7

Putting All Markets Together: The *AS–AD* Model

In Chapter 5, we looked at the determination of output in the short run. In Chapter 6, we looked at the determination of output in the medium run. We are now ready to put the two together and look at the determination of output in both the short run and the medium run.

To do so, we use the equilibrium conditions for *all* the markets we have looked at so far—the goods and financial markets in Chapter 5, the labor market in Chapter 6.

Then, using these equilibrium conditions, we derive two relations:

The first relation, which we call the *aggregate supply relation*, captures the implications of equilibrium in the labor market; it builds on what you saw in Chapter 6.

The second relation, which we call the *aggregate demand relation*, captures the implications of equilibrium in both the goods market and financial markets; it builds on what you saw in Chapter 5.

Combining these two relations gives us the *AS–AD* model (for aggregate supply–aggregate demand). This chapter presents the basic version of the model. When confronted with a macroeconomic question, this is the version we typically use to organize our thoughts. For some questions—if we want to focus on the behavior of inflation, for example, or understand the role of the financial system in the current crisis—the basic *AS–AD* model must be extended. But it provides a base on which one can build, and this is what we shall do in the next two chapters.

This chapter is organized as follows:

Section 7-1 derives the aggregate supply relation, and Section 7-2 derives the aggregate demand relation.

Section 7-3 combines the two to characterize equilibrium output in the short run and in the medium run.

Section 7-4 looks at the dynamic effects of monetary policy.

Section 7-5 looks at the dynamic effects of fiscal policy.

Section 7-6 looks at the effects of an increase in the price of oil.

Section 7-7 summarizes.

7-1 Aggregate Supply

The **aggregate supply relation** captures the effects of output on the price level. It is derived from the behavior of wages and prices we described in Chapter 6.

In Chapter 6, we derived the following equation for wage determination (equation (6.1)):

$$W = P^e F(u, z)$$

The nominal wage W, set by wage setters, depends on the expected price level P^e, on the unemployment rate u, and on the catchall variable z for all the other factors that affect wage determination, from unemployment benefits to the form of collective bargaining.

Also in Chapter 6, we derived the following equation for price determination (equation (6.3)):

$$P = (1 + m)W$$

The price P set by firms (equivalently, the price level) is equal to the nominal wage W, times 1 plus the markup m.

We then used these two relations together with the additional assumption that the actual price level was equal to the expected price level. Under this additional assumption, we derived the natural rate of unemployment and, by implication, the natural level of output.

The difference in this chapter is that we will not impose this additional assumption. (It will turn out that the price level is equal to the expected price level in the medium run but will typically not be equal to the expected price level in the short run.) Without this additional assumption, the price-setting relation and the wage-setting relation give us a relation, which we now derive, among the price level, the output level, and the expected price level.

The first step is to eliminate the nominal wage W between the two equations. Replacing the nominal wage in the second equation above by its expression from the first gives

$$P = P^e (1 + m) F(u, z) \tag{7.1}$$

The price level P depends on the expected price level P^e, on the unemployment rate u (as well as on the markup m and on the catchall variable z; but we will assume both m and z are constant here).

The second step is to replace the unemployment rate u with its expression in terms of output. To replace u, recall the relation between the unemployment rate, employment, and output we derived in Chapter 6:

$$u = \frac{U}{L} = \frac{L - N}{L} = 1 - \frac{N}{L} = 1 - \frac{Y}{L}$$

The first equality follows from the definition of the unemployment rate. The second equality follows from the definition of unemployment ($U \equiv L - N$). The third equality just simplifies the fraction. The fourth equality follows from the specification of the production function, which says that to produce one unit of output requires one worker, so that $Y = N$. What we get then is

$$u = 1 - \frac{Y}{L}$$

In words: For a given labor force, the higher the output, the lower the unemployment rate.

Replacing u by $1 - (Y/L)$ in equation (7.1) gives us the *aggregate supply relation, or AS relation for short*:

$$P = P^e (1 + m) F\left(1 - \frac{Y}{L}, z\right) \tag{7.2}$$

A better name would be "the labor market relation." But because the relation looks graphically like a supply curve (there is a positive relation between output and the price), it is called "the aggregate supply relation." we follow this tradition.

The price level P depends on the expected price level P^e and the level of output Y (and also on the markup m, the catchall variable z, and the labor force L, which we all take as constant here). The AS relation has two important properties:

The first property is that, given the expected price level, an increase in output leads to an increase in the price level. This is the result of four underlying steps:

An increase in Y leads to an increase in P.

1. An increase in output leads to an increase in employment.
2. The increase in employment leads to a decrease in unemployment and therefore to a decrease in the unemployment rate.
3. The lower unemployment rate leads to an increase in the nominal wage.
4. The increase in the nominal wage leads to an increase in the prices set by firms and therefore to an increase in the price level.

The second property is that, given unemployment, an increase in the expected price level leads, one for one, to an increase in the actual price level. For example, if the expected price level doubles, then the price level will also double. This effect works through wages:

An increase in P^e leads to an increase in P.

1. If wage setters expect the price level to be higher, they set a higher nominal wage.
2. The increase in the nominal wage leads to an increase in costs, which leads to an increase in the prices set by firms and a higher price level.

If output is equal to the natural level of output, the price level is equal to the expected price level.

The relation between the price level P and output Y, for a given value of the expected price level P^e, is represented by the curve AS in Figure 7-1. The AS curve has three properties that will prove useful in what follows:

- The aggregate supply curve is upward sloping. Put another way, an increase in output Y leads to an increase in the price level P. You saw why earlier.

Put informally: High economic activity puts pressure on prices.

- The aggregate supply curve goes through point A, where $Y = Y_n$ and $P = P^e$. Put another way: When output Y is equal to the natural level of output Y_n, the price level P turns out to be exactly equal to the expected price level P^e.

  How do we know this? From the definition of the natural level of output in Chapter 6. Recall that we defined the natural rate of unemployment (and by implication the natural level of output) as the rate of unemployment (and by implication the level of output) that prevails if the price level and the expected price level are equal.

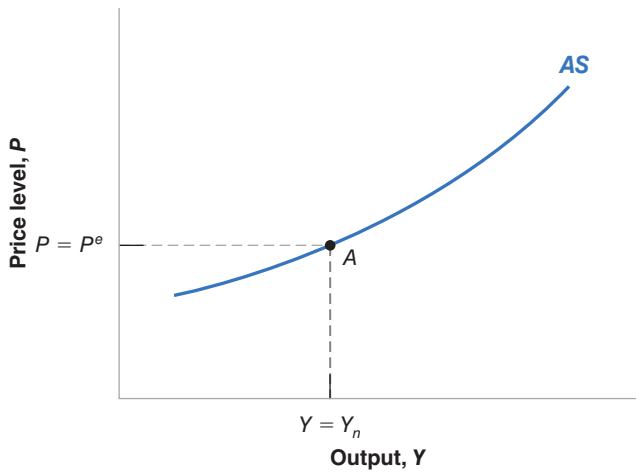


Figure 7-1

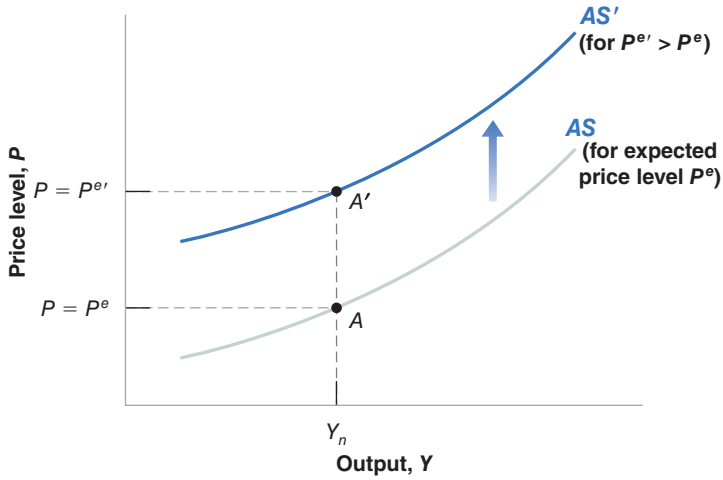
The Aggregate Supply Curve

Given the expected price level, an increase in output leads to an increase in the price level.

Figure 7-2

The Effect of an Increase in the Expected Price Level on the Aggregate Supply Curve

An increase in the expected price level shifts the aggregate supply curve up.



This property—that the price level equals the expected price level when output is equal to the natural level of output—has two straightforward implications:

When output is above the natural level of output, the price level turns out to be higher than expected. In Figure 7-1: If Y is to the right of Y_n, P is higher than P^e. Conversely: When output is below the natural level of output, the price level turns to be lower than expected. In Figure 7-1: If Y is to the left of Y_n, P is lower than P^e.

- An increase in the expected price level P^e shifts the aggregate supply curve up. Conversely: A decrease in the expected price level shifts the aggregate supply curve down.

This third property is shown in Figure 7-2. Suppose the expected price level increases from P^e to $P^{e\prime}$. At a given level of output, and, correspondingly, at a given unemployment rate, the increase in the expected price level leads to an increase in wages, which leads in turn to an increase in prices. So, at any level of output, the price level is higher: The aggregate supply curve shifts up. In particular, instead of going through point A (where $Y = Y_n$ and $P = P^e$), the aggregate supply curve now goes through point A' (where $Y = Y_n$, $P = P^{e\prime}$).

Recall: When output equals the natural level of output, the price level turns out to be equal to the expected price level. ▶

Let's summarize:

- Starting from wage determination and price determination in the labor market, we have derived the *aggregate supply relation*.
- This relation implies that for a given expected price level, the price level is an increasing function of the level of output. It is represented by an upward-sloping curve, called the *aggregate supply curve*.
- Increases in the expected price level shift the aggregate supply curve up; decreases in the expected price level shift the aggregate supply curve down.

7-2 Aggregate Demand

The **aggregate demand relation** captures the effect of the price level on output. It is derived from the equilibrium conditions in the goods and financial markets we described in Chapter 5.

In Chapter 5, we derived the following equation for goods-market equilibrium (equation (5.2)):

$$Y = C(Y - T) + I(Y, i) + G$$

Equilibrium in the goods market requires that output equal the demand for goods—the sum of consumption, investment, and government spending. This is the *IS* relation.

Also in Chapter 5, we derived the following equation for equilibrium in financial markets (equation (5.3)):

$$\frac{M}{P} = Y\,L(i)$$

Equilibrium in financial markets requires that the supply of money equal the demand for money. This is the *LM* relation.

Recall that what appears on the left side of the *LM* equation is the real money stock, M/P. We focused in Chapters 5 and 6 on changes in the real money stock that came from changes in nominal money M by the Fed. But changes in the real money stock M/P can also come from changes in the price level P. A 10% increase in the price level P has the same effect on the real money stock as a 10% decrease in the stock of nominal money M : Either leads to a 10% decrease in the real money stock.

Using the *IS* and *LM* relations, we can derive the relation between the price level and the level of output implied by equilibrium in the goods and financial markets. We do this in Figure 7-3.

- Figure 7-3(a) draws the *IS* curve and the *LM* curve. The *IS* curve is drawn for given values of G and T. It is downward sloping: An increase in the interest rate leads to a decrease in output. The *LM* curve is drawn for a given value of M/P. It is upward sloping: An increase in output increases the demand for money, and the interest rate

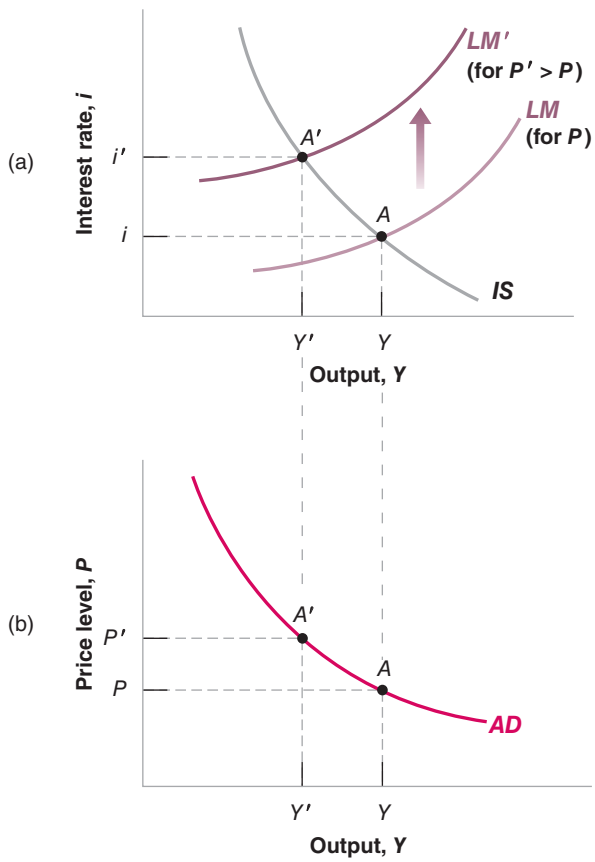


Figure 7-3

The Derivation of the Aggregate Demand Curve

An increase in the price level leads to a decrease in output.

increases so as to maintain equality of money demand and the (unchanged) money supply. The point at which the goods market and the financial markets are both in equilibrium is at the intersection of the *IS* curve and the *LM* curve, at point *A*.

Now consider the effects of an increase in the price level from P to P'. Given the stock of nominal money, M, the increase in the price level P decreases the real money stock, M/P. This implies that the *LM* curve shifts up: At a given level of output, the lower real money stock leads to an increase in the interest rate. The economy moves along the *IS* curve, and the equilibrium moves from A to A'. The interest rate increases from i to i', and output decreases from Y to Y'. In short: The increase in the price level leads to a decrease in output.

In words: The increase in the price level leads to a decrease in the real money stock. This monetary contraction leads to an increase in the interest rate, which leads in turn to a lower demand for goods and lower output.

■ The negative relation between output and the price level is drawn as the downward–sloping *AD* curve in Figure 7-3(b). Points A and A' in Figure 7-3(b) correspond to points A and A' in Figure 7-3(a). An increase in the price level from P to P' leads to a decrease in output from Y to Y'. This curve is called the *aggregate demand curve*. The underlying negative relation between output and the price level is called the *aggregate demand relation*.

A better name would be "the goods market and financial markets relation." But, because it is a long name, and because the relation looks graphically like a demand curve (that is, a negative relation between output and the price), it is called the "aggregate demand relation." We shall, again, follow tradition.

Any variable other than the price level that shifts either the IS curve or the LM curve also shifts the aggregate demand relation.

Take, for example, an increase in government spending G. At a given price level, the level of output implied by equilibrium in the goods and the financial markets is higher: In Figure 7-4, the aggregate demand curve shifts to the right, from *AD* to *AD*′.

Recall that open market operations are the means through which the Fed changes the nominal money stock.

Or take a contractionary, open market operation—a decrease in M. At a given price level, the level of output implied by equilibrium in the goods and the financial markets is lower. In Figure 7-4, the aggregate demand curve shifts to the left, from *AD* to *AD*″.

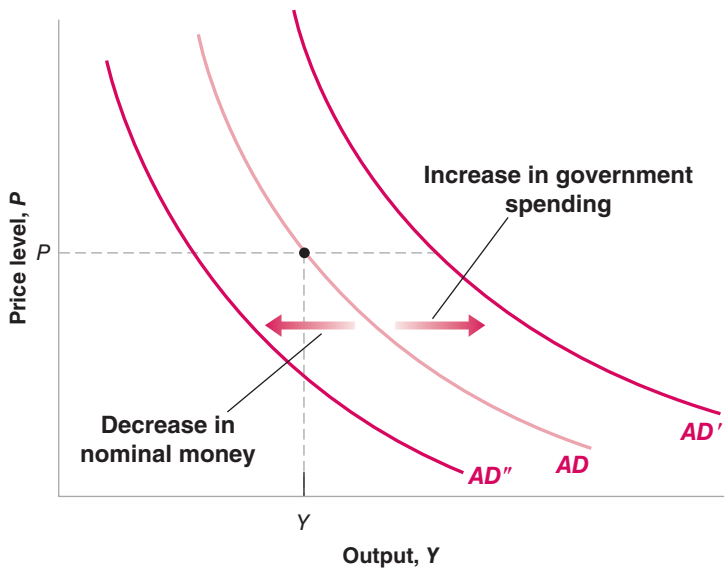
Let's represent what we have just derived by the following aggregate demand relation:

$$Y = Y\left(\frac{M}{P}, G, T\right) \qquad (7.3)$$
$$(+, \ +, -)$$

Figure 7-4

Shifts of the Aggregate Demand Curve

At a given price level, an increase in government spending increases output, shifting the aggregate demand curve to the right. At a given price level, a decrease in nominal money decreases output, shifting the aggregate demand curve to the left.



Output Y is an increasing function of the real money stock M/P, an increasing function of government spending G, and a decreasing function of taxes, T.

Given monetary and fiscal policy—that is, given M, G, and T—an increase in the price level P leads to a decrease in the real money stock, M/P, which leads to a decrease in output. This is the relation captured by the AD curve in Figure 7-3(b).

Let's summarize:

- Starting from the equilibrium conditions for the goods and financial markets, we have derived the *aggregate demand relation*.
- This relation implies that the level of output is a decreasing function of the price level. It is represented by a downward-sloping curve, called the *aggregate demand curve*.
- Changes in monetary or fiscal policy—or, more generally, in any variable, other than the price level, that shifts the IS or the LM curves—shift the aggregate demand curve.

7-3 Equilibrium in the Short Run and in the Medium Run

The next step is to put the AS and the AD relations together. From Sections 7-1 and 7-2, the two relations are given by

$$AS \text{ relation} \qquad P = P^e (1 + m) F\left(1 - \frac{Y}{L}, z\right)$$

$$AD \text{ relation} \qquad Y = Y\left(\frac{M}{P}, G, T\right)$$

For a given value of the expected price level, P^e (which enters the aggregate supply relation), and for given values of the monetary and fiscal policy variables M, G, and T (which enter the aggregate demand relation), these two relations determine the equilibrium values of output, Y, and the price level, P.

Note the equilibrium depends on the value of P^e. The value of P^e determines the position of the aggregate supply curve (go back to Figure 7-2), and the position of the aggregate supply curve affects the equilibrium. In the short run, we can take P^e, the price level expected by wage setters when they last set wages, as given. But, over time, P^e is likely to change, shifting the aggregate supply curve and changing the equilibrium. With this in mind, we first characterize equilibrium in the short run—that is, taking P^e as given. We then look at how P^e changes over time, and how that change affects the equilibrium.

Equilibrium in the Short Run

The short–run equilibrium is characterized in Figure 7-5:

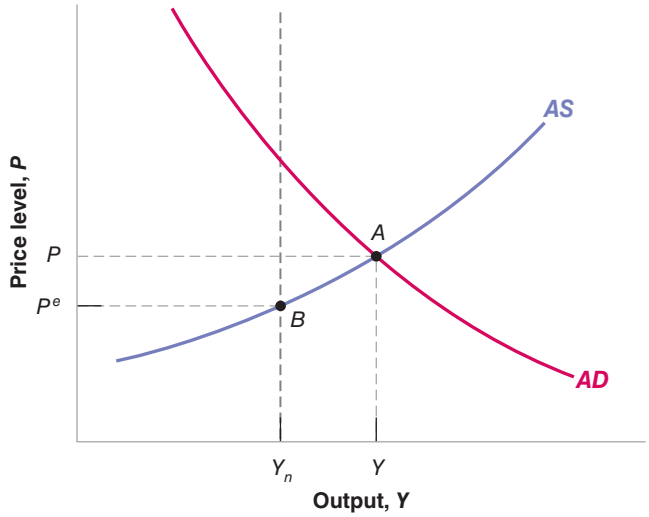
- The aggregate supply curve AS is drawn for a given value of P^e. It is upward sloping: The higher the level of output, the higher the price level. The position of the curve depends on P^e. Recall from Section 7-1 that, when output is equal to the natural level of output, the price level is equal to the expected price level. This means that, in Figure 7-5, the aggregate supply curve goes through point B : If $Y = Y_n$, then $P = P^e$.
- The aggregate demand curve AD is drawn for given values of M, G, and T. It is downward sloping: The higher the price level, the lower the level of output.

The equilibrium is given by the intersection of the AS and AD curves at point A. By construction, at point A, the goods market, the financial markets, and the labor market are *all* in equilibrium. The fact that the labor market is in equilibrium is because point

Figure 7-5

The Short-Run Equilibrium

The equilibrium is given by the intersection of the aggregate supply curve and the aggregate demand curve. At point *A*, the labor market, the goods market, and financial markets are all in equilibrium.



A is on the aggregate supply curve. That fact that the goods and financial markets are in equilibrium is because point *A* is on the aggregate demand curve. The equilibrium level of output and price level are given by Y and P.

There is no reason why, in general, equilibrium output Y should be equal to the natural level of output Y_n. Equilibrium output depends both on the position of the aggregate supply curve (and therefore on the value of P^e) and on the position of the aggregate demand curve (and therefore on the values of M,G, and T). As we have drawn the two curves, Y is greater than Y_n : In other words, the equilibrium level of output exceeds the natural level of output. But clearly we could have drawn the *AS* and the *AD* curves so equilibrium output Y was smaller than the natural level of output Y_n.

Figure 7-5 gives us our first important conclusion: In the *short run*, there is no reason why output should equal the natural level of output. Whether it does depends on the specific values of the expected price level and the values of the variables affecting the position of aggregate demand.

We must now ask, What happens over time? More precisely: Suppose, in the short run, output is above the natural level of output—as is the case in Figure 7-5. What will happen over time? Will output eventually return to the natural level of output? If so, how? These are the questions we take up in the rest of this section.

From the Short Run to the Medium Run

To think about what happens over time, consider Figure 7-6. The curves denoted *AS* and *AD* are the same as in Figure 7-5, and so the short–run equilibrium is at point *A*—which corresponds to point *A* in Figure 7-5. Output is equal to Y, and is higher than the natural level of output Y_n.

At point *A*, output exceeds the natural level of output. So we know from Section 7-1 that the price level is higher than the expected price level—higher than the price level wage setters expected when they set nominal wages.

The fact that the price level is higher than wage setters expected is likely to lead them to revise upward their expectations of what the price level will be in the future. So, next time they set nominal wages, they are likely to make that decision based on a higher expected price level, say based on $P^{e'}$, where $P^{e'} > P^e$.

If you live in an economy where the inflation rate is typically positive, then, even if the price level this year turns out equal to what you expected, you may still take into account the presence of inflation and expect the price level to be higher next year. In this chapter, we look at an economy in which there is no steady inflation. We will focus on the dynamics of output and inflation in the next chapter.

This increase in the expected price level implies that in the next period, the aggregate supply curve shifts up, from *AS* to *AS*′: At a given level of output, wage setters expect a higher price level. They set a higher nominal wage, which in turn leads firms to set a higher price. The price level therefore increases.

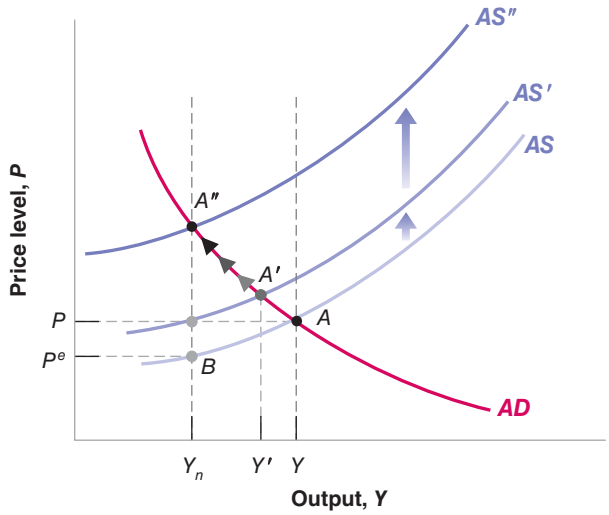


Figure 7-6

The Adjustment of Output over Time

If output is above the natural level of output, the *AS* curve shifts up over time until output has fallen back to the natural level of output.

This upward shift in the *AS* curve implies that the economy moves up along the *AD* curve. The equilibrium moves from A to A'. Equilibrium output decreases from Y to Y'.

The adjustment does not end at point A'. At A', output Y' still exceeds the natural level of output Y_n, so the price level is still higher than the expected price level. Because of this, wage setters are likely to continue to revise upwards their expectation of the price level.

This means that as long as equilibrium output exceeds the natural level of output Y_n, the expected price level increases, shifting the *AS* curve upward. As the *AS* curve shifts upward and the economy moves up along the *AD* curve, equilibrium output continues to decrease.

Does this adjustment eventually come to an end? Yes. It ends when the *AS* curve has shifted all the way to AS'', when the equilibrium has moved all the way to A'', and the equilibrium level of output is equal to Y_n. At A'', equilibrium output is equal to the natural level of output, so the price level is equal to the expected price level. At this point, wage setters have no reason to change their expectations; the *AS* curve no longer shifts, and the economy stays at A''.

In words: So long as output exceeds the natural level of output, the price level turns out to be higher than expected. This leads wage setters to revise their expectations of the price level upward, leading to an increase in the price level. The increase in the price level leads to a decrease in the real money stock, which leads to an increase in the interest rate, which leads to a decrease in output. The adjustment stops when output is equal to the natural level of output. At that point, the price level is equal to the expected price level, expectations no longer change, and, output remains at the natural level of output. Put another way, in the *medium run*, output returns to the natural level of output.

We have looked at the dynamics of adjustment starting from a case in which initial output was higher than the natural level of output. Clearly, a symmetric argument holds when initial output is below the natural level of output. In this case, the price level is lower than the expected price level, leading wage setters to lower their expectations of the price level. Lower expectations of the price level cause the *AS* curve to shift down and the economy to move down the *AD* curve until output has increased back to the natural level of output.

Let's summarize:

- In the *short run*, output can be above or below the natural level of output. Changes in any of the variables that enter either the aggregate supply relation or the aggregate demand relation lead to changes in output and to changes in the price level. ◀ In the short run, $Y \neq Y_n$.
- In the *medium run*, output eventually returns to the natural level of output. The adjustment works through changes in the price level. When output is above the natural level of output, the price level increases. The higher price level decreases demand and output. When output is below the natural level of output, the price level decreases, increasing demand and output. ◀ In the medium run, $Y = Y_n$.

The best way to understand more fully the *AS–AD* model is to use it to look at the dynamic effects of changes in policy or in the economic environment. In the next three sections, we focus on three such changes. The first two are our two favorite policy changes: a change in the stock of nominal money; and a change in the budget deficit. The third, which we could not examine before we had developed a theory of wage and price determination, is an increase in the oil price.

7-4 The Effects of a Monetary Expansion

What are the short-run and medium-run effects of an expansionary monetary policy, say of a one-time increase in the level of nominal money from M to M'?

The Dynamics of Adjustment

Look at Figure 7-7. Assume that before the change in nominal money, output is at its natural level. Aggregate demand and aggregate supply cross at point A, the level of output at A equals Y_n, and the price level equals P.

Now consider an increase in nominal money. Recall the specification of aggregate demand from equation (7.3):

$$Y = Y\left(\frac{M}{P}, G, T\right)$$

We think of shifts in the *AD* curve as shifts to the right or to the left because we think of the *AD* relation as telling us what output is for a given price level. We then ask: At a given price level, does output increase (a shift to the right) or decrease (a shift to the left)?

We think of shifts in the *AS* curve as shifts up or down because we think of the *AS* relation as telling us what the price level is for a given level of output. We then ask: At a given output level, does the price level increase (a shift up) or decrease (a shift down)?

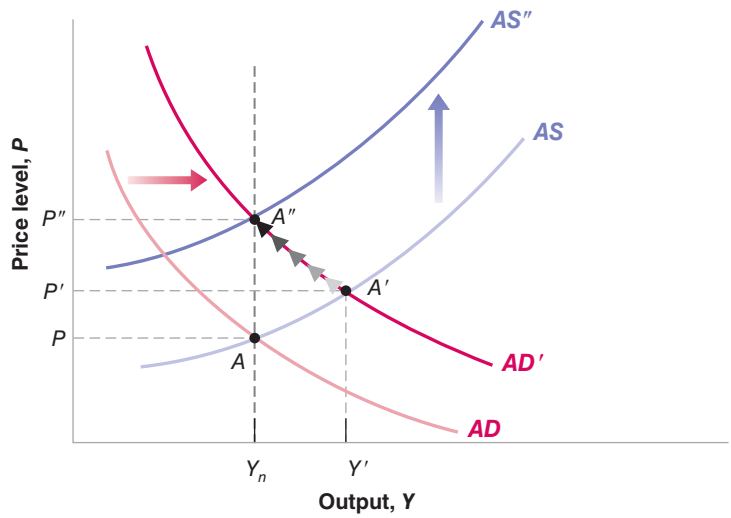
For a given price level P, the increase in nominal money M leads to an increase in the real money stock M/P, leading to an increase in output. The aggregate demand curve shifts to the right, from AD to AD'. In the short run, the economy goes from point A to A'. Output increases from Y_n to Y', and the price level increases from P to P'.

Over time, the adjustment of price level expectations comes into play. As output is higher than the natural level of output, the price level is higher than wage setters expected. They then revise their expectations, which causes the aggregate supply curve to shift up over time. The economy moves up along the aggregate demand curve AD'. The adjustment process stops when output has returned to the natural level of output. At that point, the price level is equal to the expected price level. In the medium run, the aggregate supply curve is given by AS'', and the economy is at point A'': Output is back to Y_n, and the price level is equal to P''.

Figure 7-7

The Dynamic Effects of a Monetary Expansion

A monetary expansion leads to an increase in output in the short run but has no effect on output in the medium run.



We can actually pin down the exact size of the eventual increase in the price level. If output is back to the natural level of output, the real money stock must also be back to its initial value. In other words, the proportional increase in prices must be equal to the proportional increase in the nominal money stock: If the initial increase in nominal money is equal to 10%, then the price level ends up 10% higher.

Go back to equation (7.3): If Y is unchanged (and G and T are also unchanged), then M/P must also be unchanged.

If M/P is unchanged, it must be that M and P each increase in the same proportion.

Going Behind the Scenes

To get a better sense of what is going on, it is useful to go behind the scenes to see what happens not only to output and to the price level, but also what happens to the interest rate. We can do this by looking at what happens in terms of the *IS–LM* model.

Figure 7-8(a) reproduces Figure 7-7 (leaving out the *AS*″ curve to keep things simple) and shows the adjustment of output and the price level in response to the increase in nominal money. Figure 7-8(b) shows the adjustment of output and the interest rate by looking at the same adjustment process, but in terms of the *IS–LM* model.

Look first at Figure 7-8(b). Before the change in nominal money, the equilibrium is given by the intersection of the *IS* and *LM* curves; that is, at point *A*—which corresponds to point *A* in Figure 7-8(a). Output is equal to the natural level of output, Y_n, and the interest rate is given by i.

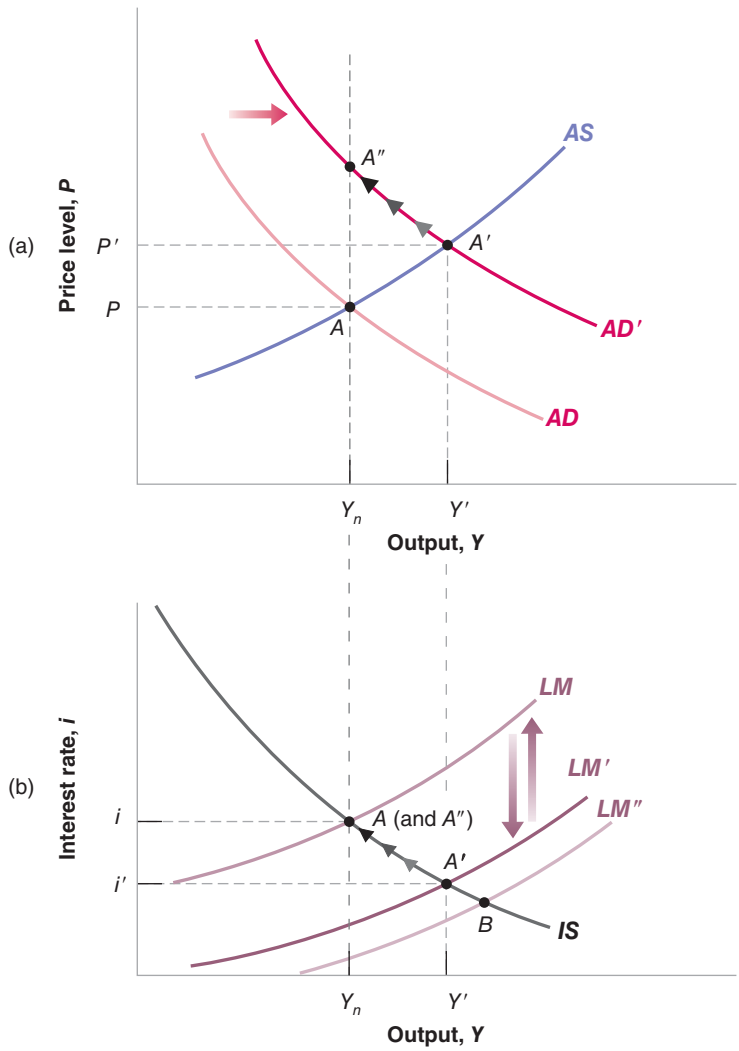


Figure 7-8

The Dynamic Effects of a Monetary Expansion on Output and the Interest Rate

The increase in nominal money initially shifts the *LM* curve down, decreasing the interest rate and increasing output. Over time, the price level increases, shifting the *LM* curve back up until output is back at the natural level of output.

The short-run effect of the monetary expansion is to shift the *LM* curve down from *LM* to *LM′*, moving the equilibrium from point *A* to point *A′*—which corresponds to point *A′* in Figure 7-8(a). The interest rate is lower, and output is higher.

Note that there are two effects at work behind the shift from *LM* to *LM′*: One is due to the increase in nominal money. The other, which partly offsets the first, is due to the increase in the price level. Let's look at these two effects more closely:

- If the price level did not change, the increase in nominal money would shift the *LM* curve down to *LM″*. So, if the price level did not change—as was our assumption in Chapter 5—the equilibrium would be at the intersection of *IS* and *LM″*, or point *B*.
- But even in the short run, the price level increases—from *P* to *P′* in Figure 7-8(a). This increase in the price level shifts the *LM* curve upward from *LM″* to *LM′*, partially offsetting the effect of the increase in nominal money.
- The net effect of these two shifts—down from *LM* to *LM″* in response to the increase in nominal money, and up from *LM″* to *LM′* in response to the increase in the price level—is a shift of the *LM* curve from *LM* to *LM′*, and the equilibrium is given by *A′*.

Why only partially? Suppose the price level increased in the same proportion as the increase in nominal money, leaving the real money stock unchanged. If the real money stock were unchanged, output would remain unchanged as well. But if output were unchanged, the price level would not increase, contradicting our premise.

Over time, the fact that output is above its natural level implies that the price level continues to increase. As the price level increases, it further reduces the real money stock and shifts the *LM* curve back up. The economy moves along the *IS* curve: The interest rate increases and output declines. Eventually, the *LM* curve returns to where it was before the increase in nominal money.

The economy ends up at point *A*, which corresponds to point *A″* in Figure 7-8(a): The increase in nominal money is exactly offset by a proportional increase in the price level. The real money stock is therefore unchanged. With the real money stock unchanged, output is back to its initial value, Y_n, which is the natural level of output, and the interest rate is also back to its initial value, i.

The Neutrality of Money

Let's summarize what we have just learned about the effects of monetary policy:

- In the *short run*, a monetary expansion leads to an increase in output, a decrease in the interest rate, and an increase in the price level.

  How much of the effect of a monetary expansion falls initially on output and how much on the price level depends on the slope of the aggregate supply curve. In Chapter 5, we assumed the price level did not respond at all to an increase in output—we assumed in effect that the aggregate supply curve was flat. Although we intended this as a simplification, empirical evidence does show that the initial effect of changes in output on the price level is indeed quite small. We saw this when we looked at estimated responses to changes in the Federal Funds rate in Figure 5-9: Despite the change in output, the price level remained practically unchanged for nearly a year.
- Over time, the price level increases, and the effects of the monetary expansion on output and on the interest rate disappear. *In the medium run, the increase in nominal money is reflected entirely in a proportional increase in the price level. The increase in nominal money has no effect on output or on the interest rate.* (How long it takes in reality for the effects of money on output to disappear is the topic of the Focus box "How Long Lasting Are the Real Effects of Money?") Economists refer to the absence of a medium-run effect of money on output and on the interest rate by saying that money is neutral in the medium run.

  The **neutrality of money** in the medium run does not mean that monetary policy cannot or should not be used to affect output. An expansionary monetary policy can, for example, help the economy move out of a recession and return more quickly to the natural level of output. As we saw in Chapter 5, this is exactly the way monetary policy was used to fight the 2001 recession. But it is a warning that monetary policy cannot sustain higher output forever.

Actually, the way the proposition is typically stated is that money is neutral in the long run. This is because many economists use "long run" to refer to what we call in this book the "medium run."

How Long Lasting Are the Real Effects of Money?

FOCUS

To determine how long lasting the real effects of money are, economists use **macroeconometric models.** These models are larger-scale versions of the aggregate supply and aggregate demand model in this chapter.

The model we examine in this box was built in the early 1990s by John Taylor, at Stanford University.

The Taylor model is substantially larger than the model we studied in this chapter. On the aggregate supply side, it has separate equations for price and for wage setting. On the demand side, it has separate equations for consumption, for investment, for exports, and for imports. (Recall that, so far, we have assumed the economy is closed, so we have ignored exports and imports altogether.) In addition, instead of looking at just one country as we have done here, it looks at eight countries (the United States, and seven major OECD countries) and solves for equilibrium in all eight countries simultaneously. Each equation, for each country, is estimated using econometrics, and allows for a richer dynamic structure than the equations we have relied on in this chapter.

The implications of the model for the effects of money on output are shown in Figure 1. The simulation looks at the effects of an increase in nominal money of 3% over the initial year, taking place over four quarters—0.1% in the first quarter, 0.6% in the second, 1.2% in the third, and 1.1% in the fourth. After these four step increases, nominal money remains at its new higher level forever.

The effects of money on output reach a maximum after three quarters. By then, output is 1.8% higher than it would have been without the increase in nominal money. Over time, however, the price level increases and output returns to the natural level of output. In year 4, the price level is up by 2.5%, while output is up by only 0.3%. Therefore, the Taylor model suggests, it takes roughly four years for output to return to its natural level, or, put another way, four years for changes in nominal money to become neutral.

Do all macroeconometric models give the same answer? No. Because they differ in the way they are constructed, in the way variables are chosen, and in the way equations are estimated, their answers are different. But most of them have the following implications in common: The effects of an increase in money on output build up for one to two years and then decline over time. (To get a sense of how the answers might differ across models, see the Focus box "Twelve Macroeconometric Models" in Chapter 22.)

Source: Figure 1 is reproduced from John Taylor, Macroeconomic Policy in a World Economy (W.W. Norton, 1993) Figure 5-1A, p. 138.

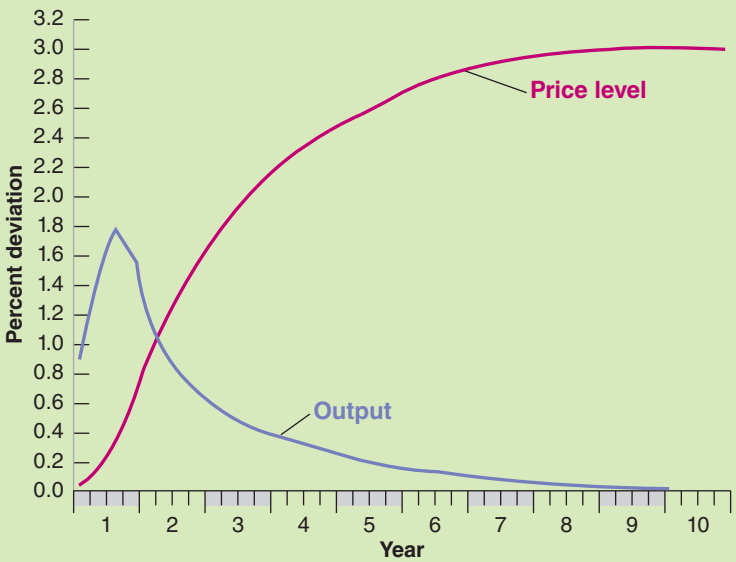


Figure 1 *The Effects of an Expansion in Nominal Money in the Taylor Model*

7-5 A Decrease in the Budget Deficit

The policy we just looked at—a monetary expansion—led to a shift in aggregate demand coming from a shift in the *LM* curve. Let's now look at the effects of a shift in aggregate demand coming from a shift in the *IS* curve.

Recall, from Chapter 5, that a reduction in the budget deficit is also called a fiscal contraction, or a fiscal consolidation.

Suppose the government is running a budget deficit and decides to reduce it by decreasing its spending from G to G' while leaving taxes T unchanged. How will this affect the economy in the short run and in the medium run?

Assume that output is initially at the natural level of output, so that the economy is at point A in Figure 7-9: Output equals Y_n. The decrease in government spending from G to G' shifts the aggregate demand curve to the left, from AD to AD': For a given price level, output is lower. In the short run, the equilibrium moves from A to A'; output decreases from Y_n to Y' and the price level decreases from P to P'.

The initial effect of the deficit reduction triggers lower output. We first derived this result in Chapter 3, then in Chapter 5, and it holds here as well.

What happens over time? As long as output is below the natural level of output, we know that the aggregate supply curve keeps shifting down. The economy moves down along the aggregate demand curve AD' until the aggregate supply curve is given by AS'' and the economy reaches point A''. By then, the recession is over, and output is back at Y_n.

Like an increase in nominal money, a reduction in the budget deficit does not affect output forever. Eventually, output returns to its natural level. But there is an important difference between the effects of a change in money and the effects of a change in the deficit. At point A'', not everything is the same as before: Output is back to the natural level of output, but the price level and the interest rate are lower than before the shift. (The fact that the price level decreases may feel strange given that, as we saw in Chapters 1 and 2, inflation is nearly always positive. This result comes from the fact that we are looking at an economy in which money growth is zero—we are assuming that M is constant, not growing—and there is no sustained inflation. If we were to allow for money growth and thus for inflation, then the result would be that the price level decreases relative to what it would have been, or, in other words, that inflation goes down for a while. More on money growth and inflation in the next chapter.) The best way to see these specific effects is again to look at the adjustment in terms of the underlying *IS*–*LM* model.

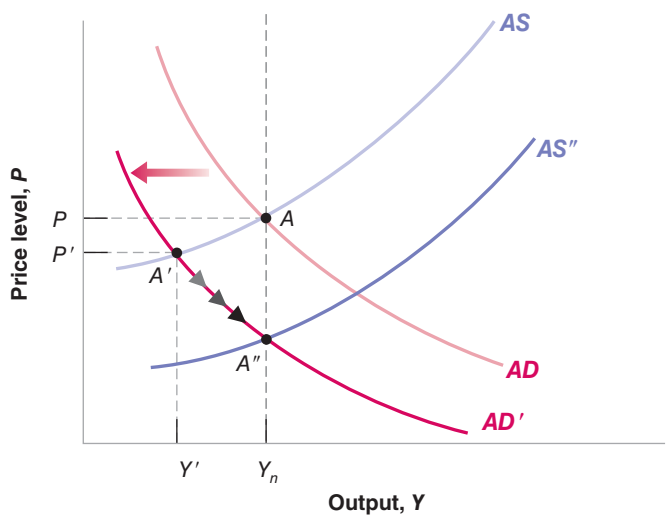


Figure 7-9

The Dynamic Effects of a Decrease in the Budget Deficit

A decrease in the budget deficit leads initially to a decrease in output. Over time, however, output returns to the natural level of output.

Deficit Reduction, Output, and the Interest Rate

Figure 7-10(a) reproduces Figure 7-9, showing the adjustment of output and the price level in response to the increase in the budget deficit (but leaving out AS'' to keep things visually simple). Figure 7-10(b) shows the adjustment of output and the interest rate by looking at the same adjustment process, but in terms of the *IS–LM* model.

Look first at Figure 7-10(b). Before the change in fiscal policy, the equilibrium is given by the intersection of the *IS* curve and the *LM* curve, at point *A*—which corresponds to point *A* in Figure 7-10(a). Output is equal to the natural level of output, Y_n, and the interest rate is given by i.

As the government reduces the budget deficit, the *IS* curve shifts to the left, to IS'. If the price level did not change (the assumption we made in Chapter 5), the economy would move from point *A* to point *B*. But, because the price level declines in response to the decrease in output, the real money stock increases, leading to a partially offsetting shift of the *LM* curve, down to LM'. So, the initial effect of deficit reduction is to move the economy from point *A* to point A'. (Point A' in Figure 7-10(b) corresponds to point A' in Figure 7-10(a).) Both output and the interest rate are lower than before the

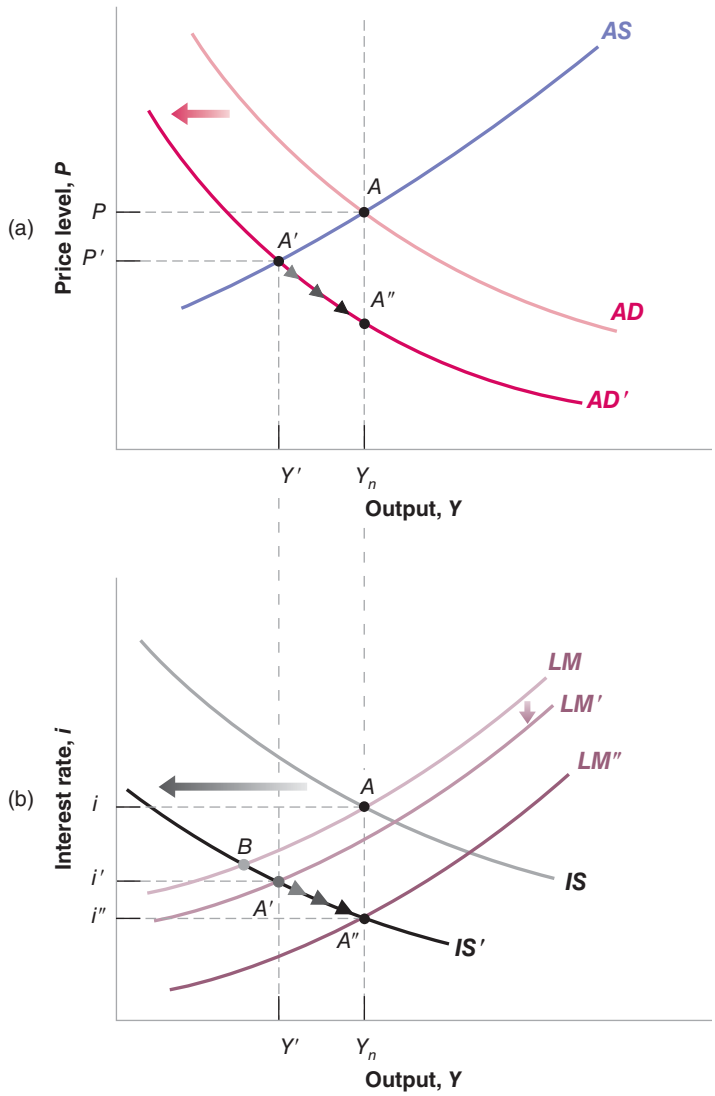


Figure 7-10

The Dynamic Effects of a Decrease in the Budget Deficit on Output and the Interest Rate

A deficit reduction leads in the short run to a decrease in output and to a decrease in the interest rate. In the medium run, output returns to its natural level, while the interest rate declines further.

fiscal contraction. Note that, just as was the case in Chapter 5, we cannot tell whether investment increases or decreases in the short run: Lower output decreases investment, but the lower interest rate increases investment.

So long as output remains below the natural level of output, the price level continues to decline, leading to a further increase in the real money stock. The *LM* curve continues to shift down. In Figure 7-10(b), the economy moves down from point A' along IS', and eventually reaches A'' (which corresponds to A'' in Figure 7-10(a)). At A'', the *LM* curve is given by LM''.

At A'', output is back at the natural level of output. But the interest rate is lower than it was before deficit reduction, down from i to i''. The composition of output is also different: To see how and why, let's rewrite the *IS* relation, taking into account that at A'', output is back at the natural level of output, so that $Y = Y_n$

$$Y_n = C(Y_n - T) + I(Y_n, i) + G$$

Because income Y_n and taxes T are unchanged, consumption C is the same as before the deficit reduction. By assumption, government spending G is lower than before. Therefore investment I must be higher than before the deficit reduction—higher by an amount exactly equal to the decrease in G. Put another way, in the medium run, a reduction in the budget deficit unambiguously leads to a decrease in the interest rate and an increase in investment.

Budget Deficits, Output, and Investment

Let's summarize what you have just learned about the effects of fiscal policy:

- In the *short run*, a budget deficit reduction, if implemented alone—that is, without an accompanying change in monetary policy—leads to a decrease in output and may lead to a *decrease* in investment.

  Note the qualification "without an accompanying change in monetary policy": In principle, these adverse short-run effects on output can be avoided by using the right monetary–fiscal policy mix. What is needed is for the central bank to increase the money supply enough to offset the adverse effects of the decrease in government spending on aggregate demand. This is what happened in the United States in the 1990s. As the Clinton administration reduced budget deficits, the Fed made sure that, even in the short run, the deficit reduction did not lead to a recession and lower output.

Recall the discussion of the policy mix in Chapter 5. ▶

Go back to Figure 7-10. What would the Fed need to do in order to avoid a short run decrease in output in response to the fiscal contraction? ▶

- In the *medium run*, output returns to the natural level of output, and the interest rate is lower. In the medium run, a deficit reduction leads unambiguously to an *increase* in investment.

  We have not taken into account so far the effects of investment on capital accumulation and the effects of capital on production (we will do so in Chapters 10 to 13 when we look at the long run). But it is easy to see how our conclusions would be modified if we did take into account the effects on capital accumulation. In the long run, the level of output depends on the capital stock in the economy. So if a lower government budget deficit leads to more investment, it will lead to a higher capital stock, and the higher capital stock will lead to higher output.

Effects of a deficit reduction:

Short run: Y decreases, I increases or decreases.

Medium run: Y unchanged, I increases. ▶

Long run: Y increases, I increases.

Everything we have just said about the effects of deficit reduction through a fiscal consolidation would apply equally to policy measures aimed at increasing private saving. An increase in the private saving rate—that is, lower consumption at the same level of disposable income—decreases demand and output in the short run, leaves output unchanged in the medium run, and, through increases in the capital stock from increased investment, increases output in the long run.

Disagreements among economists about the effects of measures aimed at increasing either public saving or private saving often come from differences in time frames. Those who are concerned with short-run effects worry that measures to increase saving, public or private, might create a recession and decrease saving and investment for some time. Those who look beyond the short run see the eventual increase in saving and investment and emphasize the favorable medium-run and long-run effects on output.

7-6 An Increase in the Price of Oil

So far we have looked so far at shocks that shift the aggregate demand curve: an increase in the money supply, or a reduction in the budget deficit. There are other shocks, however, that affect both aggregate demand and aggregate supply and play an important role in fluctuations. An obvious candidate is movements in the price of oil. To see why, turn to Figure 7-11.

Figure 7-11 plots two series. The first, represented by the red line, is the dollar price of oil—that is, the price of a barrel of oil in dollars— since 1970. It is measured on the vertical axis on the left. This is the series that is quoted in the newspapers, more or less every day. What matters, however, for economic decisions is not the dollar price, but the real price of oil; that is, the dollar price of oil divided by the price level. Thus, the second series in the figure, represented by the blue line, shows the real price of oil, constructed as the dollar price of oil divided by the U.S. consumer price index. Note that the real price is an index; it is normalized to equal 100 in 1970. It is measured on the vertical axis on the right.

What is perhaps most striking in the figure is the large increase in the real price of oil in the 2000s: In 10 years, from 1998 to 2008, the index for the real price went from about 100 to more than 500, a more than five-fold increase. As the figure shows, however, there were two similar increases in the price of oil in the 1970s, the first in 1973–1975 and the second in 1977–1981. Just as in the more recent episode, the real price of oil increased from 100 in 1970 (this is the normalization we have chosen) to more than 500 in 1981.

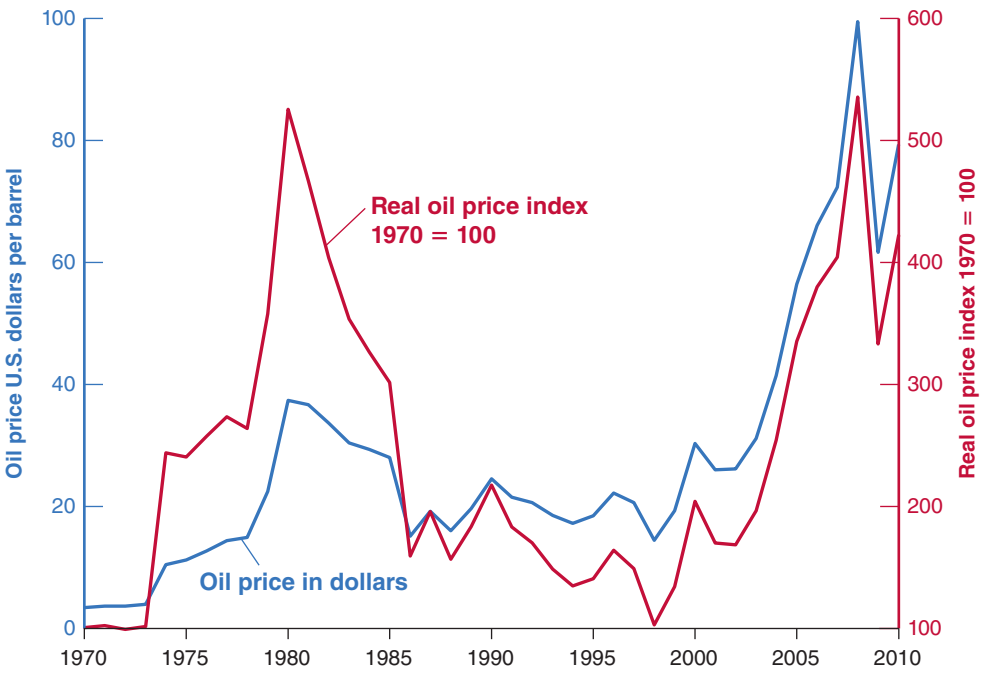


Figure 7-11

The Nominal and the Real Price of Oil, 1970–2010

Over the last 40 years, there have been three sharp increases in the real price of oil. The first two increases took place in the 1970s. The more recent one took place in the 2000s, until the crisis hit.

Source: Series OILPRICE, CPIAUSCL Federal Reserve Economic Data (FRED) http://research.stlouisfed.org/fred2/. The value of the index is set equal to 100 in 1970.)

What was behind these large increases? In the 1970s, the main factors were the formation of **OPEC** (the Organization of Petroleum Exporting Countries), a cartel of oil producers that was able to act as a monopoly and increase prices, and disruptions due to wars and revolutions in the Middle East. In the 2000s, the main factor was quite different, namely the fast growth of emerging economies, in particular China, which led to a rapid increase in the world demand for oil and, by implication, a steady increase in real oil prices. Whether coming from changes in supply in the 1970s or from changes in the demand from emerging countries in the 2000s, the implication for U.S. firms and consumers was the same: more expensive oil, more expensive energy.

In thinking about the macroeconomic effects of such increases, it is clear that we face a serious problem in using the model we have developed so far: The price of oil appears neither in our aggregate supply relation nor in our aggregate demand relation! The reason is that, until now, we have assumed that output was produced using only labor. One way to extend our model would be to recognize explicitly that output is produced using labor *and* other inputs (including energy), and then figure out what effect an increase in the price of oil has on the price set by firms and on the relation between output and employment. An easier way, and the way we shall go here, is simply to capture the increase in the price of oil by an increase in m—the markup of the price over the nominal wage. The justification is straightforward: Given wages, an increase in the price of oil increases the cost of production, forcing firms to increase prices.

Having made this assumption, we can then track the dynamic effects of an *increase in the markup* on output and the price level. It will be easiest here to work backward in time, first asking what happens in the medium run, and then working out the dynamics of adjustment from the short run to the medium run.

Effects on the Natural Rate of Unemployment

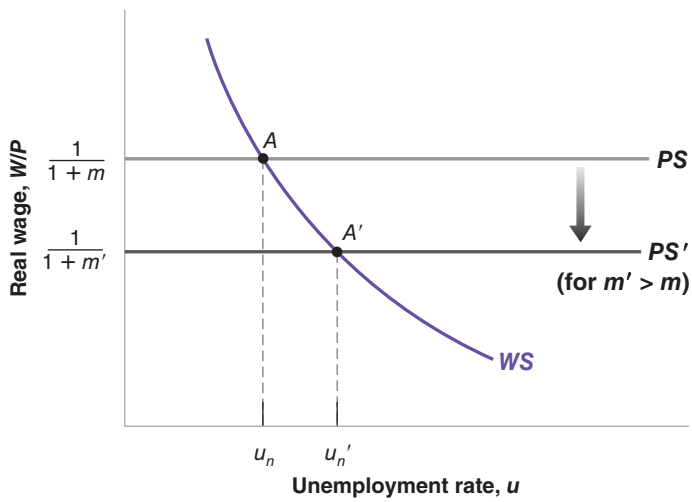
Let's start by asking what happens to the natural rate of unemployment when the real price of oil increases (for simplicity, we shall drop "real" in what follows). Figure 7-12 reproduces the characterization of labor-market equilibrium from Figure 6-8 in Chapter 6:

The wage-setting curve is downward sloping. The price-setting relation is represented by the horizontal line at $W/P = 1/(1 + m)$. The initial equilibrium is at point A, and the initial natural unemployment rate is u_n. An increase in the markup leads to a downward shift of the price-setting line, from PS to PS': The higher the markup, the lower the real wage implied by price setting. The equilibrium moves from A to A'. The

Figure 7-12

The Effects of an Increase in the Price of Oil on the Natural Rate of Unemployment

An increase in the price of oil leads to a lower real wage and a higher natural rate of unemployment.



real wage is lower. The natural unemployment rate is higher: Getting workers to accept the lower real wage requires an increase in unemployment.

The increase in the natural rate of unemployment leads in turn to a decrease in the natural level of employment. If we assume that the relation between employment and output is unchanged—that is, that each unit of output still requires one worker in addition to the energy input—then the decrease in the natural level of employment leads to an identical decrease in the natural level of output. Putting things together: An increase in the price of oil leads to a decrease in the natural level of output.

This assumes that the increase in the price of oil is permanent. If, in the medium run, the price of oil goes back to its initial value, then the natural rate is clearly unaffected.

The Dynamics of Adjustment

Let's now turn to dynamics. Suppose that before the increase in the price of oil, the aggregate demand curve and the aggregate supply curve are given by AD and AS, respectively, so the economy is at point A in Figure 7-13, with output at the natural level of output, Y_n, and by implication $P = P^e$.

We have just established that the increase in the price of oil decreases the natural level of output. Call this lower level Y'_n. We now want to know what happens in the short run and how the economy moves from Y_n to Y'_n.

To think about the short run, recall that the aggregate supply relation is given by

$$P = P^e (1 + m) F\left(1 - \frac{Y}{L}, z\right)$$

Recall that we capture the effect of an increase in the price of oil by an increase in the markup m. So, in the short run (given P^e), the increase in the price of oil shows up as an increase in the markup m. This increase in the markup leads firms to increase their prices, leading to an increase in the price level P at any level of output Y. The aggregate supply curve shifts up.

We can be more specific about the size of the shift, and knowing the size of this shift will be useful in what follows. We know from Section 7-1 that the aggregate supply curve always goes through the point such that output equals the natural level of output and the price level equals the expected price level. Before the increase in the price of oil, the aggregate supply curve in Figure 7-13 goes through point A, where output equals Y_n and the price level is equal to P^e. After the increase in the price of oil, the new aggregate supply curve goes through point B, where output equals the new lower

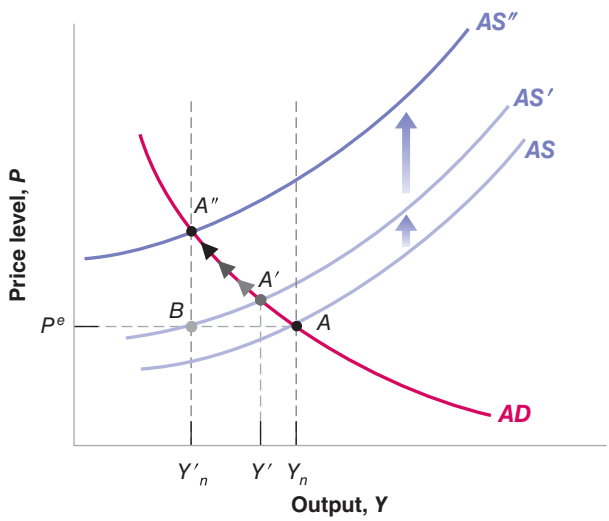


Figure 7-13

The Dynamic Effects of an Increase in the Price of Oil

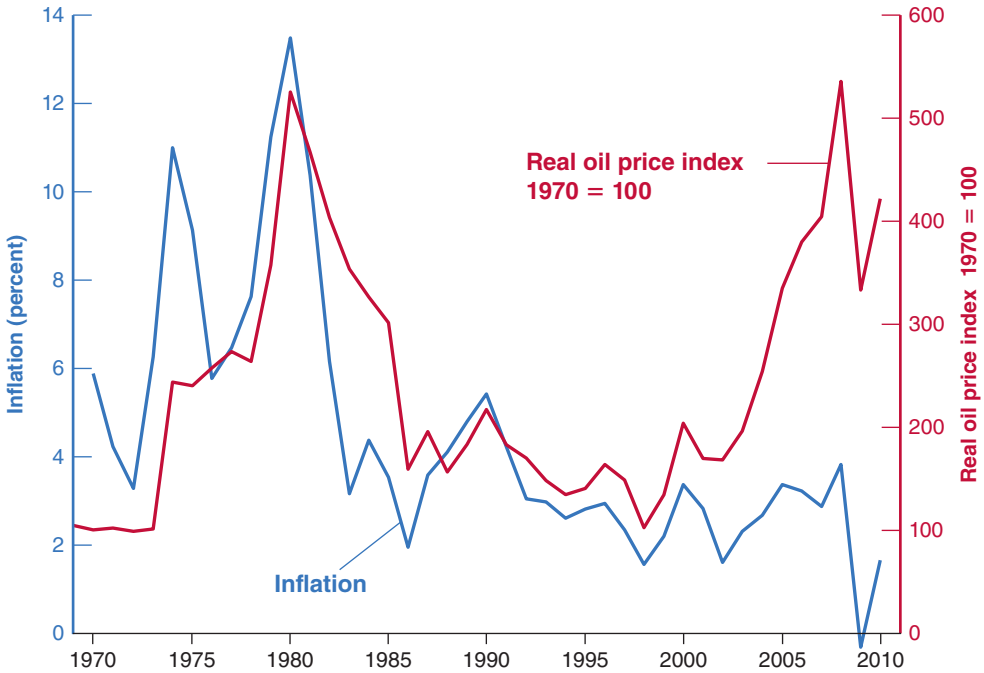
An increase in the price of oil leads, in the short run, to a decrease in output and an increase in the price level. Over time, output decreases further and the price level increases further.

Figure 7-14

Oil Price Increases and Inflation in the United States since 1970

The oil price increases of the 1970s were associated with large increases in inflation. This was however not the case in the 2000s.

Source: Real Oil Price Index—see Figure 7-10. *Inflation calculated as annual rate of change of series, CPIAUSCL Federal Reserve Economic Data (FRED)* http://research.stlouisfed.org/fred2/



natural level of output Y'_n and the price level equals the expected price level, P^e. The aggregate supply curve shifts left from AS to AS'.

Does the aggregate demand curve shift as a result of the increase in the price of oil? The answer is: maybe. There are many channels through which demand might be affected at a given price level: The higher price of oil may lead firms to change their investment plans, canceling some investment projects and/or shifting to less energy-intensive equipment. The increase in the price of oil also redistributes income from oil buyers to oil producers. Oil producers may spend less than than oil buyers, leading to a decrease in consumption demand. Let's take the easy way out: Because some of the effects shift the aggregate demand curve to the right and others shift the aggregate demand curve to the left, let's simply assume that the effects cancel each other out and that aggregate demand does not shift.

Higher gas prices may lead you to get rid of your gas guzzler.

This is indeed typically the case. Oil producers realize that high oil revenues might not last forever. This leads them to save a large proportion of the income from oil revenues.

Under this assumption, in the short run, only the AS shifts. The economy therefore moves along the AD curve, from A to A'. Output decreases from Y_n to Y'. The increase in the price of oil leads firms to increase their prices. This increase in the price level then decreases demand and output.

What happens over time? Although output has fallen, the natural level of output has fallen even more: At point A', output Y' is still above the new natural level of output Y'_n, so the aggregate supply curve continues to shift up. The economy therefore moves over time along the aggregate demand curve, from A' to A''. At point A'', output Y' is equal to the new lower natural level of output Y'_n, and the price level is higher than before the oil shock: Shifts in aggregate supply affect output not only in the short run but in the medium run as well.

To summarize: Increases in the price of oil decrease output and increase prices in the short run. If the increase in the price of oil is permanent, then output is lower not only in the short run, but also in the medium run.

How do these implications fit what we observed in response to increases in the price of oil both in the 1970s and in the 2000s? The answers are given by Figure 7-14, which plots the evolution of the real price of oil and inflation—using the CPI—and

Oil Price Increases: Why Were the 2000s so Different from the 1970s?

FOCUS

The question raised by Figures 7-14 and 7-15 is an obvious one: Why is it that oil price increases were associated with stagflation in the 1970s, but have had so little apparent effect on the economy in the 2000s?

A first line of explanation is that shocks other than the increase in the price of oil were at work in the 1970s and in the 2000s.

In the 1970s, not only did the price of oil increase, but so did the price of many other raw materials. This implies that the aggregate supply relation shifted up by more than implied by just the increase in the price of oil, and so the adverse effect on output was stronger than in the 2000s.

In the 2000s, many economists believe that, partly because of globalization and foreign competition, workers bargaining power weakened. If true, this implies that, while the increase in oil prices shifted the aggregate supply curve up, the decrease in bargaining power of workers shifted it down, dampening or even eliminating the adverse effects of the oil price increase on output and the price level.

Econometric studies suggest, however, that more was at work, and that, even after controlling for the presence of these other factors, the effects of the price of oil have changed since the 1970s. Figure 1 shows the effects of a 100% increase in the price of oil on output and on the price level, estimated using data from two different periods. The black and blue lines show the effects of an increase in the price of oil on the CPI deflator and on GDP, based on data from 1970:1 to 1986:4; the green and red lines do the same, but based on data from 1987:1 to 2006:4 (the time scale on the horizontal axis is in quarters). The figure suggests two main conclusions. First, in both periods, as predicted by our model, the increase in the price of oil leads to an increase in the CPI and a decrease in GDP. Second, the effects of the increase in the price of oil on both the CPI and on GDP have become smaller, roughly half of what they were earlier.

Why have the adverse effects of the increase in the price of oil become smaller? This is still very much a topic of research. But, at this stage, two hypotheses appear plausible:

The first hypothesis is that, today, U.S. workers have less bargaining power than they did in the 1970s. Thus, as the price of oil has increased, workers have been more willing to accept a reduction in wages, limiting the upward shift in the aggregate supply curve, and thus limiting the adverse effect on the price level and on output. (Make sure you understand this statement; use Figure 7-13 to increase your understanding.)

The second hypothesis concerns monetary policy. When the price of oil increased in the 1970s, people started expecting much higher prices in general, and P^e increased dramatically. The result was further shifts of the aggregate supply curve, leading to a larger increase in the price level and a larger decrease in output. In the 2000s, monetary policy was conducted in a very different way than in the 1970s, and expectations were that the Fed would not let the increase in the price of oil lead to a much higher price level. Thus, P^e barely increased over time, leading to a smaller shift of the aggregate supply curve, and thus a smaller effect on output and the price level than in the 1970s. (Again, use Figure 7-13 to make sure you understand this statement.)

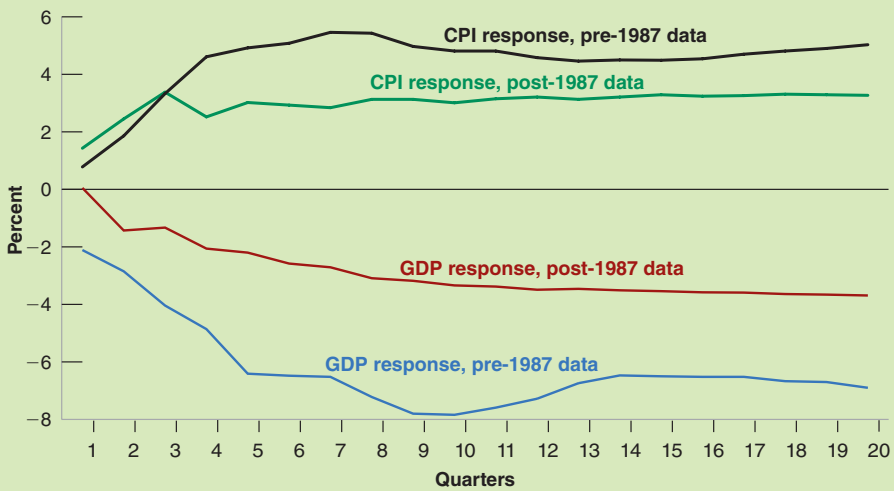


Figure 1 *The Effects of a 100% Permanent Increase in the Price of Oil on the CPI and on GDP. The effects of an increase in the price of oil on output and the price level are smaller than they used to be*

Figure 7-15

Oil Price Increases and Unemployment in the United States since 1970

The oil price increases of the 1970s were associated with large increases in unemployment. This was however not the case in the 2000s.

Source: Real Oil Price Index—see Figure 7-11. Unemployment rate Series UNRATE: Federal Reserve Economic Data (FRED) http://research.stlouisfed.org/fred2/

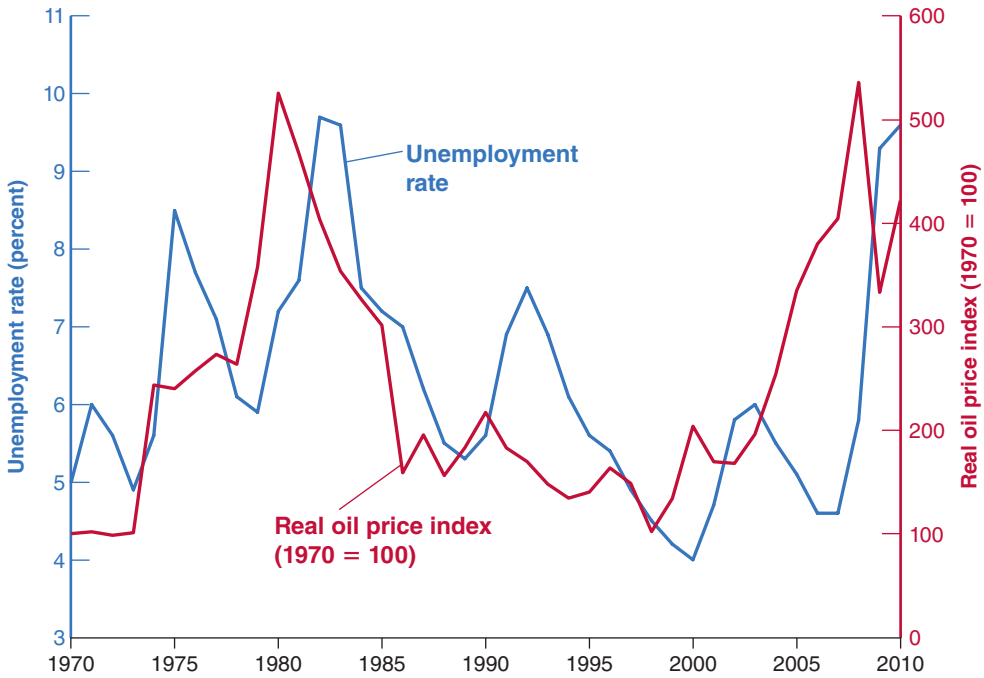


Figure 7-15, which plots the evolution of the real price of oil and the unemployment rate, in the United States since 1970.

First, the good news (for our model, although surely not for the U.S. economy at the time): Note how both of the increases in the price of oil of the 1970s were followed by major increases in inflation and in unemployment. This fits our conclusions very well. Now, the bad news (for our model, but not for the U.S. economy): Note how the increase in the price of oil in the 2000s was associated with neither an increase in inflation nor an increase in unemployment. In light of what happened in the 1970s, this lack of an effect has come as a surprise to macroeconomists. The state of research, and various hypotheses being explored, are discussed in the Focus box "Oil Price Increases: Why Were the 2000s so Different from the 1970s?". A summary of the conclusions goes like this: Oil price increases still decrease output and increase inflation. Because of decreases in the use of oil in production, because of changes in the labor market, and because of improvements in the conduct of monetary policy, the effect of oil price increases on both output and inflation was smaller in the 2000s than it was in the 1970s. And the reason it is hard to see an adverse effect on output and on inflation in the 2000s in Figures 7-14 and 7-15 is that these oil price shocks were largely offset by other, favorable shocks.

True, output decreased dramatically, starting in 2008. But it is clear that this was not due to the earlier increase in oil prices, but due instead to the financial crisis.

7-7 Conclusions

This chapter has covered a lot of ground. Let us repeat some key ideas and develop some of the earlier conclusions.

The Short Run versus the Medium Run

One key message of this chapter is that changes in policy typically have different effects in the short run and in the medium run. The main results of this chapter are summarized in Table 7-1. A monetary expansion, for example, affects output in the short run but not in the medium run. In the short run, a reduction in the budget deficit decreases output and decreases the interest rate and may decrease investment. But in

Table 7-1 Short-Run Effects and Medium-Run Effects of a Monetary Expansion and a Budget Deficit Reduction on Output, the Interest Rate, and the Price Level

	Short Run			Medium Run		
	Output Level	Interest Rate	Price Level	Output Level	Interest Rate	Price Level
Monetary expansion	increase	decrease	increase (small)	no change	no change	increase
Deficit reduction	decrease	decrease	decrease (small)	no change	decrease	decrease

the medium run, the interest rate decreases and output returns to the natural level of output, and investment unambiguously increases.

Disagreements among economists about the effects of various policies often come from differences in the time frame they have in mind. If you are worried about output and investment in the short run, you might be reluctant to proceed with fiscal consolidation. But if your focus is on the medium or the long run, you will see the consolidation as helping investment and eventually, through higher capital accumulation, increasing output. One implication is that where you stand depends in particular on how fast you think the economy adjusts to shocks. If you believe that it takes a long time for output to return to its natural level, you will naturally focus more on the short run and be willing to use policies that increase output in the short run, even if medium-run effects are nil or negative. If you believe instead that output returns to its natural level quickly, you will put more emphasis on the medium-run implications and will, by implication, be more reluctant to use those policies.

Shocks and Propagation Mechanisms

This chapter also gives you a general way of thinking about **output fluctuations** (sometimes called **business cycles**)—movements in output around its trend (a trend that we have ignored so far but on which we will focus in Chapters 10 to 13):

You can think of the economy as being constantly hit by **shocks**. These shocks may be shifts in consumption coming from changes in consumer confidence, shifts in investment, shifts in the demand for money, and so on. Or they may come from changes in policy—from the introduction of a new tax law, to a new program of infrastructure investment, to a decision by the central bank to fight inflation by tightening the money supply.

How to define *shocks* is harder than it looks. Suppose a failed economic program in an Eastern European country leads to political chaos in that country, which leads to increased risk of nuclear war in the region, which leads to a fall in consumer confidence in the United States, which leads to a recession in the United States. What is the "shock"? The failed program? The fall of democracy? The increased risk of nuclear war? Or the decrease in consumer confidence? In practice, we have to cut the chain of causation somewhere. Thus, we may refer to the drop in consumer confidence as "the shock" and ignore its underlying causes.

Each shock has dynamic effects on output and its components. These dynamic effects are called the **propagation mechanism** of the shock. Propagation mechanisms are different for different shocks. The effects of a shock on activity may build up over time, affecting output in the medium run. Or the effects may build up for a while and then decrease and disappear. We saw, for example, that the effects of an increase in money on output reach a peak after six to nine months and then slowly decline afterward as the price level eventually increases in proportion to the increase in nominal money. At times, some shocks are sufficiently large or come in sufficiently bad combinations that they create a recession. The two recessions of the 1970s were due largely to increases in the price of oil; the recession of the early 1980s was due to a sharp contraction in money; the recession of the early 1990s was due primarily to a sudden decline in consumer confidence; the recession of 2001 was due to a sharp drop in investment spending. The current crisis and the sharp decrease in output in 2010 had its origins in

the problems of the housing market, which then led to a major financial shock, and in turn to a sharp reduction in output. What we call economic fluctuations are the result of these shocks and their dynamic effects on output.

Where We Go from Here

- We assumed in this chapter that the nominal money stock was constant, that there was no nominal money growth. This led to a constant price level in the medium run. What we observe most of the time, however, is positive inflation, namely a steady increase in the price level. This in turn requires us to extend our analysis to the case where money growth is positive and to revisit the relation among output, unemployment, inflation, and money growth. We take this up in Chapter 8.
- The *AS–AD* model we constructed in this chapter has a reassuring property. While shocks move output away from its natural level in the short run, there are forces that tend to take it back to its natural level over time. Output below its natural level leads to a decrease in the price level, which leads in turn to an increase in the real money stock, a decrease in the interest rate, and an increase in demand and in output. This process takes place until output has returned to its natural level and there is no longer pressure on the price level to adjust further. And, if this process is too slow, fiscal and monetary policies can help accelerate the return to the natural rate. The crisis and the very slow recovery (recall the facts presented in Chapter 1) we are experiencing force us to reconsider these conclusions. This is what we do in Chapter 9.

Summary

- The model of aggregate supply and aggregate demand describes the movements in output and the price level when account is taken of equilibrium in the goods market, the financial markets, and the labor market.
- The aggregate supply relation captures the effects of output on the price level. It is derived from equilibrium in the labor market. It is a relation among the price level, the expected price level, and the level of output. An increase in output decreases unemployment; the decrease in unemployment increases wages and, in turn, increases the price level. An increase in the expected price level leads, one for one, to an increase in the actual price level.
- The aggregate demand relation captures the effects of the price level on output. It is derived from equilibrium in goods and financial markets. An increase in the price level decreases the real money stock, increasing the interest rate and decreasing output.
- In the short run, movements in output come from shifts in either aggregate demand or aggregate supply. In the medium run, output returns to the natural level of output, which is determined by equilibrium in the labor market.
- An expansionary monetary policy leads in the short run to an increase in the real money stock, a decrease in the interest rate, and an increase in output. Over time, the price level increases, and the real money stock decreases until output has returned to its natural level. In the medium run, money does not affect output, and changes in money are reflected in proportional increases in the price level. Economists refer to this fact by saying that, in the medium run, money is neutral.
- A reduction in the budget deficit leads in the short run to a decrease in the demand for goods and therefore to a decrease in output. Over time, the price level decreases, leading to an increase in the real money stock and a decrease in the interest rate. In the medium run, output increases back to the natural level of output, but the interest rate is lower and investment is higher.
- An increase in the price of oil leads, in both the short run and in the medium run, to a decrease in output. In the short run, it leads to an increase in the price level, which decreases the real money stock and leads to a contraction of demand and output. In the medium run, an increase in the price of oil decreases the real wage paid by firms, increases the natural rate of unemployment, and therefore decreases the natural level of output.
- The difference between short-run effects and medium-run effects of policies is one of the reasons economists disagree in their policy recommendations. Some economists

believe the economy adjusts quickly to its medium-run equilibrium, so they emphasize medium-run implications of policy. Others believe the adjustment mechanism through which output returns to the natural level of output is a slow process at best, and so they put more emphasis on the short-run effects of policy.

- Economic fluctuations are the result of a continual stream of shocks to aggregate supply or to aggregate demand and of the dynamic effects of each of these shocks on output. Sometimes the shocks are sufficiently adverse, alone or in combination, that they lead to a recession.

Key Terms

aggregate supply relation, 134
aggregate demand relation, 136
neutrality of money, 144
macroeconometric models, 145
Organization of Petroleum Exporting Countries (OPEC), 150
output fluctuations, 155
business cycles, 155
shocks, 155
propagation mechanism, 155

Questions and Problems

QUICK CHECK

All Quick Check questions and problems are available on MyEconLab.

1. Using the information in this chapter, label each of the following statements true, false, or uncertain. Explain briefly.

a. The aggregate supply relation implies that an increase in output leads to an increase in the price level.
b. The natural level of output can be determined by looking solely at the aggregate supply relation.
c. The aggregate demand relation is downward sloping because at a higher price level, consumers wish to purchase fewer goods.
d. In the absence of changes in fiscal or monetary policy, the economy will always remain at the natural level of output.
e. Expansionary monetary policy has no effect on the level of output in the medium run.
f. Fiscal policy cannot affect investment in the medium run because output always returns to its natural level.
g. In the medium run, output and the price level always return to the same value.

2. Aggregate demand shocks and the medium run

Suppose the economy begins with output equal to its natural level. Then, there is a reduction in income taxes.

a. Using the *AS–AD* model developed in this chapter, show the effects of a reduction in income taxes on the position of the *AD*, *AS*, *IS*, and *LM* curves in the medium run.
b. What happens to output, the interest rate, and the price level in the medium run? What happens to consumption and investment in the medium run?

3. Aggregate supply shocks and the medium run

Consider an economy with output equal to the natural level of output. Now suppose there is an increase in unemployment benefits.

a. Using the model developed in this chapter, show the effects of an increase in unemployment benefits on the position of the *AD* and *AS* curves in the short run and in the medium run.
b. How will the increase in unemployment benefits affect output and the price level in the short run and in the medium run?

4. The neutrality of money

a. In what sense is money neutral? How is monetary policy useful if money is neutral?
b. Fiscal policy, like monetary policy, cannot change the natural level of output. Why then is monetary policy considered neutral but fiscal policy is not?
c. Discuss the statement "Because neither fiscal nor monetary policy can affect the natural level of output, it follows that, in the medium run, the natural level of output is independent of all government policies."

DIG DEEPER

All DIG Deeper questions and problems are available on MyEconLab.

5. The paradox of saving, one more time

In chapter problems at the end of Chapters 3 and 5, we examined the paradox of saving in the short run, under different assumptions about the response of investment to output and the interest rate. Here we consider the issue one last time in the context of the AS–AD *model.*

Suppose the economy begins with output equal to its natural level. Then there is a decrease in consumer confidence as households attempt to increase their saving for a given level of disposable income.

a. In *AS–AD* and *IS–LM* diagrams, show the effects of the decline in consumer confidence in the short run and the medium run. Explain why the curves shift in your diagrams.
b. What happens to output, the interest rate, and the price level in the short run? What happens to consumption,

investment, and private saving in the short run? Is it possible that the decline in consumer confidence will actually lead to a fall in private saving in the short run?

c. Repeat part (b) for the medium run. Is there any paradox of saving in the medium run?

6. Suppose that the interest rate has no effect on investment.

a. Can you think of a situation in which this may happen?
b. What does this imply for the slope of the *IS* curve?
c. What does this imply for the slope of the *LM* curve?
d. What does this imply for the slope of the *AD* curve?

Continue to assume that the interest rate has no effect on investment. Assume that the economy starts at the natural level of output. Suppose there is a shock to the variable z*, so that the* AS *curve shifts up.*

e. What is the short-run effect on output and the price level? Explain in words.
f. What happens to output and the price level over time? Explain in words.

7. Demand shocks and demand management

Assume that the economy starts at the natural level of output. Now suppose there is a decline in business confidence, so that investment demand falls for any interest rate.

a. In an *AS–AD* diagram, show what happens to output and the price level in the short run and the medium run.
b. What happens to the unemployment rate in the short run? in the medium run?

Suppose that the Federal Reserve decides to respond immediately to the decline in business confidence in the short run. In particular, suppose that the Fed wants to prevent the unemployment rate from changing in the short run after the decline in business confidence.

a. What should the Fed do? Show how the Fed's action, combined with the decline in business confidence, affects the *AS–AD* diagram in the short run and the medium run.
b. How do short-run output and the short-run price level compare to your answers from part (a)?
c. How do the short-run and medium-run unemployment rates compare to your answers from part (b)?

8. Supply shocks and demand management

Assume that the economy starts at the natural level of output. Now suppose there is an increase in the price of oil.

a. In an *AS–AD* diagram, show what happens to output and the price level in the short run and the medium run.
b. What happens to the unemployment rate in the short run? in the medium run?

Suppose that the Federal Reserve decides to respond immediately to the increase in the price of oil. In particular, suppose that the Fed wants to prevent the unemployment rate from changing in the short run after the increase in the price of oil. Assume that the Fed changes the money supply once—immediately after the increase in the price of oil—and then does not change the money supply again.

c. What should the Fed do to prevent the unemployment rate from changing in the short run? Show how the Fed's action, combined with the decline in business confidence, affects the *AS–AD* diagram in the short run and the medium run.
d. How do output and the price level in the short run and the medium run compare to your answers from part (a)?
e. How do the short-run and medium-run unemployment rates compare to your answers from part (b)?

9. Based on your answers to Problems 7 and 8 and the material from the chapter, comment on the following statement:

"The Federal Reserve has the easiest job in the world. All it has to do is conduct expansionary monetary policy when the unemployment rate increases and contractionary monetary policy when the unemployment rate falls."

10. Taxes, oil prices, and workers

Everyone in the labor force is concerned with two things: whether they have a job and, if so, their after-tax income from that job (i.e., their after-tax real wage). An unemployed worker may also be concerned with the availability and amount of unemployment benefits, but we will leave that issue aside for this problem.

a. Suppose there is an increase in oil prices. How will this affect the unemployment rate in the short run and the medium run? How will it affect the real wage (W/P)?
b. Suppose there is a reduction in income taxes. How will this affect the unemployment rate in the short run and the medium run? How about the real wage? For a given worker, how will after-tax income be affected?
c. According to our model, what policy tools does the government have available to increase the real wage?
d. During 2003 and 2004, oil prices increased more or less at the same time that income taxes were reduced. A popular joke at the time was that people could use their tax refunds to pay for the higher gas prices. How do your answers to this problem make sense of this joke?

EXPLORE FURTHER

11. Adding energy prices to the AS *curve*

In this problem, we incorporate the price of energy inputs (e.g., oil) explicitly into the AS *curve.*

Suppose the price-setting equation is given by

$$P = (1 + m)W^{a} P_{E}^{1-a}$$

where P_E *is the price of energy resources and* $0 < a < 1$. *Ignoring a multiplicative constant,* $W^a P_E^{1-a}$ *is the marginal cost function that would result from the production technology,* $Y = N^a E^{1-a}$, *where N is employed labor and* E *represents units of energy resources used in production.*

As in the text, the wage-setting relation is given by

$$W = P^{e} F(u, z)$$

Make sure to distinguish between P_E, *the price of energy resources, and* P^e, *the expected price level for the economy as a whole.*

a. Substitute the wage-setting relation into the price-setting relation to obtain the aggregate supply relation.
b. Let $x = P_E/P$, the real price of energy. Observe that $P \times x = P_E$ and substitute for P_E in the *AS* relation you derived in part (a). Solve for P to obtain

$$P = P^{e} (1 + m)^{1/a} F(u, z)\, x^{(1-a)/a}$$

c. Graph the *AS* relation from part (b) for a given P^e and a given x.

d. Suppose that $P = P^e$. How will the natural rate of unemployment change if x, the real price of energy, increases? [*Hint*: You can solve the *AS* equation for x to obtain the answer, or you can use your intuition. If $P = P^e$, how must $F(u, z)$ change when x increases to maintain the equality in part (b)? How must u change to have the required effect on $F(u, z)$?]

e. Suppose that the economy begins with output equal to the natural level of output. Then the real price of energy increases. Show the short-run and medium-run effects of the increase in the real price of energy in an *AS–AD* diagram.

The text suggests that a change in expectations about monetary policy may help explain why increases in oil prices over the past few years have had less of an adverse effect on the economy than the oil price shocks of the 1970s. Let us examine how such a change in expectations would alter the effect of an oil price shock.

f. Suppose there is an increase in the real price of energy. In addition, despite the increase in the real price of energy, suppose that the expected price level (i.e., P^e) does not change. After the short-run effect of the increase in the real price of energy, will there be any further adjustment of the economy over the medium run? In order for the expected price level not to change, what monetary action must wage-setters be expecting after an increase in the real price of energy?

12. Growth and fluctuations: some economic history

When economists think about history, fluctuations often stand out—oil shocks and stagflation in the 1970s, a recession followed by a long expansion in the 1980s, a recession followed by an extraordinary low-unemployment, low-inflation boom in the 1990s. This question puts these fluctuations into some perspective.

Go to the Web site of the Bureau of Economic Analysis ***(www.bea.gov)*** *and retrieve the quarterly version of NIPA Table 1.1.6, real GDP in chained (2005) dollars. Get real GDP for the fourth quarter of 1959, 1969, 1979, 1989, 1999, 2000, and 2010 as well as for the fourth quarter of the most recent year available.*

a. Using the real GDP numbers for 1959 and 1969, calculate the decadal growth rate of real GDP for the 1960s. Do the same for the 1970s, 1980s, 1990s, and the 2000s and for the available years of the most recent decade.

b. How does growth in the 1970s compare to growth in the later decades? How does growth in the 1960s compare to the later decades? Which decade looks most unusual?