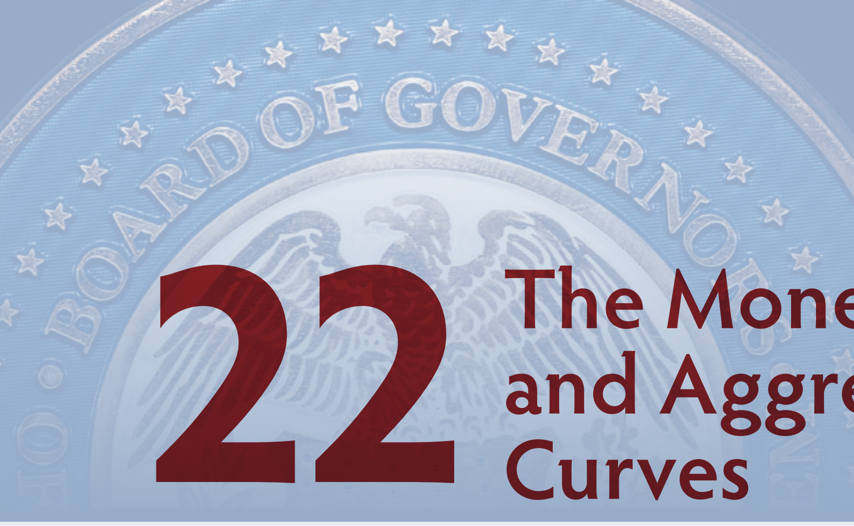


22 The Monetary Policy and Aggregate Demand Curves

Learning Objectives

- Recognize the impact of changes in the nominal federal funds rate on short-term real interest rates.
- Define and illustrate the monetary policy (*MP*) curve, and explain shifts in the *MP* curve.
- Explain why the aggregate demand (*AD*) curve slopes downward, and explain shifts in the *AD* curve.

Preview

At the height of the financial crisis in December 2008, the Federal Open Market Committee of the Federal Reserve announced a surprisingly bold policy decision that sent the markets into a frenzy. The committee lowered the federal funds rate, the interest rate charged on overnight loans between banks, by 75 basis points (0.75 percentage point), moving the federal funds rate almost all the way to zero.

To see how a monetary policy action like the one described above affects the economy, we need to analyze how monetary policy affects aggregate demand. We start this chapter by explaining why monetary policymakers set interest rates higher when inflation increases, leading to a positive relationship between real interest rates and inflation that can be illustrated using the *monetary policy (MP) curve*. Then, by combining the *MP* curve with the *IS* curve we developed in the previous chapter, we derive the *aggregate demand curve*, a key element in the aggregate demand/aggregate supply model framework used in the rest of this book to discuss short-run economic fluctuations.

THE FEDERAL RESERVE AND MONETARY POLICY

Central banks throughout the world use a very short-term interest rate as their primary policy tool. In the United States, the Federal Reserve conducts monetary policy via its setting of the federal funds rate. For example, after the FOMC meeting of July 30, 2014, the Federal Reserve issued a statement that the Committee would "maintain the current 0 to ¼ percent target for the federal funds rate."

As we saw in Chapter 16, the Federal Reserve controls the federal funds rate by varying the reserves it provides to the banking system. When it provides more reserves, banks have more money to lend to each other, and this excess liquidity causes the federal funds rate to fall. When the Fed drains reserves from the banking system, banks have less to lend, and the lack of liquidity leads to a rise in the federal funds rate.

The federal funds rate is a *nominal* interest rate, but as we learned in the previous chapter, it is the *real* interest rate that affects net exports and business spending, thereby determining the level of equilibrium output. How does the Federal Reserve's control of the federal funds rate enable it to control the real interest rate, through which monetary policy impacts the economy?

Recall from Chapter 4 that the real interest rate, r, is the nominal interest rate, i, minus expected inflation, π^e.

$$r = i - \pi^e$$

Changes in nominal interest rates can change the real interest rate only if actual and expected inflation remain unchanged in the short run. Because prices typically are slow to move—that is, they are *sticky*—changes in monetary policy will not have an immediate effect on inflation and expected inflation. As a result, ***when the Federal Reserve lowers the federal funds rate, real interest rates fall; when the Federal Reserve raises the federal funds rate, real interest rates rise.***

THE MONETARY POLICY CURVE

We have seen how the Federal Reserve can control real interest rates in the short run. The next step in our analysis is to examine how monetary policy reacts to inflation. The **monetary policy (*MP*) curve** indicates the relationship between the real interest rate set by the central bank and the inflation rate. We can write the equation of this curve as follows:

$$r = \bar{r} + \lambda\pi \tag{1}$$

where $\bar{r}$ is the autonomous (exogenous) component of the real interest rate set by the monetary policy authorities, which is unrelated to the current level of the inflation rate or any other variable in the model, and λ is the responsiveness of the real interest rate to the inflation rate.

To make our discussion of the monetary policy curve more concrete, Figure 1 shows an example of a monetary policy curve *MP* in which $\bar{r} = 1.0$ and $\lambda = 0.5$:

$$r = 1.0 + 0.5\pi \tag{2}$$

At point *A*, where inflation is 1%, the Federal Reserve sets the real interest rate at 1.5%; at point *B*, where inflation is 2%, the Fed sets the real interest rate at 2%; and at point *C*, where inflation is 3%, the Fed sets the real interest rate at 2.5%. The line going through points *A*, *B*, and *C* is the monetary policy curve *MP*, and it is upward-sloping, indicating that monetary policymakers raise real interest rates when the inflation rate rises.

The Taylor Principle: Why the Monetary Policy Curve Has an Upward Slope

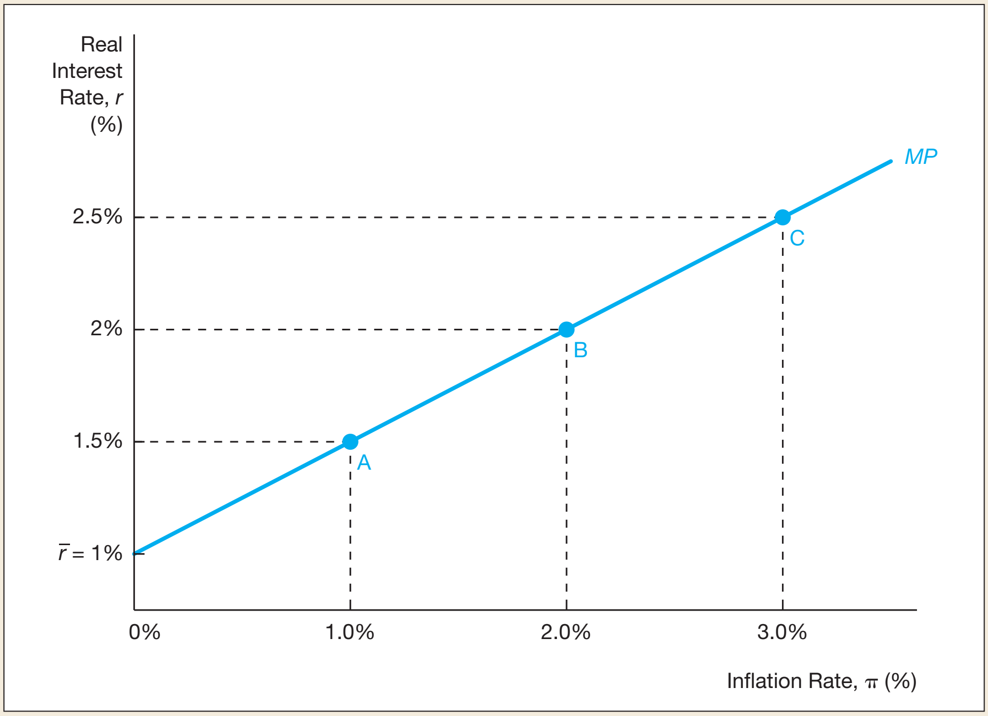
To see why the *MP* curve has an upward slope, we need to recognize that central banks seek to keep inflation stable. To stabilize inflation, monetary policymakers tend to follow the **Taylor principle**, named after John Taylor of Stanford University: They raise *nominal* rates by more than any rise in expected inflation so that *real* interest rates will rise when there is a rise in inflation, as illustrated by the *MP* curve.[1]

[1]Note that the Taylor principle differs from the Taylor rule, described in Chapter 17, in that it does not provide a rule for how monetary policy should react to conditions in the economy, whereas the Taylor rule does.

MyEconLab Mini-lecture

FIGURE 1
The Monetary Policy Curve

The upward slope of the *MP* curve indicates that the central bank reacts to higher inflation by raising real interest rates, because monetary policy follows the Taylor principle.



To see why monetary policymakers follow the Taylor principle, reacting to rising inflation by raising real interest rates, consider what would happen if monetary policymakers instead allowed the real interest rate to fall when inflation rose. In this case, an increase in inflation would lead to a decline in the real interest rate, which, as we saw in the previous chapter, would increase aggregate output, which would in turn cause inflation to rise further, which would then cause the real interest rate to fall even more, increasing aggregate output again. Schematically, we can write this chain of events as follows:[2]

$$\pi\uparrow \Rightarrow r\downarrow \Rightarrow Y\uparrow \Rightarrow \pi\uparrow \Rightarrow r\downarrow \Rightarrow Y\uparrow \Rightarrow \pi\uparrow$$

Under these conditions, inflation would keep rising and eventually spin out of control. Indeed, this is exactly what happened in the 1970s, when the Federal Reserve did not raise nominal interest rates by as much as inflation rose, so that real interest rates fell. Inflation accelerated to over 10%.[3]

[2]The liquidity preference framework developed in Chapter 5 gives another rationale for using the Taylor principle when the path of the money supply curve and inflation expectations are unchanged. A rise in inflation means that the price level will be higher than it otherwise would be, and so the money demand curve shifts to the right, causing both nominal and real interest rates to rise (because inflation expectations are unchanged). Schematically, this can be written as follows:

$$\pi\uparrow \Rightarrow P\uparrow \Rightarrow M^d \text{ to the right} \Rightarrow i\uparrow \Rightarrow r\uparrow$$

[3]In Web Appendix D to Chapter 23 we formally demonstrate the instability of inflation when central banks do not follow the Taylor principle.

Shifts in the *MP* Curve

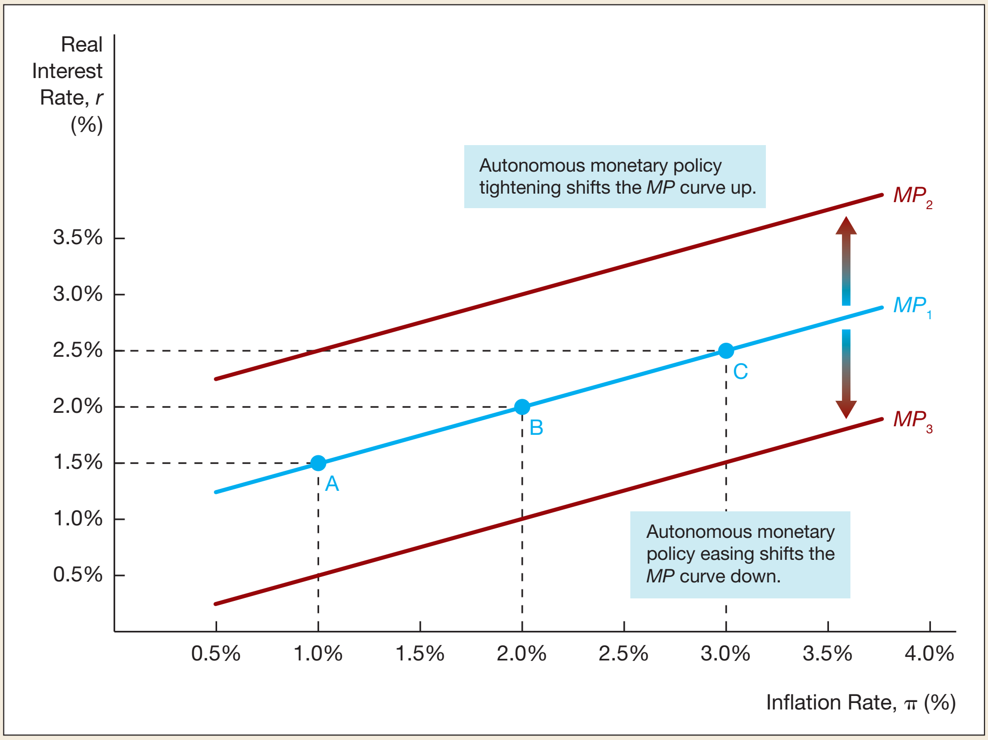
In common parlance, the Federal Reserve is said to "tighten" monetary policy when it raises real interest rates and to "ease" it when it lowers real interest rates. It is important, however, to distinguish between changes in monetary policy that shift the monetary policy curve, which we call *autonomous* changes, and the Taylor principle–driven changes that are reflected in movements along the monetary policy curve, which are called *automatic* adjustments to interest rates.

Central banks may make autonomous changes to monetary policy for various reasons. They may wish to change the inflation rate from its current value. For example, to lower inflation, they could increase $\bar{r}$ by one percentage point and so raise the real interest rate at any given inflation rate, a move that we will refer to as an **autonomous tightening of monetary policy**. This autonomous monetary tightening would shift the monetary policy curve upward by one percentage point, from MP_1 to MP_2 in Figure 2, thereby causing the economy to contract and inflation to fall. Or, the central banks may have other information, unrelated to inflation, suggesting that interest rates must be adjusted to achieve good economic outcomes. For example, if the economy is going into a recession, monetary policymakers will want to lower real interest rates at any given inflation rate, an **autonomous easing of monetary policy**, in order to stimulate the economy and to prevent inflation from falling. This autonomous easing of monetary policy would result in a downward shift of the monetary policy curve by, say, one percentage point, from MP_1 to MP_3 in Figure 2.

MyEconLab Mini-lecture

FIGURE 2
Shifts in the Monetary Policy Curve

Autonomous changes in monetary policy—for example, when a central bank changes the real interest rate at any given inflation rate—shift the *MP* curve. An autonomous tightening of monetary policy that increases the real interest rate shifts the *MP* curve up to MP_2, whereas an autonomous easing of monetary policy that lowers the real interest rate shifts the *MP* curve down to MP_3.



Movements Along Versus Shifts in the *MP* Curve

A stumbling block for many students studying the aggregate demand/aggregate supply (*AD/AS*) framework is understanding the distinction between *shifts in* the *MP* curve versus *movements along* the *MP* curve. Movements along the *MP* curve—that is, movements from point *A* to *B* to *C* in Figure 1—should be viewed as a central bank's normal response (also known as an endogenous response) of raising interest rates when inflation is rising. Thus we can think of a movement along the *MP* curve as an *automatic* response of the central bank to a change in inflation. Such an automatic response does not involve a shift in the *MP* curve.

On the other hand, when the central bank raises interest rates *at a given level of the inflation rate*, this action is not an automatic response to higher inflation but is instead an autonomous tightening of monetary policy that shifts the *MP* curve up, from MP_1 to MP_2 in Figure 2.

The distinction between autonomous monetary policy changes and movements along the monetary policy curve is illustrated by the two applications below, which describe the monetary policy actions taken by the Federal Reserve in the period from 2004–2006 and at the onset of the global financial crisis in the fall of 2007. ◆

APPLICATION Movement Along the *MP* Curve: The Rise in the Federal Funds Rate Target, 2004–2006

Fears of deflation—i.e., fears that inflation could turn negative—led the Federal Reserve to commit to the very low federal funds rate of 1% from June of 2003 to June of 2004. However, with the economy growing rapidly, inflationary pressures began to rise, and at its June 2004 meeting the FOMC decided to increase the federal funds rate by ¼ of a percentage point. Furthermore, the FOMC made this increase a very automatic process, raising the federal funds rate by exactly the same amount at every subsequent FOMC meeting through June of 2006 (see Figure 3). What does this tell us about the monetary policy curve during that time period?

Because the Federal Reserve was reacting to inflationary pressures, its monetary policy actions were clearly movements along the *MP* curve, say, from point *A* to *B* to *C* in Figure 1. The Fed was following the Taylor principle, reacting to higher inflation by raising the real interest rate. ◆

APPLICATION Shift in the *MP* Curve: Autonomous Monetary Easing at the Onset of the Global Financial Crisis

When the global financial crisis started in August 2007, inflation was rising and economic growth was quite strong. Yet the Fed began an aggressive easing of monetary policy, lowering the federal funds rate as shown in Figure 3. What were the effects on the monetary policy curve?

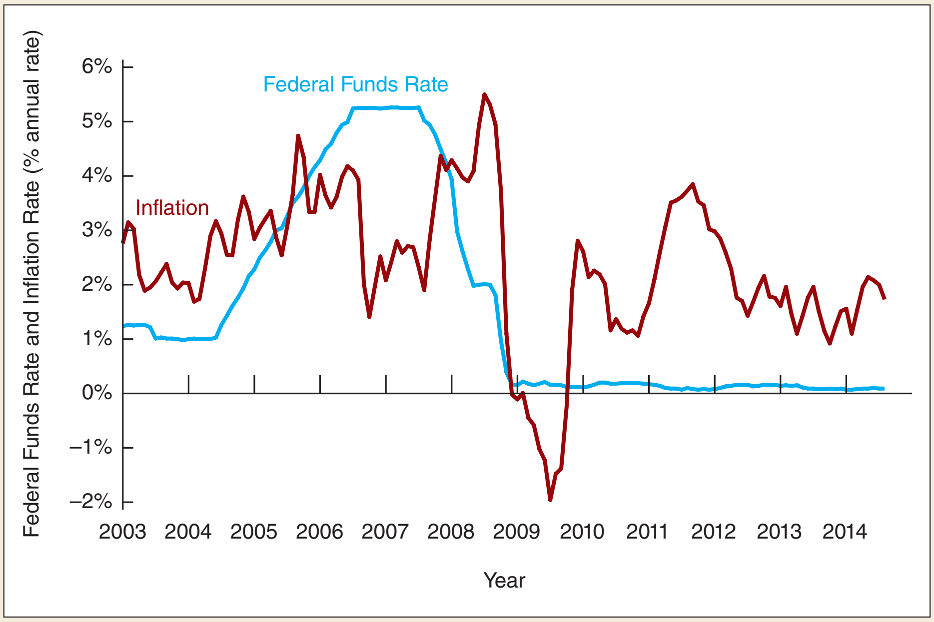
A movement along the *MP* curve would have suggested that the Fed planned to continue hiking interest rates because inflation was rising, but instead the Fed did the opposite. The Fed's actions thus shifted the monetary policy curve down, from MP_1 to MP_3, as shown in Figure 2. The Fed pursued this autonomous monetary policy

MyEconLab Mini-lecture MyEconLab Real-time data

FIGURE 3
The Federal Funds Rate and Inflation Rate, 2003–2014

From June of 2004 through June of 2006, because of pressures from rising inflation, the Fed increased its policy rate, the federal funds rate, by 1/4 of a percentage point at every FOMC meeting. These Fed actions were a movement along the MP curve. In contrast, the Fed began an autonomous easing of monetary policy in September 2007, bringing down the federal funds rate despite the continuing high inflation.

Source: Federal Reserve Bank of St. Louis FRED database. http://research.stlouisfed.org/fred2/



easing because the negative shock to the economy caused by the disruption to financial markets (discussed in Chapter 12) indicated that, despite the high inflation rates at the time, the economy was likely to weaken in the near future, and the inflation rate would then fall. Indeed, this is exactly what came to pass, with the economy going into a recession in December 2007 and the inflation rate falling sharply after July 2008. ◆

THE AGGREGATE DEMAND CURVE

We are now ready to derive the relationship between the inflation rate and aggregate output when the goods market is in equilibrium: the **aggregate demand curve**. The *MP* curve that we just developed demonstrates how central banks respond to changes in inflation by changing the interest rate in line with the Taylor principle. The *IS* curve we developed in Chapter 21 showed that changes in real interest rates, in turn, affect equilibrium output. With these two curves, we can now link the quantity of aggregate output demanded with the inflation rate, given the public's expectations of inflation and the stance of monetary policy. The aggregate demand curve is central to the aggregate demand and supply analysis we will develop further in the next chapter, which will enable us to explain short-run fluctuations in both aggregate output and inflation.

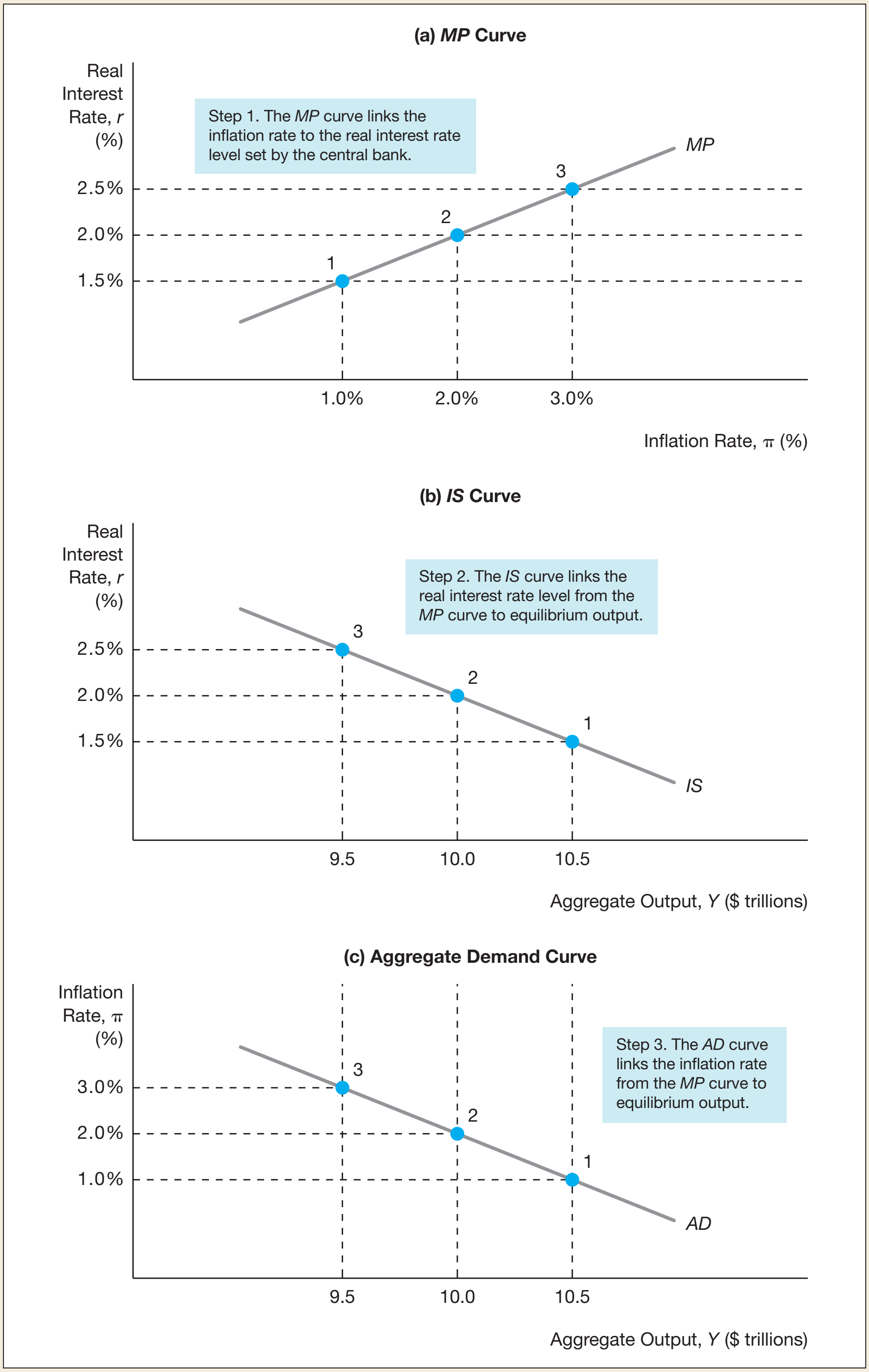
Deriving the Aggregate Demand Curve Graphically

Using the hypothetical *MP* curve from Equation 2, we know that when the inflation rate rises from 1% to 2% to 3%, the Federal Reserve reacts by raising the real interest rate from 1.5% to 2% to 2.5%. We plot these points in panel (a) of Figure 4 as the

MyEconLab Mini-lecture

FIGURE 4
Deriving the *AD* Curve

The *MP* curve in panel (a) shows that as inflation rises from 1.0% to 2.0% to 3.0%, the real interest rate rises from 1.5% to 2.0% to 2.5%. The *IS* curve in panel (b) then shows that higher real interest rates lead to lower planned investment spending and net exports, and hence aggregate output falls from \$10.5 trillion to \$10.0 trillion to \$9.5 trillion. Finally, panel (c) plots the level of equilibrium output corresponding to each of the three inflation rates: the line that connects these points is the *AD* curve, and it is downward-sloping.



MP curve. In panel (b), we graph the *IS* curve described in Equation 13 of Chapter 21 ($Y = 12 - r$). As the real interest rate rises from 1.5% to 2% to 2.5%, the equilibrium moves from point 1 to point 2 to point 3, and aggregate output falls from \$10.5 trillion to \$10 trillion to \$9.5 trillion. In other words, as real interest rates rise, investment and net exports decline, leading to a reduction in aggregate demand. Using the information from panels (a) and (b), we can create the curve shown in panel (c). As inflation rises from 1% to 2% to 3%, the equilibrium moves from point 1 to point 2 to point 3 in panel (c), and aggregate output falls from \$10.5 trillion to \$10 trillion to \$9.5 trillion.

The line that connects the three points shown in panel (c) is the aggregate demand curve, *AD*, and it indicates the level of aggregate output corresponding to each of the three real interest rates consistent with equilibrium in the goods market for any given inflation rate. The aggregate demand curve has a downward slope because a higher inflation rate leads the central bank to raise the real interest rate, thereby lowering planned spending and hence lowering the level of equilibrium aggregate output.

By using some algebra (see the FYI box, "Deriving the Aggregate Demand Curve Algebraically"), the *AD* curve in Figure 4 can be written numerically as follows:

$$Y = 11 - 0.5\pi \tag{3}$$

Factors That Shift the Aggregate Demand Curve

Movements along the aggregate demand curve describe how the equilibrium level of aggregate output changes when the inflation rate changes. When factors other than the inflation rate change, however, the aggregate demand curve shifts. We first review the factors that shift the *IS* curve, and then consider the factors that shift the *AD* curve.

FYI Deriving the Aggregate Demand Curve Algebraically

To derive a numerical *AD* curve, we start by taking the numerical *IS* curve given by Equation 13 in Chapter 21:

$$Y = 12 - r$$

We then use the numerical *MP* curve given in Equation 2, $r = 1.0 + 0.5\pi$, to substitute for r, yielding

$$\begin{aligned} Y &= 12 - (1.0 + 0.5\pi) \\ &= (12 - 1) - 0.5\pi \\ &= 11 - 0.5\pi \end{aligned}$$

which is the same as Equation 3 in the text.

Similarly, we can derive a more general version of the *AD* curve by using the algebraic version of the *IS* curve given by Equation 12 in Chapter 21:

$$Y = [\bar{C} + \bar{I} - d\bar{f} + \bar{G} + \overline{NX} - mpc \times \bar{T}] \times \frac{1}{1 - mpc} - \frac{d + x}{1 - mpc} \times r$$

We then substitute for r using the algebraic *MP* curve given in Equation 1, $r = \bar{r} + \lambda\pi$, to get the more general equation of the *AD* curve:

$$Y = [\bar{C} + \bar{I} - d\bar{f} + \bar{G} + \overline{NX} - mpc \times \bar{T}] \times \frac{1}{1 - mpc} - \frac{d + x}{1 - mpc} \times (\bar{r} + \lambda\pi)$$

Shifts in the *IS* Curve We saw in the preceding chapter that there are six factors that cause the *IS* curve to shift. It turns out that these same factors will cause the aggregate demand curve to shift as well:

1. Autonomous consumption expenditure
2. Autonomous investment spending
3. Government purchases
4. Taxes
5. Autonomous net exports
6. Financial frictions

We examine how changes in these factors lead to a shift in the aggregate demand curve, as shown in Figure 5.

Suppose that inflation is at 2.0%, and so the *MP* curve in panel (a) of Figure 5 shows that the real interest rate is at 2.0%. The IS_1 curve in panel (b) then shows that the equilibrium level of output is at \$10 trillion at point A_1, which corresponds to an equilibrium level of output of \$10 trillion at point A_1 on the AD_1 curve in panel (c). Now suppose there is a rise in, for example, government purchases of \$1 trillion. Panel (b) shows that with both the inflation rate and the real interest rate held constant at 2.0%, the equilibrium moves from point A_1 to point A_2, with output rising to \$12.5 trillion,[4] and so the *IS* curve shifts to the right from IS_1 to IS_2. The rise in output to \$12.5 trillion means that, holding inflation and the real interest rate constant, the equilibrium in panel (c) also moves from point A_1 to point A_2, and so the *AD* curve also shifts to the right, from AD_1 to AD_2.

Figure 5 shows that ***any factor that shifts the IS curve shifts the aggregate demand curve in the same direction.*** Therefore, any factor that shifts the *IS* curve to the right—a rise in autonomous consumption expenditure or planned investment spending encouraged by "animal spirits," a rise in government purchases, an autonomous rise in net exports, a fall in taxes, or a decline in financial frictions—will also shift the aggregate demand curve to the right. Conversely, any factor that shifts the *IS* curve to the left—a fall in autonomous consumption expenditure, a fall in planned investment spending, a fall in government purchases, a fall in net exports, a rise in taxes, or a rise in financial frictions—will shift the aggregate demand curve to the left.

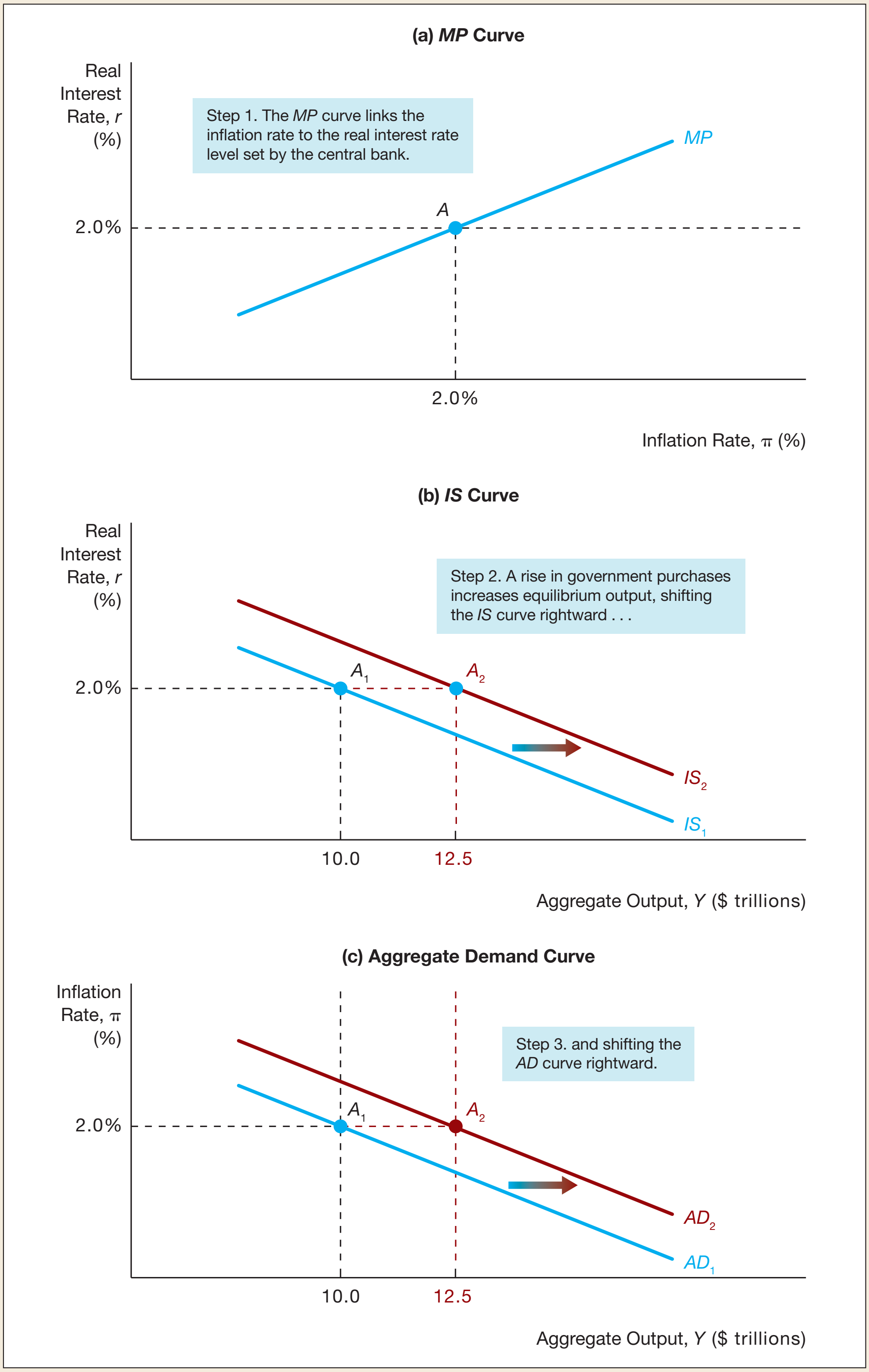
Shifts in the *MP* Curve We now examine what happens to the aggregate demand curve when the *MP* curve shifts. Suppose the Federal Reserve is worried about the economy overheating and so decides to autonomously tighten monetary policy by raising the real interest rate by one percentage point at any given level of the inflation rate. At an inflation rate of 2.0%, the real interest rate rises from 2.0% to 3.0% in Figure 6. The *MP* curve shifts up from MP_1 to MP_2 in panel (a). Panel (b) shows that when the inflation rate is at 2.0%, the higher real interest rate of 3.0% causes the equilibrium to move from point A_1 to point A_2 on the *IS* curve, with output falling from \$10 trillion to \$9 trillion. The lower output of \$9 trillion occurs because the higher real interest leads to a decline in investment and net exports, which lowers aggregate demand. The lower output of \$9 trillion then decreases the equilibrium output level from point A_1 to point A_2 in panel (c), and so the *AD* curve shifts to the left, from AD_1 to AD_2.

[4]As we saw in the numerical example in Chapter 21, a rise in government purchases of \$1 trillion leads to a \$2.5 trillion increase in equilibrium output at any given real interest rate, and this is why output rises from \$10 trillion to \$12.5 trillion when the real interest rate is at 2.0%.

MyEconLab Mini-lecture

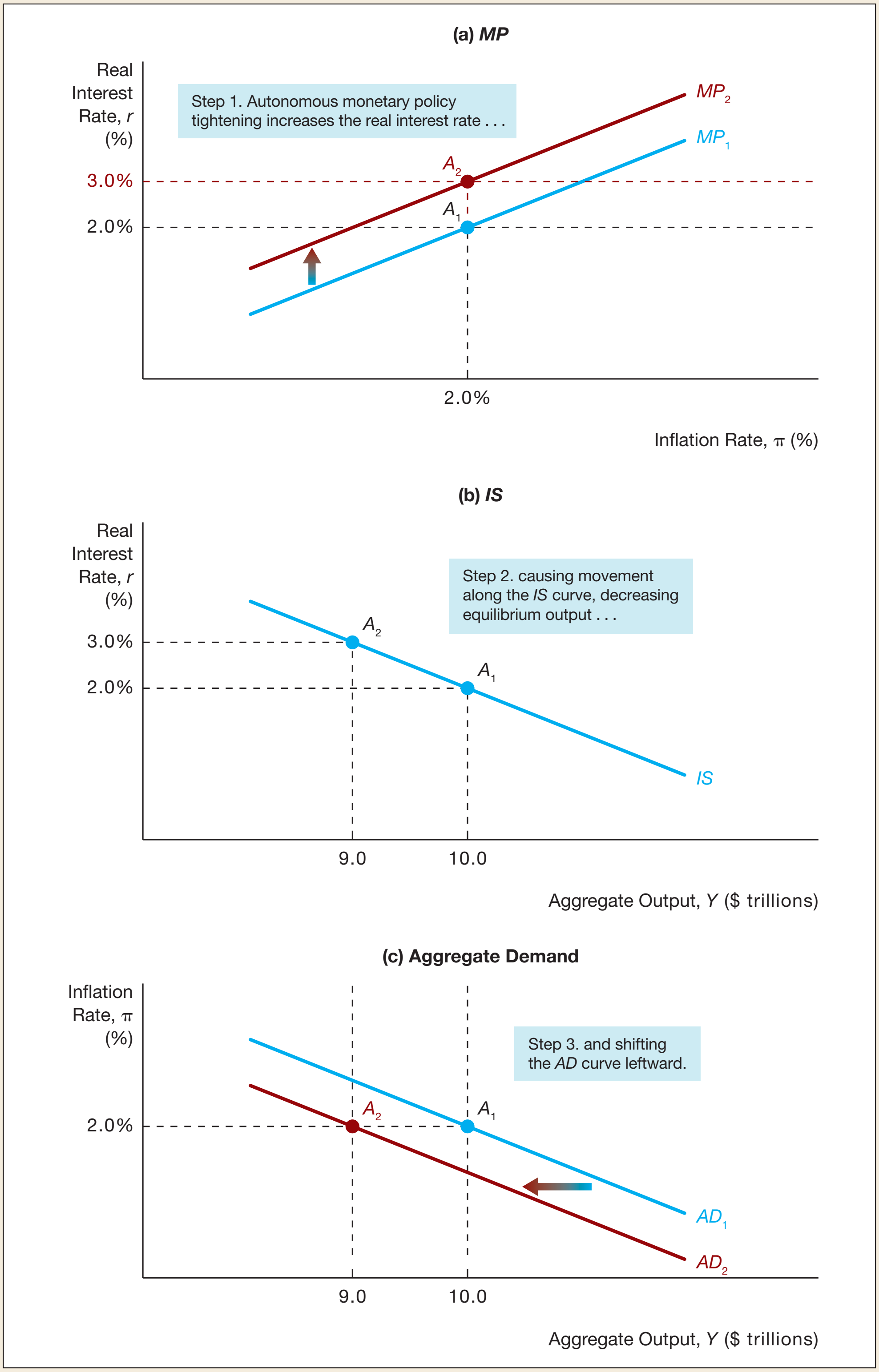
FIGURE 5
Shift in the *AD* Curve from Shifts in the *IS* Curve

At a 2% inflation rate in panel (a), the monetary policy curve indicates that the real interest rate is 2%. An increase in government purchases shifts the *IS* curve to the right in panel (b). At a given inflation rate and real interest rate of 2.0%, equilibrium output rises from \$10 trillion to \$12.5 trillion, which is shown as a movement from point A_1 to point A_2 in panel (c), shifting the aggregate demand curve to the right from AD_1 to AD_2. Any factor that shifts the *IS* curve shifts the *AD* curve in the same direction.



MyEconLab Mini-lecture

FIGURE 6
Shift in the *AD* Curve from Autonomous Monetary Policy Tightening
Autonomous monetary tightening that raises real interest rates by one percentage point at any given inflation rate shifts the *MP* curve up, from MP_1 to MP_2 in panel (a). With the inflation rate at 2.0%, the higher 3% interest rate results in a movement from point A_1 to A_2 on the *IS* curve, with output falling from \$10 trillion to \$9 trillion. This change in equilibrium output leads to movement from point A_1 to point A_2 in panel (c), shifting the aggregate demand curve to the left, from AD_1 to AD_2.



Our conclusion from Figure 6 is that ***an autonomous tightening of monetary policy—that is, a rise in the real interest rate at any given inflation rate—shifts the aggregate demand curve to the left. Conversely, an autonomous easing of monetary policy shifts the aggregate demand curve to the right.***

We have now derived and analyzed the aggregate demand curve, an essential element in the aggregate demand and supply framework that we will examine in the next chapter. We will use the aggregate demand curve in this framework to determine both aggregate output and inflation, as well as to examine events that cause these variables to change.

SUMMARY

1. When the Federal Reserve lowers the federal funds rate by providing more liquidity to the banking system, real interest rates fall in the short run; when the Federal Reserve raises the federal funds rate by reducing the amount of liquidity in the banking system, real interest rates rise in the short run.
2. The monetary policy (*MP*) curve shows the relationship between inflation and the real interest rate that arises from monetary authorities' actions. Monetary policy follows the Taylor principle, in which higher inflation results in higher real interest rates, represented by upward movements along the monetary policy curve. An autonomous tightening of monetary policy occurs when monetary policymakers raise the real interest rate at any given inflation rate, resulting in an upward shift of the monetary policy curve. An autonomous easing of monetary policy and a downward shift of the monetary policy curve occur when monetary policymakers lower the real interest rate at any given inflation rate.
3. The aggregate demand curve gives the level of equilibrium aggregate output (which equals the total quantity of output demanded) for any given inflation rate. It slopes downward because a higher inflation rate leads the central bank to raise real interest rates, which leads to a lower level of equilibrium output. The aggregate demand curve will shift in the same direction as the *IS* curve; hence the *AD* curve shifts to the right when government purchases increase, taxes decrease, "animal spirits" encourage consumer and business spending, autonomous net exports increase, or financial frictions decrease. An autonomous tightening of monetary policy—that is, an increase in the real interest rate at any given inflation rate—leads to a decline in aggregate demand, and the aggregate demand curve shifts to the left.

KEY TERMS

aggregate demand curve, p. 569
autonomous easing of monetary policy, p. 567
autonomous tightening of monetary policy, p. 567
monetary policy (*MP*) curve, p. 565
Taylor principle, p. 565

QUESTIONS

Select questions are available in MyEconLab *at* http://www.myeconlab.com.

1. When the inflation rate increases, what happens to the federal funds rate? Operationally, how does the Fed adjust the federal funds rate?
2. What is the key assumption underlying the Fed's ability to control the real interest rate?
3. Why does the *MP* curve necessarily have an upward slope?
4. If $\lambda = 0$, what does this imply about the relationship between the nominal interest rate and the inflation rate?
5. How does an autonomous tightening or easing of monetary policy by the Fed affect the *MP* curve?

6. How is an autonomous tightening or easing of monetary policy different from a change in the real interest rate caused by a change in the current inflation rate?
7. Suppose that a new Fed chair is appointed and that his or her approach to monetary policy can be summarized by the following statement: "I care only about increasing employment. Inflation has been at very low levels for quite some time; my priority is to ease monetary policy to promote employment." How would you expect the monetary policy curve to be affected, if at all?
8. "The Fed decreased the fed funds rate in late 2007, even though inflation was increasing. This action demonstrated a violation of the Taylor principle." Is this statement true, false, or uncertain? Explain your answer.
9. What factors affect the slope of the aggregate demand curve?
10. "Autonomous monetary policy is more effective at changing output when λ is higher." Is this statement true, false, or uncertain? Explain your answer.
11. If net exports were not sensitive to changes in the real interest rate, would monetary policy be more or less effective in changing output?
12. How does an autonomous tightening or easing of monetary policy by the Fed affect the aggregate demand curve?
13. For each of the following situations, describe how (if at all) the *IS*, *MP*, and *AD* curves are affected.
    a. A decrease in financial frictions
    b. An increase in taxes and an autonomous easing of monetary policy
    c. An increase in the current inflation rate
    d. A decrease in autonomous consumption
    e. Firms become more optimistic about the future of the economy.
    f. The new Federal Reserve chair begins to care more about fighting inflation.
14. What would be the effect of a decrease in U.S. net exports on the aggregate demand curve? Would a decrease in net exports affect the monetary policy curve? Explain.
15. Why does the aggregate demand curve shift when "animal spirits" change?
16. If government spending increases and taxes are raised to keep the budget balanced, what happens to the aggregate demand curve?
17. Suppose that government spending is increased at the same time that an autonomous monetary policy tightening occurs. What will happen to the position of the aggregate demand curve?
18. "If $\bar{f}$ increases, then the Fed can keep output constant by reducing the real interest rate by the same amount as the increase in financial frictions." Is this statement true, false, or uncertain? Explain your answer.

APPLIED PROBLEMS

Select applied problems are available in MyEconLab *at* http://www.myeconlab.com.

19. Assume the monetary policy curve is given by $r = 1.25 + 0.75\pi$.
    a. Calculate the real interest rate when the inflation rate is 3%, 4%, and 5%.
    b. Draw the *MP* curve showing the points found above. Properly label the points from part (a).
    c. Assume now that the monetary policy curve is $r = 2.25 + 0.75\pi$. Does the new monetary policy curve represent an autonomous tightening or loosening of monetary policy?
    d. Calculate the real interest rate when the inflation rate is 3%, 4%, and 5%, and draw the new *MP* curve, showing the shift from part (b).
20. Use an *IS* curve and an *MP* curve to derive graphically the *AD* curve.
21. Suppose the monetary policy curve is given by $r = 1 + 0.5\pi$, and the *IS* curve is given by $Y = 11 - r$.
    a. Calculate an expression for the aggregate demand curve.
    b. Calculate the real interest rate and aggregate output when the inflation rate is 3%, 5%, and 6%.

c. Draw graphs of the *IS*, *MP*, and *AD* curves, labeling the points from part (b) on the appropriate graphs.

22. Consider an economy described by the following:

$$\bar{C} = \$4 \text{ trillion}$$
$$\bar{I} = \$2 \text{ trillion}$$
$$\bar{G} = \$3 \text{ trillion}$$
$$\bar{T} = \$3 \text{ trillion}$$
$$\overline{NX} = \$1 \text{ trillion}$$
$$\bar{f} = 0$$
$$mpc = 0.8$$
$$d = 0.25$$
$$x = 0.05$$
$$\lambda = 0.5$$
$$\bar{r} = 1$$

a. Derive expressions for the *MP* curve and the *AD* curve.

b. Calculate the real interest rate when $\pi = 4\%$ and $\pi = 6\%$.

c. Calculate the aggregate output when $\pi = 3\%$ and $\pi = 4\%$.

d. Draw a graph of the *MP* curve and the *AD* curve, labeling the points given in part (b) and (c).

23. Consider an economy described by the following:

$$\bar{C} = \$3 \text{ trillion}$$
$$\bar{I} = \$1.3 \text{ trillion}$$
$$\bar{G} = \$3.5 \text{ trillion}$$
$$\bar{T} = \$3.0 \text{ trillion}$$
$$\overline{NX} = \$1.5 \text{ trillion}$$
$$\bar{f} = 1$$
$$mpc = 0.75$$
$$d = 0.3$$
$$x = 0.1$$
$$\lambda = 0.5$$
$$\bar{r} = 1$$

a. Derive expressions for the *MP* curve and the *AD* curve.

b. Assume that $\pi = 1.5$. Calculate the real interest rate, the equilibrium level of output, consumption, planned investment, and net exports.

c. Suppose the Fed increases $\bar{r}$ to 2. Calculate the real interest rate, the equilibrium level of output, consumption, planned investment, and net exports at this new level of $\bar{r}$.

d. Considering that output, consumption, planned investment, and net exports all decreased in part (c), why might the Fed choose to increase $\bar{r}$?

24. Consider the economy described in Applied Problem 23.

a. Derive expressions for the *MP* curve and the *AD* curve.

b. Assume that $\pi = 2$. What are the real interest rate and the equilibrium level of output?

c. Suppose government spending increases to \$4 trillion. What happens to equilibrium output?

d. If the Fed wants to keep output constant, then what monetary policy change should it make?

25. Suppose the *MP* curve is given by $r = 1 + 2\pi$, and the *IS* curve is given by $Y = 20 - 2r$.

a. Derive an expression for the *AD* curve, and draw a graph labeling points at $\pi = 0$, $\pi = 2.25$, and $\pi = 4.5$.

b. Suppose that λ increases to $\lambda = 4$. Derive an expression for the new *AD* curve, and draw the new *AD* curve using the graph from part (a).

c. What does your answer to part (b) imply about the relationship between a central bank's distaste for inflation and the slope of the *AD* curve?

DATA ANALYSIS PROBLEMS

The Problems update with real-time data in MyEconLab and are available for practice or instructor assignment.

1. A measure of real interest rates can be approximated by the Treasury Inflation-Indexed Security, or *TIIS*. Go to the St. Louis Federal Reserve FRED database, and find data on the five-year *TIIS* (FII5) and the personal consumption expenditure price index (PCECTPI), a measure of the price index. Choose "Quarterly" for the *frequency* setting of the *TIIS*, and download both data series. Convert the price index data to annualized inflation rates by taking the quarter-to-quarter percent change in the price index and multiplying it by 4. Be sure to multiply by 100 so that your results are percentages.

a. Calculate the average inflation rate and the average real interest rate over the most recent four quarters of data available, and the four quarters prior to that.

b. Calculate the change in the average inflation rate between the most recent annual period and the year prior. Then calculate the change in the average real interest rate over the same period.

c. Using your answers to part (b), compute the ratio of the change in the average real interest rate to the change in the average inflation rate. What does this ratio represent? Comment on how it relates to the Taylor principle.

2. A measure of real interest rates can be approximated by the Treasury Inflation-Indexed Security, or *TIIS*. Go to the St. Louis Federal Reserve FRED database, and find data on the five-year *TIIS* (FII5) and the personal consumption expenditure price index (PCECTPI), a measure of the price index. Choose "Quarterly" for the *frequency* setting for the *TIIS*, and choose "Percent Change From Year Ago" for the *units* setting on (PCECTPI). Plot both series on the same graph, using data from 2007 through the most current data available. Use the graph to identify periods of autonomous monetary policy changes. Briefly explain your reasoning.

WEB EXERCISES

1. Go to http://www.federalreserve.gov/pf/pdf/pf_2.pdf. Review the FOMC's document, "Longer-Run Goals and Monetary Policy Strategy." Explain why these goals are consistent with the Taylor principle.

2. Go to http://www.federalreserve.gov/fomc/. Read the latest FOMC statement and the minutes of the most recent FOMC meeting. Are the statement and the discussion in the minutes consistent with the Taylor principle?

WEB REFERENCES

http://www.federalreserve.gov/pf/pf.htm

Describes the purposes and functions of the Federal Reserve System and its rationale for the conduct of monetary policy.

http://www.federalreserve.gov/fomc

Provides information on all the FOMC's actions, including the statement and minutes for each meeting.