Putting All Markets Together: The AS-AD Model

We looked in Chapter 5 at the determination of output in the short run. We looked in Chapter 6 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 the short 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:

- One, 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 other, 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, it is the version I typically use to organize my thoughts. For some questions, however (in particular for the study of inflation), the basic AS-AD model must be extended—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.

- Sections 7-4 to 7-6 show how we can use the model to look at the dynamic effects of monetary policy, of fiscal policy, and of changes in the price of oil.

- Section 7-7 summarizes.
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.

Recall the equations for wage determination (equation [6.1]), and for price determination (equation [6.3]) we derived in Chapter 6:

\[ W = P^e F(u, z) \]
\[ P = (1 + \mu)W \]

- 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, \( z \), which stands for all the other factors that affect wage determination, from unemployment benefits to the form of collective bargaining.
- The price, \( P \), set by firms (equivalently, the price level) is equal to the nominal wage, \( W \), times 1 plus the markup, \( \mu \).

In Section 6.5 we used these two relations together with the additional assumption that the 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 do 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, between 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:

\[ P = P^e (1 + \mu) F(u, z) \]  

(7.1)

This tells us that the price level, \( P \), depends on the expected price level, \( P^e \), on the unemployment rate, \( u \) (as well as on the markup, \( \mu \), and on the catchall variable, \( z \); but we shall take both \( u \) and \( z \) as constant here).

- The second step is to replace the unemployment rate, \( u \), by 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, \( u = U/L \), follows from the definition of the unemployment rate. The second equality, \( U/L = (L - N)/L \), follows from the definition of unemployment \( (U = L - N) \). The third equality, \( (L - N)/L - 1 \ (N/L) \), just simplifies the fraction. The fourth equality, \( 1 - (N/L) = 1 - (Y/L) \), 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 is output, the lower is the unemployment rate.
Replacing \( u \) by \( 1 - (Y/L) \) in equation (7.1) gives us the aggregate supply relation, or AS relation for short:

\[
P = P^e (1 + \mu) \left( 1 - \frac{Y}{L} \right) z
\]

(7.2)

The price level, \( P \), depends on the expected price level, \( P^e \), and on the level of output, \( Y \) (and also on the markup, \( \mu \), on the catchall variable, \( z \), and on the labor force, \( L \); but we take them as constant here).

The AS relation has two important properties:

- **An increase in output leads to an increase in the price level.** This is the result of four underlying steps:
  1. An increase in output leads to an increase in employment.
  2. The increase in employment leads to a decrease in unemployment, so 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 price set by firms—equivalently, an increase in the price level.

- **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 \( P^e \rightarrow P^e \) will also double. This effect works through wages:
  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 price set by firms—equivalently, a higher 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 which 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.

An informal way of saying the same thing: Higher economic activity puts pressure on prices.

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**Figure 7-1**

**The Aggregate Supply Curve**

Given the expected price level, an increase in output leads to an increase in the price level. If output is equal to the natural level of output, the price level is equal to the expected price level.
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 exactly equal the expected price level $P^e$.

How do we know this? From the definition of the natural level of output in Chapter 6. Recall, 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.

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 is 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 is 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 $P''$. At a given level of output, and so at a given unemployment rate, the increase in the expected price level leads to an increase in wages, leading 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 $Y = Y_n$, $P = P''$).

To 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, and of the expected price level. 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.

**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.
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.

Start with the description of equilibrium in the goods and financial markets (the IS-LM model) you saw in equations (5.2) and (5.3) of Chapter 5:

\[ IS: \quad Y = C(Y - T) + I(Y, i) + G \]

\[ LM: \quad \frac{M}{P} = YL(i) \]

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

Note that what appears on the left side of the **LM** equation is the real money stock, \( M/P \). We focused in Chapter 5 on changes in the real money stock that come from changes in nominal money, \( M \). But changes in the real money stock, \( M/P \), can also come from changes in the price level, \( P \). An increase of 10% 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 the **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, panel (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 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. 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, which leads to an increase in the interest rate. The increase in the interest rate leads to a decrease in the demand for goods and to a decrease in output.

- The implied negative relation between output and the price level is drawn as the downward-sloping curve \( AD \) in Figure 7-3, panel (b). Points \( A \) and \( A' \) in Figure 7-3, panel (b) correspond to points \( A \) and \( A' \) in Figure 7-3, panel (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.

Any variable other than the price level that shifts either the **IS** curve or the **LM** curve also shifts 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 (i.e., a negative relation between output and the price), it is called the "aggregate demand relation:" I shall follow tradition. But again be aware: The aggregate demand curve is very different from a regular demand curve.
Figure 7.3

The Derivation of the Aggregate Demand Curve

(a) Interest rate, \( i \)

\[ \text{LM}' \quad \text{(for } P' > P \text{)} \]

\[ \text{LM} \quad \text{(for } P \text{)} \]

(b) Price level, \( P \)

\[ \text{AD} \]

Output, \( Y \)

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

Recall that a contractionary open-market operation is a decrease in nominal money, \( M \), through the sales of bonds by the central bank.

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 \( AD' \).

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 you have learned by the following aggregate demand relation:

\[
Y = Y\left(\frac{M}{P}, G, T\right) \tag{7.3}
\]

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 \( P \uparrow \Rightarrow Y \downarrow \) decrease in output. This is the relation captured by the \( AD \) curve back in Figure 7.3, panel (b).

To 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.

**Equilibrium in the Short Run and in the Medium Run**

We now put together the AS and the AD relations. From Sections 7.1 and 7.2, the two relations are given by

\[
\text{AS relation} \quad P = P^e (1 + \mu) P \left( 1 - \frac{Y}{L} \right)
\]

\[
\text{AD relation} \quad Y = Y \left( \frac{M}{P}, G, T \right)
\]

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 clearly 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, drawn for a given value of $P^e$, 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 implies 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, $AD$, drawn for given values of $M$, $G$, and $T$, 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. That the labor market is in equilibrium comes from the fact that point $A$ is on the aggregate supply curve. That goods and financial markets are in equilibrium comes from the fact that 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—thus on the value of $P^e$—and on the position of the aggregate demand curve—thus on the values of $M$, $G$, and $T$. As I have drawn the two curves, $Y$ is greater than $Y_n$: The equilibrium level of output exceeds the natural level of output. But I could clearly 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 our first result: In the short run, there is no reason why output should equal the natural level of output. It all depends on the specific values of the expected price level, and the values of the variables affecting the position of aggregate demand.

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

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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.
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 wage setters to revise upwards 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 \( P^e > P^e \).

  This increase in the expected price level implies that, 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. So they set a higher nominal wage, which in turn leads firms to set a higher price. The price level increases.

  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 \( Y' \).

In words: The fact that output initially exceeds the natural level of output leads to an increase in the expected price level. This expectation leads to an increase in nominal wages, which leads to an increase in the price level. This higher price level leads to a decrease in the real money stock. The interest rate increases, leading to a decrease in output.

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

  This implies that so long as equilibrium output exceeds the natural level of output \( Y_n \), the expected price level increases, shifting the \( AS \) curve upward. As the

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 decreased back to the natural level of output.
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. 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 exceeds the expected price level. 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 so, 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 lead 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.

To 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 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 leads to a decrease in demand and output. When output is below the natural level of output, the price level decreases, increasing demand and output.

In the rest of the chapter, we use the AS-AD model to look at the dynamic effects of changes in policy or in the economic environment. We focus on three such changes. The first two are old favorites by now: an open-market operation, which changes the stock of nominal money, and a decrease in the budget deficit. The third, which we could not examine until we had developed a theory of wage and price determination, is an increase in the price of oil. Each of these changes is interesting in its own right:

- Monetary policy was responsible for the recession of 1980–1982.
- Budget deficit reduction made headlines throughout the 1990s.
- Increases in the price of oil were the main cause of the 1973–1975 recession.

#### The Effects of a Monetary Expansion

What are the short-run and medium-run effects of an expansionary monetary policy. Say, of an 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 the natural level of output, so aggregate demand and aggregate supply cross at point A, the level of output 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):

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

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 $A$ to $A'$. Output increases from $Y_n$ to $Y'$; the price level increases from $P$ to $P'$.

Over time, the adjustment of price expectations comes into play. As output is higher than the natural level of output, the price level is higher than wage setters expected. They revise their expectations, leading 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 $P^*$.

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 than it was initially.

Going Behind the Scenes

To get a better sense of what is going on, it is useful to go behind the scenes and look at 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.

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)?

Look at the equation above. 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 $P$ increase in the same proportion.

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.
Figure 7-8, panel (a) reproduces Figure 7-7 (although leaving out the $AS^*$ curve to keep things visually simple), and shows the adjustment of output and the price level in response to the increase in nominal money. Figure 7-8, panel (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 at Figure 7-8, panel (b). Before the change in nominal money, the equilibrium is given by the intersection of the IS and LM curves, at point $A$—which corresponds to point $A$ in Figure 7-8, panel (a). Output is equal to the natural level of output, $Y_n$, and the interest rate is given by $i$.

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, panel (a). The interest rate is lower, output is higher.

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.

**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 Medium Run The Core
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 \(LM''\), so at point \(B\).

But even in the short run, the price level increases—from \(P\) to \(P'\) in Figure 7-8, panel (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 short run equilibrium is given by \(A'\).

Over time, the fact that output is above the natural level of output implies that the price level continues to increase. As the price level increases, it further reduces the real money stock and shifts the LM 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, panel (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 you 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 quite small. We saw this when we looked at estimated responses to changes in the federal funds rate in Figure 5.11. Despite the increase 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 medium-run effects 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 faster to the natural level of output. 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 I call in this book the "medium run."
How long lasting are the effects of an increase in money on output?

One way to answer is to turn to macroeconometric models. These models, which are used both to forecast activity, and to look at the effects of alternative macroeconomic policies, are large-scale versions of the aggregate supply and aggregate demand model presented in this chapter. Figure 1 shows the effects in such a model (built by John Taylor of Stanford University) of a 3% permanent increase in nominal money. The increase in nominal money takes place over the four quarters of year 1: 0.1% in the first quarter, another 0.6% in the second, another 1.2% in the third, and another 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 its initial level. 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 initial level, four years for changes in nominal money to become neutral.

Some economists are skeptical of the results of simulations from such large models. Building such a model requires making decisions about which equations to include, which variables to include in each equation and which ones to leave out. Some decisions are bound to be wrong, because the models are so large, it is often difficult to know how each of these decisions affects the outcome of a particular simulation. So, these economists argue, whenever possible simpler methods should be used.

One such method is simply to trace out, using econometrics, the effects of a change in money on output. This method is not without its own problems: A strong relation between money and output may not come from an effect of money on output, but rather from an effect of output on the conduct of monetary policy and thus on nominal money (the econometric problems raised by such two-way causation are discussed further in Appendix 3 at the end of the book). But the method can provide a useful first pass. The results of such a study by Frederic Mishkin, building on earlier work by Robert Barro, are summarized in Table 1.

Following Barro, Mishkin first separates movements in nominal money into those movements that could have been predicted based on the information available up to that time (a component he calls anticipated money) and those movements that could not have been predicted (a component he calls unanticipated

Figure 1  The Effects of an Expansion in Nominal Money in the Taylor Model
The Effects of a 1% Increase in Nominal Money (Anticipated or Unanticipated) on Output

<table>
<thead>
<tr>
<th>Quarters</th>
<th>0</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>12</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effects on output</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anticipated</td>
<td>1.3</td>
<td>1.9</td>
<td>1.0</td>
<td>1.0</td>
<td>0.7</td>
<td>0.4</td>
</tr>
<tr>
<td>Unanticipated</td>
<td>2.0</td>
<td>2.3</td>
<td>2.2</td>
<td>2.0</td>
<td>0.5</td>
<td>-0.4</td>
</tr>
</tbody>
</table>

money. The motivation for this distinction should be clear from this chapter: If wage setters anticipate increases in money, they may anticipate that the price level will be higher and therefore they will ask for higher wages. Thus, to the extent that changes in money are anticipated, they may have a larger effect on the price level and a smaller effect on output.

The results in Table 1 confirm that changes in money have stronger effects when they are anticipated. Whether anticipated or unanticipated, the effects of changes in money on output peak after about two quarters. The effects are substantially larger than in the Taylor model (which looked at a 3% increase in nominal money; Table 1 looks at the effects of 1% increase). As in the Taylor model, the effects disappear after three to four years (12 to 16 quarters).

Although results using the two approaches are not identical, they share a number of features. Money has a strong effect on output in the short run. But the effect is largely gone after four years. By then, the effect of higher nominal money is largely reflected in a higher price level, not in a higher level of output.

Sources: Figure 1 is reproduced from John Taylor, Macroeconomic Policy in a World Economy (New York: W.W. Norton, 1993) Figure 5.1A, p. 138.

Table 1 is taken from Frederic Mishkin, A Rational Expectations Approach to Macroeconometrics (Chicago: NBER and University of Chicago, 1983), Table 6.5, p. 122.


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.

Suppose the government decides to reduce its budget deficit 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 Yn. 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 Yn to Y’ and the price level decreases from P to P’.

The initial effect of deficit reduction is thus to trigger a decrease in output. We first derived this result in Chapter 3, 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 initial recession is over, and output is back at Yn.

Like an increase in nominal money, a reduction in the budget deficit does not affect output forever. Eventually, output returns to the natural level of output.
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, output returns to the natural level of output.

That the price level decreases for some time feels strange: We rarely observe deflation (although recall Japan, in Chapter 1). 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 so there is no inflation in the medium run. When we introduce money growth in the next chapter, we shall see that a recession typically leads to a decrease in inflation, not to a decrease in the price 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; in particular, the interest rate is lower than before the shift. The best way to see this is to look at the adjustment in terms of the underlying IS-LM model.

**Deficit Reduction, Output, and the Interest Rate**

Figure 7-10, panel (a) reproduces Figure 7-9, showing the adjustment of output and the price level in response to the decrease in the budget deficit (but leaving out $AS''$ to keep things visually simple). Figure 7-10, panel (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 at Figure 7-10, panel (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, panel (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 partly 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, panel (b) corresponds to point $A'$ in Figure 7-10, panel (a). Both output and the interest rate are lower than before the fiscal contraction. Note that whether investment increases or decreases in the short run is ambiguous: Lower output decreases investment, but the lower interest rates increase investment.

As 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, panel (b), the economy moves down from point $A'$ along $IS'$, and eventually reaches $A''$ (which corresponds to $A''$ in Figure 7-10, panel (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, in terms of
spending, is also different. To see how and why, let us 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 deficit reduction. By assumption, government spending, $G$, is lower than before; therefore, investment, $I$, must be higher than before 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—i.e., 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 mix. What is needed is for the central bank to decrease the interest rate enough to offset the adverse effects of the decrease in government spending on aggregate demand. As you saw in Chapter 5, this is what happened in the United States in the 1990s: The Fed made sure that, even in the short run, deficit reduction did not lead to a recession and to a decrease in output.

In the medium run, output returns to the natural level of output, and the interest rate is lower. In the medium run, 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 shall do so when we look at the long run, starting in Chapter 11). 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.

Everything we have just said about the effects of deficit reduction would apply equally to measures aimed at increasing private (rather than public) saving. An increase in the saving rate increases output and investment in the medium run and in the long run. But it may also create a recession and a decrease in investment in the short 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, may 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.

### Changes in the Price of Oil

In the 1970s, the price of oil increased dramatically. This large increase was the result of the formation of the Organization of Petroleum Exporting Countries (OPEC), a cartel of oil producers. Behaving as a monopolist, OPEC reduced the supply of oil and in doing so, increased its price. Figure 7-11, which plots the ratio of the price of crude petroleum to the producer price index since 1960, shows the effects of the formation of OPEC (the ratio is set to 100 in 1960.) The relative price of petroleum, which had remained roughly constant throughout the 1960s, almost tripled between 1970 and 1982. There were two particularly sharp increases in the price, the first in 1973–1975 and the second in 1979–1981.

These high prices did not last very long. From 1982 to 1998, the OPEC cartel became steadily weaker, unable to enforce the production quotas it had set for its members. Some member countries started to produce more than their assigned quota, and the supply of oil increased, leading to a large decline in the price. From a high of 264 in 1982, the relative price bottomed out at 65 in 1998.

In the late 1990s, however, the OPEC cartel became stronger, and the price of oil increased again. In 2000, the relative price stood at 130, twice its 1998 value. While the relative price was still far from its peak in the 1970s, the increase was similar in size to the increase of the mid-1970s, triggering fears that the U.S. economy may be in for a repeat of the 1974–1975 recession. But, in 2001, the price of oil fell again, and, for the time being, earlier fears have been alleviated. Nevertheless, these movements in the
price of oil are still more than enough motivation for us to ask: What are the effects of an increase in the price of oil in our model?

We face a problem in thinking about the macroeconomic effects of an increase in the price of oil. The price of oil appears neither in our aggregate supply relation nor in our aggregate demand relation! The reason is that we have assumed so far that output was produced using only labor. One way of proceeding would be to relax this assumption, recognize explicitly that output is produced using labor and other inputs (including energy), and derive the implications for the relation of prices both to wages and to the price of oil. I shall instead use a shortcut and capture the increase in the price of oil by an increase in $\mu$, 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.

We can then track the dynamic effects of an increase in the markup on output and the price level. It is 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 as a result of the increase in the price of oil. Figure 7-12 reproduces the characterization of labor-market equilibrium from Chapter 6:

- The wage-setting curve is downward sloping. The price-setting relation is represented by the horizontal line at $W/P = 1/(1 + \mu)$. 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 $P = \frac{P_S}{P_N}$. The higher the markup, the lower the real wage implied by price setting. The equilibrium moves from $A$ to $A'$. The real wage is lower. The natural unemployment rate is $u$.

Do not be confused: $u$ and $\mu$ are not the same; $u$ is the unemployment rate, $\mu$ is the markup.
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.

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

The increase in the natural rate of unemployment implies 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. In short, an increase in the price of oil leads to a decrease in the natural level of output.

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 from $Y_n$ to $Y'$. We now want to know what happens in the short run and how the economy moves from $Y_n$ to $Y'$.

To think about the short run, recall from equation (7.2) that the aggregate supply relation is given by

$$P = P^e (1 + \mu) F \left( 1 \frac{Y}{L} \right) Z$$

Recall that we capture the effect of an increase in the price of oil by an increase in the markup, $u$. So, in the short run (given $P^e$), the increase in the price of oil shows up as an increase in the markup, $\mu$. 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 where 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
natural level of output $Y^*_n$ and the price level equals the expected price level, $P^e$. So, the aggregate supply curve shifts 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 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 have a higher propensity to save than oil buyers. Let’s take the easy way here: 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.

Under this assumption, only the $AS$ shifts in the short run. 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 price; the increase in the price level decreases demand and output.

What happens over time? While output has decreased, the natural level of output has decreased 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.

How does our story compare to what actually happened after the first oil shock? Table 7-1 gives the basic macroeconomic facts.

From 1973 to 1975, the cumulative increase in petroleum prices (that is, the sum of the rates of change of petroleum prices in 1973, 1974, and 1975, in dollars) was 77.3%. The effects on output and the price level were very much what our model predicts: a combination of a recession and large increases in the price level. In 1974 and 1975, GDP growth was negative. In both 1974 and 1975, inflation (as measured by the rate of change of the GDP deflator) was higher than the year before. At the time, this combination of negative growth and high inflation—which was baptized stagflation, to capture the combination of stagnation and inflation—came as a surprise to economists. It was the trigger for a large amount of research on the effects of supply shocks (shocks that shift
the aggregate supply curve) for the rest of the decade. By the time of the second oil shock in the late 1970s, macroeconomists were better equipped to understand it.

**Conclusions**

This chapter has covered a lot of ground. Let me repeat some key concepts and develop some of the conclusions.

### The Short Run Versus the Medium Run

One message in this chapter is that changes in policy, and changes in the economic environment—from changes in consumer confidence to changes in the price of oil—typically have different effects in the short run and in the medium run. We looked at the effects of a monetary expansion, of a deficit reduction, and of an increase in the price of oil. The main results are summarized in Table 7-2. 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 the interest rate, and may decrease investment. But in the medium run, the interest rate decreases and output returns to the natural level of output, so investment increases. An increase in the price of oil decreases output not only in the short run but also in the medium run. And so on.

This difference between the short-run effects and the medium-run effects of policies is one of the reasons economists disagree in their policy recommendations. Some economists believe the economy returns quickly to its medium-run equilibrium, and so they emphasize medium-run implications of policy. Others believe the adjustment mechanism through which output returns to the natural level of output can be very slow, so they put more emphasis on the short-run effects of policy. They are more
willing to use monetary policy or budget deficits to get out of a recession, even if money is neutral in the medium run, and budget deficits have adverse implications in the long run.

**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 shall focus in Chapters 10 to 13).

The economy is constantly hit by shocks to aggregate supply, or to aggregate demand, or to both. These shocks may be shifts in consumption coming from changes in consumer confidence, shifts in investment, shifts in the demand for money, shifts in labor productivity, changes in oil prices, and so on. Or they may come from changes in policy—from the introduction of a tax law, a program of infrastructure investment, to the decision by the central bank to fight inflation through tight money, and so on.

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 on output may be largest at the beginning and then decrease over time. 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. Some shocks have effects even in the medium run. This case is for any shock that has a permanent effect on aggregate supply, such as a permanent change in the price of oil.

Fluctuations in output come from the continual appearance of new shocks, each with its propagation mechanism. At times, some shocks are sufficiently bad, 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 change in monetary policy; the recession of the early 1990s was due primarily to a sudden decline in consumer confidence; the slowdown of 2001 appears to be due to a sharp drop in investment spending and to the events of September 11 of that year. What we call economic fluctuations are the result of these shocks and their dynamic effects on output.

**Where We Go from Here: Output, Unemployment, and Inflation**

In developing the model of this chapter, we assumed the nominal money stock was constant. That is, although we considered the effects of a one-time change in the level of nominal money (in Section 7-4), we did not allow for sustained nominal money growth. We are now ready to relax this assumption and allow for nominal money growth. Only by considering positive nominal money growth can we explain why inflation is typically positive, and think about the relation between economic activity and inflation. Movements in unemployment, output, and inflation are the topics of the next two chapters.

**Summary**

- The model of aggregate supply and aggregate demand describes 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. The aggregate supply relation is a relation between the price level, the expected price level, and the level of output. An increase in output decreases unemployment, increasing wages and, in turn, increasing the price level. An increase in the expected price level leads, for one period, to an increase in the actual price level.

We shall return to these issues many times in this book. See the discussion of the Great Depression and of the current situation in Japan in Chapter 22, and Chapter 24 to 26 on policy.

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," ignoring its underlying causes.
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 sniffs 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, leading to a decrease in the real money stock 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 decrease in the budget deficit leads in the short run to a decrease in the demand for goods, and so 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 is back to the natural level of output, but the interest rate is lower and investment is higher.

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