the change in equilibrium output divided by the change in taxes, or \( 600/200 = -3 \).

d. To find the value of the money supply that will keep output at the original level of 5,000 after the tax cut, rewrite the LM curve equation so that it is a function of \( M \), and solve for \( r \):

\[ \frac{M}{2} = Y - 200r \]
\[ 200r = Y - \frac{M}{2} \]
\[ r = \frac{Y}{200} - \frac{M}{400}. \]

Rewrite the IS curve equation so that \( r \) is defined as a function of \( Y \):

\[ Y = 7,600 - 200r \]
\[ 200r = 7,600 - Y \]
\[ r = \frac{7,600}{200} - \frac{Y}{200}. \]

Now we can equate these new equations for the IS and LM curves, plug in the value of 5,000 for the level of output \( Y \) and solve for the money supply \( M \):

\[ \frac{7,600}{200} - \frac{Y}{200} = \frac{Y}{200} - \frac{M}{400} \]
\[ 7,600 - Y = Y - \frac{M}{2} \]
\[ M = 4,800. \]

If the money supply has a value of 4,800 then the level of the interest rate is 13. The decrease in the money supply will shift the LM curve to the left. This new equilibrium point is illustrated as point d in Figure 12-17 in part e below. The tax multiplier measures the change in equilibrium output divided by the change in taxes, or \( 0/200 = 0 \).

Note that this problem could have been solved in a different way. From the IS curve equation, if you know \( Y \) is equal to 5,000 then you can solve for the interest rate \( r \). You can then plug these values for output and the interest rate into the LM curve equation and solve for the money supply \( M \).
e. The four equilibrium points are illustrated in Figure 12-17.

![Figure 12-17](image)

6. a. To raise investment while keeping output constant, the government should adopt a loose monetary policy and a tight fiscal policy, as shown in Figure 12-22. In the new equilibrium at point B, the interest rate is lower, so that investment is higher. The tight fiscal policy—reducing government purchases, for example—offsets the effect of this increase in investment on output.

![Figure 12-22](image)

b. The policy mix in the early 1980s did exactly the opposite. Fiscal policy was expansionary, while monetary policy was contractionary. Such a policy mix shifts the IS curve to the right and the LM curve to the left, as in Figure 12-23. The real interest rate rises and investment falls.
8. Figure 12-27(A) shows what the IS–LM model looks like for the case in which the Fed holds the money supply constant. Figure 12-27(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.

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 12-28(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.
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 12-29(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 12-29(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.

Chapter 13 #2, 4, 5, 6, and 8 (on pages 400-401) and Appendix problems #1, 2, 3, and 4 (on pages 406-407).

2. a. In the Mundell-Fleming model, a small open economy with perfect capital mobility has an \( IS^* \) equation given by \( Y = C(Y - T) + I(r) + G + NX(e) \). If we substitute in the given information, then we get
\[
Y = 50 + 0.75(Y - 200) + 200 - 20r + 200 + 200 - 50\varepsilon
\]
\[
Y = 500 + 0.75Y - 20r - 50\varepsilon.
\]

We know the interest rate is equal to the world rate of 5 percent, so the \( IS^* \) equation becomes

\[
Y = 1,600 - 200\varepsilon.
\]

Equilibrium in the money market requires that the supply of real balances \( M/P \) must equal demand:

\[
\frac{M}{P} = L(r^*, Y).
\]

Therefore, the \( LM^* \) equation is given by

\[
\frac{3,000}{3} = Y - 40r
\]
\[
Y = 1,000 + 40r.
\]

b. Given the interest rate is equal to the world rate of 5 percent, equilibrium income \( Y \) is equal to 1,200. Once we know equilibrium income, we find the equilibrium exchange rate is 2 from the \( IS^* \) equation. Substituting the equilibrium exchange rate into the net export function we find net exports are 100.

c. If government spending increases by 50, then the \( IS^* \) equation becomes

\[
Y = 50 + 0.75(Y - 200) + 200 - 20r + 250 + 200 - 50\varepsilon
\]
\[
Y = 550 + 0.75Y - 20r - 50\varepsilon.
\]

We know the interest rate is equal to the world rate of 5 percent, so the \( IS^* \) equation becomes

\[
Y = 1,800 - 200\varepsilon.
\]

The \( LM^* \) curve is unchanged because there is no change in the money supply, price level, or world interest rate. Therefore, equilibrium income remains at 1,200. From the new \( IS^* \) equation, we find the new equilibrium exchange rate is 3. The exchange rate has appreciated because the increase in government spending will put upward pressure on the interest rate, and this will increase capital inflow and the exchange rate value of the currency. Given the currency has appreciated, net exports will fall to 50. Since income did not change, the increase in government spending is matched by a fall in net exports. Graphically, the \( IS^* \) curve shifts to the right, as illustrated in Figure 13-15.

**Figure 13-15**
d. If government spending increases by 50, the new IS* equation is \( Y = 1,800 - 200\varepsilon \) as derived in part (c) above. If the exchange rate is fixed at a value of 2, then income must increase to a value of 1,400. We know that the LM* equation is given by \( M/3 = Y - 40r \), so substituting in the values for income \( Y \) and the world interest rate \( r^* \), we find the money supply must increase to 3,600. To prevent the currency from appreciating, the central bank must sell dollars and buy foreign currency. This will shift the LM* curve to the right, as illustrated in Figure 13-16.

![Figure 13-16](image)

4. a. The Mundell–Fleming model takes the world interest rate \( r^* \) as an exogenous variable. However, there is no reason to expect the world interest rate to be constant. In the closed-economy model of Chapter 3, the equilibrium of saving and investment determines the real interest rate. In an open economy in the long run, the world real interest rate is the rate that equilibrates world saving and world investment demand. Anything that reduces world saving or increases world investment demand increases the world interest rate. In addition, in the short run with fixed prices, anything that increases the worldwide demand for goods or reduces the worldwide supply of money causes the world interest rate to rise.

b. Figure 13-18 shows the effect of an increase in the world interest rate under floating exchange rates. Both the IS* and the LM* curves shift. The IS* curve shifts to the left, because the higher interest rate causes investment \( I(r^*) \) to fall. The LM* curve shifts to the right because the higher interest rate reduces money demand. Intuitively, when the world interest rate rises, capital outflow will increase as the interest rate in the small country adjusts to the new higher level of the world interest rate. The increase in capital outflow causes the exchange rate to fall, causing net exports and hence output to increase, which increases money demand.
We see from the figure that output rises and the exchange rate falls (depreciates). Hence, the trade balance increases.

c. Figure 13-19 shows the effect of an increase in the world interest rate if exchange rates are fixed. Both the $IS^*$ and $LM^*$ curves shift. As in part (b), the $IS^*$ curve shifts to the left since the higher interest rate causes investment demand to fall. The $LM^*$ schedule, however, shifts to the left instead of to the right. This is because the downward pressure on the exchange rate causes the central bank to buy dollars and sell foreign exchange. This reduces the supply of money $M$ and shifts the $LM^*$ schedule to the left. The $LM^*$ curve must shift all the way back to $LM^*_{2}$ in the figure, where the fixed-exchange-rate line crosses the new $IS^*$ curve.

In equilibrium, output falls while the exchange rate remains unchanged. Since the exchange rate does not change, neither does the trade balance.

5. a. A depreciation of the currency makes American goods more competitive. This is because a depreciation means that the same price in dollars translates into fewer units of foreign currency. That is, in terms of foreign currency, American goods become cheaper so that foreigners can buy more of them. For example, suppose the exchange rate between yen and dollars falls from 200 yen/dollar to 100 yen/dollar. If an American can of tennis balls costs $2.50, its price in yen falls from 500 yen to 250 yen. This fall in price increases the quantity of American-made tennis balls demanded in Japan. That is, American tennis balls are more competitive.
b. Consider first the case of floating exchange rates. We know that the position of the $LM^*$ curve determines output. Hence, we know that we want to keep the money supply fixed. As shown in Figure 13-20A, we want to use fiscal policy to shift the $IS^*$ curve to the left to cause the exchange rate to fall (depreciate). We can do this by reducing government spending or increasing taxes.

Now suppose that the exchange rate is fixed at some level. If we want to increase competitiveness, we need to reduce the exchange rate; that is, we need to fix it at a lower level. The first step is to devalue the dollar, fixing the exchange rate at the desired lower level. This increases net exports and tends to increase output, as shown in Figure 13-20B. We can offset this rise in output with contractionary fiscal policy that shifts the $IS^*$ curve to the left, as shown in the figure.

6. In the text, we assumed that net exports depend only on the exchange rate. This is analogous to the usual story in microeconomics in which the demand for any good (in this case, net exports) depends on the price of that good. The “price” of net exports is the exchange rate. However, we also expect that the demand for any good depends on income, and this may be true here as well: as income rises, we want to buy more of all goods, both domestic and imported. Hence, as income rises, imports increase, so net exports fall. Thus, we can write net exports as a function of both the exchange rate and income:

$$NX = NX(e, Y).$$

Figure 13-21 shows the net exports schedule as a function of the exchange rate. As before, the net exports schedule is downward sloping, so an increase in the exchange rate reduces net exports. We have drawn this schedule for a given level of income. If income increases from $Y_1$ to $Y_2$, the net exports schedule shifts inward from $NX(Y_1)$ to $NX(Y_2)$. 
a. Figure 13-22 shows the effect of a fiscal expansion under floating exchange rates. The fiscal expansion (an increase in government expenditure or a cut in taxes) shifts the $I_S^*$ schedule to the right. This increases income ($Y$) and shifts the net export curve to the left. However, the rise in the exchange rate causes net exports to fall such that it offsets the effect of the rise in income due to the expansionary fiscal policy and returns income to the original level.

Net exports fall because of the appreciation of the currency. Thus, our answer is the same as that given in Table 13–1.

b. Figure 13-23 shows the effect of a fiscal expansion under fixed exchange rates. The fiscal expansion shifts the $I_S^*$ curve to the right, from $I_S^*1$ to $I_S^*2$. As in part (a), for unchanged real balances, this tends to push the exchange rate up. To prevent this appreciation, however, the central bank intervenes in currency markets, selling dollars and buying foreign exchange. This increases the money supply and shifts the $LM^*$ curve to the right, from $LM^*1$ to $LM^*2$. 

The final result is that income does not change, and the exchange rate appreciates from $e_1$ to $e_2$. 
Output rises while the exchange rate remains fixed. Despite the unchanged exchange rate, the higher level of income reduces net exports because the net-exports schedule shifts inward. Thus, our answer differs from the answer in Table 13-1 only in that under fixed exchange rates, a fiscal expansion reduces the trade balance.

8. Since people demand money balances in order to buy goods and services, it makes sense to think that the price level that is relevant is the price level of the goods and services they buy. This includes both domestic and foreign goods. But the dollar price of foreign goods depends on the exchange rate. For example, if the dollar rises from 100 yen/dollar to 150 yen/dollar, then a Japanese good that costs 300 yen falls in price from $3 to $2. Hence, we can write the condition for equilibrium in the money market as

\[ \frac{M}{P} = L(r, Y), \]

where

\[ P = \lambda P_d + (1 - \lambda)P_f/e. \]

a. A higher exchange rate makes foreign goods cheaper. To the extent that people consume foreign goods (a fraction 1 – \( \lambda \)), this lowers the price level \( P \) that is relevant for the money market. This lower price level increases the supply of real balances \( M/P \). To keep the money market in equilibrium, we require income to rise to increase money demand as well. Hence, the \( LM^* \) curve is upward sloping.

b. In the standard Mundell–Fleming model, expansionary fiscal policy has no effect on output under floating exchange rates. As shown in Figure 13-26, this is no longer true here. A cut in taxes or an increase in government spending shifts the \( IS^* \) curve to the right, from \( IS^*_1 \) to \( IS^*_2 \). Since the \( LM^* \) curve is upward sloping, the result is an increase in output.
c. The increase in the risk premium raises the interest rate for this country, lowering money demand at any given exchange rate and thereby shifting the $LM^*$ curve to the right. Intuitively, if real-money balances are fixed, then real-money demand must remain fixed. The decline in money demand caused by the increase in the interest rate must be offset by an increase in money demand caused by an increase in income. The reduction in money demand caused by the increase in the interest rate leads to a higher level of income for any given money supply. The higher interest rate also reduces investment spending at any given exchange rate, shifting the $IS^*$ curve to the left. As shown in Figure 13-27, the exchange rate falls and output may either rise or fall depending on the size of the shifts.

If money demand is not very sensitive to the interest rate and investment is very sensitive to the interest rate, then $IS^*$ will shift by more than $LM^*$ and output will decline. Compared to the traditional Mundell–Fleming model, where $LM^*$ is vertical, output can fall here, whereas it does not fall in the traditional model but instead always rises. This model gives the more realistic result that both the exchange rate and output are likely to decline when the risk premium rises.
Appendix to Chapter 13

1. a. Higher taxes shift the IS curve inward. To keep output unchanged, the central bank must increase the money supply, shifting the LM curve to the right. At the new equilibrium (point C in Figure 13-29), the interest rate is lower, the exchange rate has depreciated, and the trade balance has risen.

Figure 13-29
b. Restricting the import of foreign cars shifts the $NX(e)$ schedule outward [see panel (C)]. This has no effect on either the $IS$ curve or the $LM$ curve, however, because the $CF$ schedule is unaffected. Hence, output doesn’t change and there is no need for any change in monetary policy. As shown in Figure 13-30, interest rates and the trade balance don’t change, but the exchange rate appreciates.

**Figure 13-30**
2. a. The $CF$ curve becomes flatter because a small change in the interest rate now has a larger effect on capital flows.

b. As argued in the text, a flatter $CF$ curve makes the $IS$ curve flatter, as well.

c. Figure 13-31 shows the effect of a shift in the $LM$ curve for both a steep and a flat $IS$ curve. It is clear that the flatter the $IS$ curve is, the less effect any change in the money supply has on interest rates. Hence, the Fed has less control over the interest rate when investors are more willing to substitute foreign and domestic assets.

d. It is clear from Figure 13-31 that the flatter the $IS$ curve is, the greater effect any change in the money supply has on output. Hence, the Fed has more control over output.

![Figure 13-31](image)

3. a. No. It is impossible to raise investment without affecting income or the exchange rate just by using monetary and fiscal policies. Investment can only be increased through a lower interest rate. Regardless of what policy is used to lower the interest rate (e.g., expansionary monetary policy and contractionary fiscal policy), net foreign investment will decrease, lowering total investment and raising final interest rates.
b. Yes. Policymakers can raise investment without affecting income or the exchange rate with a combination of expansionary monetary policy and contractionary fiscal policy, and protection against imports can raise investment without affecting the other variables. Both the monetary expansion and the fiscal contraction would put downward pressure on interest rates and stimulate investment. It is necessary to combine these two policies so that their effects on income exactly offset each other. The lower interest rates will, as in part (a), increase net capital outflow, which will put downward pressure on the exchange rate. The protectionist policies, however, shift the net-exports curve out; this puts countervailing upward pressure on the exchange rate and offsets the effect of the fall in interest rates. Figure 13-32 shows this combination of policies.

![Figure 13-32](image-url)
c. Yes. Policymakers can raise investment without affecting income or the exchange rate through a home monetary expansion and fiscal contraction, combined with a lower foreign interest rate either through a foreign monetary expansion or fiscal contraction. The domestic policy lowers the interest rate, stimulating investment. The foreign policy shifts the CF curve inward. Even with lower interest rates, the quantity of capital outflow would be unchanged and there would be no pressure on the exchange rate. This combination of policies is shown in Figure 13-33.
4. a. Figure 13-34 shows the effect of a fiscal expansion on a large open economy with a fixed exchange rate. The fiscal expansion shifts the IS curve to the right in panel (A), which puts upward pressure on the interest rate. This tends to decrease net capital outflow and cause the exchange rate to appreciate [see panels (B) and (C)]. To avoid this, the central bank intervenes and sells dollars. This keeps the exchange rate from appreciating; it also shifts the LM curve to the right. The new equilibrium, at point C, has an unchanged interest rate and exchange rate, but higher output. This effect is the same as in a small open economy.

Figure 13-34
b. A monetary expansion tends to shift the \textit{LM} curve to the right, lowering the interest rate [panel (A) in Figure 13-35]. This tends to increase net capital outflow and cause the exchange rate to depreciate [see panels (B) and (C)]. To avoid this depreciation, the central bank must buy its currency and sell foreign exchange. This reduces the money supply and shifts the \textit{LM} curve back to its original position. As in the model of a small open economy, monetary policy is ineffectual under a fixed exchange rate.

Figure 13-35