



CHAPTER 16

Output and the Exchange Rate in the Short Run

In 2004, the United States and New Zealand registered two of the highest rates of output growth among the advanced industrial economies. While the U.S. dollar depreciated in real terms, however, the New Zealand dollar appreciated sharply. What explains these contrasting experiences? This chapter will sort out the complicated factors that cause output, exchange rates, and inflation to change by completing the macroeconomic model built in the last three chapters.

Chapters 14 and 15 presented the connections among exchange rates, interest rates, and price levels but always assumed that output levels were determined outside of the model. Those chapters give us only a partial picture of how macroeconomic changes affect an open economy because events that change exchange rates, interest rates, and price levels may also affect output. Now we complete the picture by examining how output and the exchange rate are determined in the short run.

Our discussion combines what we have learned about asset markets and the long-run behavior of exchange rates with a new element, a theory of how the output market adjusts to demand changes when product prices in the economy are themselves slow to adjust. As we learned in Chapter 14, institutional factors like long-term nominal contracts can give rise to “sticky” or slowly adjusting output market prices. By putting a short-run model of the output market together with our models of the foreign exchange and money markets (the asset markets), we build a model that explains the short-run behavior of all the important macroeconomic variables in an open economy. The long-run exchange rate model of the preceding chapter provides the framework that participants in the asset markets use to form their expectations about future exchange rates.

Because output changes may push the economy away from full employment, the links among output and other macroeconomic variables such as the merchandise trade balance and the current account are of great concern to economic policy makers. In the last part of this chapter we use our short-run model to examine how macroeconomic policy tools affect output and the current account, and how those tools can be used to maintain full employment.

Learning Goals

After reading this chapter, you will be able to:

- Explain the role of the real exchange rate in determining the aggregate demand for a country's output.
- See how an open economy's short-run equilibrium can be analyzed as the intersection of an asset market equilibrium schedule (*AA*) and an output market equilibrium schedule (*DD*).
- Understand how monetary and fiscal policies affect the exchange rate and national output in the short run.
- Describe and interpret the long-run effects of permanent macroeconomic changes.
- Explain the relationship among macroeconomic policies, the current account balance, and the exchange rate.

Determinants of Aggregate Demand in an Open Economy

To analyze how output is determined in the short run when product prices are sticky, we introduce the concept of **aggregate demand** for a country's output. Aggregate demand is the amount of a country's goods and services demanded by households and firms throughout the world. Just as the output of an individual good or service depends in part on the demand for it, a country's overall short-run output level depends on the aggregate demand for its products. The economy is at full employment in the long run (by definition) because wages and the price level eventually adjust to ensure full employment. In the long run, domestic output therefore depends only on the available domestic supplies of factors of production such as labor and capital. As we will see, however, these productive factors can be over- or underemployed in the short run as a result of shifts in aggregate demand that have not yet had their full long-run effects on prices.

In Chapter 12 we learned that an economy's output is the sum of four types of expenditure that generate national income: consumption, investment, government purchases, and the current account. Correspondingly, aggregate demand for an open economy's output is the sum of consumption demand (*C*), investment demand (*I*), government demand (*G*), and net export demand, that is, the current account (*CA*). Each of these components of aggregate demand depends on various factors. In this section we examine the factors that determine consumption demand and the current account. We discuss government demand later in this chapter when we examine the effects of fiscal policy; for now we assume that *G* is given. To avoid complicating our model, we also assume that investment demand is given. The determinants of investment demand are incorporated into the model in the Online Appendix to this chapter.

Determinants of Consumption Demand

In this chapter we view the amount a country's residents wish to consume as depending on disposable income, Y^d (that is, national income less taxes, $Y - T$).¹ (*C*, *Y*, and *T* are all

¹A more complete model would allow other factors, such as real wealth and the real interest rate, to affect consumption plans. This chapter's Appendix 1 links the formulation here to the microeconomic theory of the consumer, which was the basis of the discussion in the appendix to Chapter 7.

measured in terms of domestic output units.) With this assumption, a country's desired consumption level can be written as a function of disposable income:

$$C = C(Y^d).$$

Because each consumer naturally demands more goods and services as his or her real income rises, we expect consumption to increase as disposable income increases at the aggregate level, too. Thus, consumption demand and disposable income are positively related. When disposable income rises, however, consumption demand generally rises by *less* because part of the income increase is saved.

Determinants of the Current Account

The current account balance, viewed as the demand for a country's exports less that country's own demand for imports, is determined by two main factors: the domestic currency's real exchange rate against foreign currency (that is, the price of a typical foreign expenditure basket in terms of domestic expenditure baskets) and domestic disposable income. (In reality, a country's current account depends on many other factors, such as the level of foreign expenditure, but for now we regard these other factors as being held constant.)²

We express a country's current account balance as a function of its currency's real exchange rate, $q = EP^*/P$, and of domestic disposable income, Y^d :

$$CA = CA(EP^*/P, Y^d).$$

As a reminder of the last chapter's discussion, note that the domestic currency prices of representative foreign and domestic expenditure baskets are, respectively, EP^* and P , where E (the nominal exchange rate) is the price of foreign currency in terms of domestic, P^* is the foreign price level, and P is the home price level. The *real* exchange rate q , defined as the price of the foreign basket in terms of the domestic one, is therefore EP^*/P . If, for example, the representative basket of European goods and services costs €40 (P^*), the representative U.S. basket costs \$50 (P), and the dollar/euro exchange rate is \$1.10 per euro (E), then the price of the European basket in terms of U.S. baskets is

$$\begin{aligned} EP^*/P &= \frac{(1.10 \text{ \$/€}) \times (40 \text{ €/European basket})}{(50 \text{ \$/U.S. basket})} \\ &= 0.88 \text{ U.S. baskets/European basket.} \end{aligned}$$

Real exchange rate changes affect the current account because they reflect changes in the prices of domestic goods and services relative to foreign. Disposable income affects the current account through its effect on total spending by domestic consumers. To understand how these real exchange rate and disposable income effects work, it is helpful to look separately at the demand for a country's exports, EX , and the demand for imports by the

²In Chapter 19 we study a two-country framework that takes account of how events in the domestic economy affect foreign output and how these changes in foreign output, in turn, feed back to the domestic economy. As the previous footnote observed, we are ignoring a number of factors (such as wealth and interest rates) that affect consumption along with disposable income. Since some part of any consumption change goes into imports, these omitted determinants of consumption also help to determine the current account. Following the convention of Chapter 12, we are also ignoring unilateral transfers in analyzing the current account balance.

country's residents, IM . As we saw in Chapter 12, the current account is related to exports and imports by the identity

$$CA = EX - IM$$

when CA , EX , and IM all are measured in terms of domestic output.

How Real Exchange Rate Changes Affect the Current Account

You will recall that a representative domestic expenditure basket includes some imported products but places a relatively heavier weight on goods and services produced domestically. At the same time, the representative foreign basket is skewed toward goods and services produced in the foreign country. Thus a rise in the price of the foreign basket in terms of domestic baskets, say, will be associated with a rise in the relative price of foreign output in general relative to domestic.³

To determine how such a change in the relative price of national outputs affects the current account, other things equal, we must ask how it affects both EX and IM . If EP^*/P rises, for example, foreign products have become more expensive relative to domestic products: Each unit of domestic output now purchases fewer units of foreign output. Foreign consumers will respond to this price shift by demanding more of our exports. This response by foreigners will therefore raise EX and will tend to improve the domestic country's current account.

The effect of the same real exchange rate increase on IM is more complicated. Domestic consumers respond to the price shift by purchasing fewer units of the more expensive foreign products. Their response does not imply, however, that IM must fall. IM denotes the value of imports *measured in terms of domestic output*, and not the volume of foreign products imported: Because a rise in EP^*/P tends to raise the value of each unit of imports in terms of domestic output units, imports measured in domestic output units may rise as a result of a rise in EP^*/P even if imports decline when measured in foreign output units. IM can therefore rise or fall when EP^*/P rises, so the effect of a real exchange rate change on the current account CA is ambiguous.

Whether the current account improves or worsens depends on which effect of a real exchange rate change is dominant, the *volume effect*, of consumer spending shifts on export and import quantities or the *value effect*, which changes the domestic output worth of a given volume of foreign imports. We assume for now that the volume effect of a real exchange rate change always outweighs the value effect, so that, other things equal, a real depreciation of the currency improves the current account and a real appreciation of the currency worsens the current account.⁴

While we have couched our discussion of real exchange rates and the current account in terms of consumers' responses, *producers'* responses are just as important and work in much the same way. When a country's currency depreciates in real terms, foreign firms will

³The real exchange rate is being used here essentially as a convenient summary measure of the relative prices of domestic against foreign products. A more exact (but much more complicated) analysis would work explicitly with separate demand and supply functions for each country's nontradables and tradables but would lead to conclusions very much like those we reach below.

⁴This assumption requires that import and export demands be relatively *elastic* with respect to the real exchange rate. Appendix 2 to this chapter describes a precise mathematical condition, called the Marshall-Lerner condition, under which the assumption in the text will be valid. The appendix also examines empirical evidence on the time horizon over which the Marshall-Lerner condition holds.

TABLE 16-1 Factors Determining the Current Account

Change	Effect on current account, CA
Real exchange rate, $EP^*/P \uparrow$	$CA \uparrow$
Real exchange rate, $EP^*/P \downarrow$	$CA \downarrow$
Disposable income, $Y^d \uparrow$	$CA \downarrow$
Disposable income, $Y^d \downarrow$	$CA \uparrow$

find that the country can supply intermediate production inputs more cheaply. These effects have become stronger as a result of the increasing tendency for multinational firms to locate different stages of their production processes in a variety of countries. For example, the German auto manufacturer BMW can shift production from Germany to its Spartanburg, South Carolina, plant if a dollar depreciation lowers the relative cost of producing in the United States. The production shift represents an increase in world demand for U.S. labor and output.

How Disposable Income Changes Affect the Current Account

The second factor influencing the current account is domestic disposable income. Since a rise in Y^d causes domestic consumers to increase their spending on *all* goods, including imports from abroad, an increase in disposable income worsens the current account, other things equal. (An increase in Y^d has no effect on export demand because we are holding foreign income constant and not allowing Y^d to affect it.)

Table 16-1 summarizes our discussion of how real exchange rate and disposable income changes influence the domestic current account.

The Equation of Aggregate Demand

We now combine the four components of aggregate demand to get an expression for total aggregate demand, denoted D :

$$D = C(Y - T) + I + G + CA(EP^*/P, Y - T),$$

where we have written disposable income Y^d as output, Y , less taxes, T . This equation shows that aggregate demand for home output can be written as a function of the real exchange rate, disposable income, investment demand, and government spending:

$$D = D(EP^*/P, Y - T, I, G).$$

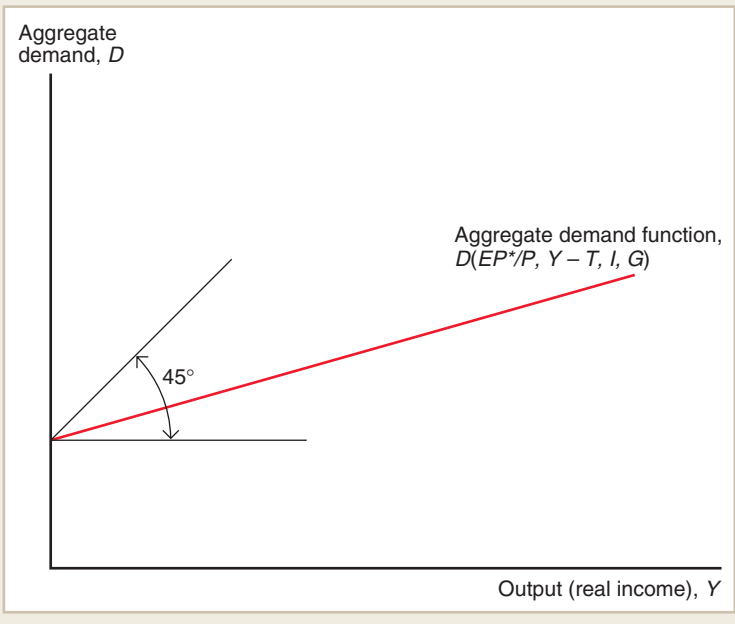
We now want to see how aggregate demand depends on the real exchange rate and domestic GNP given the level of taxes, T , investment demand, I , and government purchases, G .

The Real Exchange Rate and Aggregate Demand

A rise in EP^*/P makes domestic goods and services cheaper relative to foreign goods and services and shifts both domestic and foreign spending from foreign goods to domestic goods. As a result, CA rises (as assumed in the previous section) and aggregate demand D therefore goes up. *A real depreciation of the home currency raises aggregate demand for home output, other things equal; a real appreciation lowers aggregate demand for home output.*

Figure 16-1**Aggregate Demand as a Function of Output**

Aggregate demand is a function of the real exchange rate (EP^*/P), disposable income ($Y - T$), investment demand (I), and government spending (G). If all other factors remain unchanged, a rise in output (real income), Y , increases aggregate demand. Because the increase in aggregate demand is less than the increase in output, the slope of the aggregate demand function is less than 1 (as indicated by its position within the 45-degree angle).

**Real Income and Aggregate Demand**

The effect of domestic real income on aggregate demand is slightly more complicated. If taxes are fixed at a given level, a rise in Y represents an equal rise in disposable income Y^d . While this rise in Y^d raises consumption, it worsens the current account by raising home spending on foreign imports. The first of these effects raises aggregate demand, but the second lowers it. Since the increase in consumption is divided between higher spending on home products and higher spending on foreign imports, however, the first effect (the effect of disposable income on total consumption) is greater than the second (the effect of disposable income on import spending alone). Therefore, *a rise in domestic real income raises aggregate demand for home output, other things equal, and a fall in domestic real income lowers aggregate demand for home output.*

Figure 16-1 shows the relation between aggregate demand and real income Y for fixed values of the real exchange rate, taxes, investment demand, and government spending. As Y rises, consumption rises by a fraction of the increase in income. Part of this increase in consumption, moreover, goes into import spending. The effect of an increase in Y on the aggregate demand for home output is therefore smaller than the accompanying rise in consumption, which is smaller, in turn, than the increase in Y . We show this in Figure 16-1 by drawing the aggregate demand schedule with a slope less than 1. (The schedule intersects the vertical axis above the origin because investment, government, and foreign demand would make aggregate demand greater than zero, even in the hypothetical case of zero domestic output.)

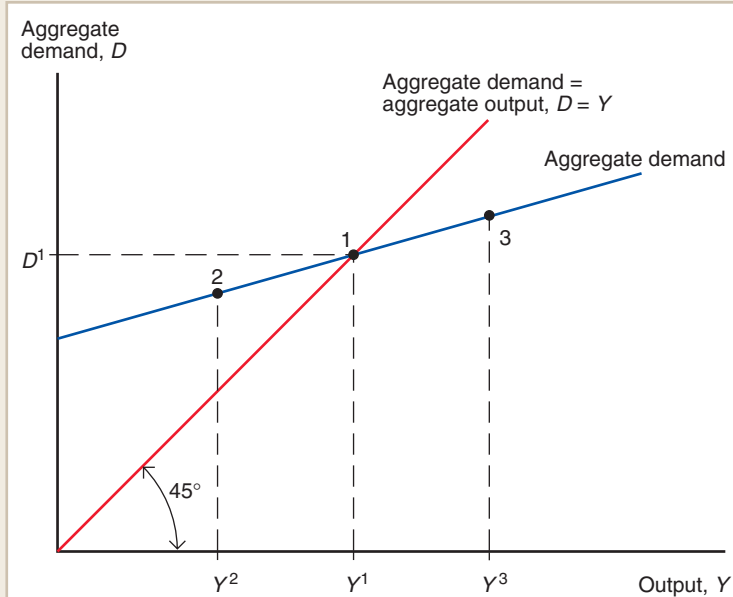
How Output Is Determined in the Short Run

Having discussed the factors that influence the demand for an open economy's output, we now study how output is determined in the short run. We show that the output market is in equilibrium when real domestic output, Y , equals the aggregate demand for domestic output:

$$Y = D(EP^*/P, Y - T, I, G). \quad (16-1)$$

Figure 16-2**The Determination of Output in the Short Run**

In the short run output settles at Y^1 (point 1), where aggregate demand, D^1 , equals aggregate output, Y^1 .



The equality of aggregate supply and demand therefore determines the short-run equilibrium output level.⁵

Our analysis of real output determination applies to the short run because we assume that the money prices of goods and services are *temporarily fixed*. As we will see later in the chapter, the short-run real output changes that occur when prices are temporarily fixed eventually cause price level changes that move the economy to its long-run equilibrium. In long-run equilibrium, factors of production are fully employed, the level of real output is completely determined by factor supplies, and the real exchange rate has adjusted to equate long-run real output to aggregate demand.⁶

The determination of national output in the short run is illustrated in Figure 16-2, where we again graph aggregate demand as a function of output for fixed levels of the real exchange rate, taxes, investment demand, and government spending. The intersection (at point 1) of the aggregate demand schedule and a 45-degree line drawn from the origin (the equation $D = Y$) gives us the unique output level Y^1 at which aggregate demand equals domestic output.

⁵Superficially, equation (16-1), which may be written as $Y = C(Y^d) + I + G + CA(EP^*/P, Y^d)$, looks like the GNP identity we discussed in Chapter 12, $Y = C + I + G + CA$. How do the two equations differ? They differ in that (16-1) is an equilibrium condition, not an identity. As you will recall from Chapter 12, the investment quantity I appearing in the GNP identity includes *undesired* or involuntary inventory accumulation by firms, so that the GNP identity always holds as a matter of definition. The investment demand appearing in equation (16-1), however, is *desired* or planned investment. Thus, the GNP identity always holds but equation (16-1) holds only if firms are not unwillingly building up or drawing down inventories of goods.

⁶Thus, equation (16-1) also holds in long-run equilibrium, but the equation determines the long-run real exchange rate when Y is at its long-run value, as in Chapter 15. (We are holding foreign conditions constant.)

Let's use Figure 16-2 to see why output tends to settle at Y^1 in the short run. At an output level of Y^2 , aggregate demand (point 2) is higher than output. Firms therefore increase their production to meet this excess demand. (If they did not, they would have to meet the excess demand out of inventories, reducing investment below the desired level I .) Thus, output expands until national income reaches Y^1 .

At point 3 there is an excess supply of domestic output and firms find themselves involuntarily accumulating inventories (involuntarily raising their investment spending above its desired level). As inventories start to build up, firms cut back on production; only when output has fallen to Y^1 will firms be content with their level of production. Once again, output settles at point 1, the point at which output exactly equals aggregate demand. In this short-run equilibrium, consumers, firms, the government, and foreign buyers of domestic products are all able to realize their desired expenditures with no output left over.

Output Market Equilibrium in the Short Run: The *DD* Schedule

Now that we understand how output is determined for a given real exchange rate EP^*/P , let's look at how the exchange rate and output are simultaneously determined in the short run. To understand this process, we need two elements. The first element, developed in this section, is the relationship between output and the exchange rate (the *DD* schedule) that must hold when the output market is in equilibrium. The second element, developed in the next section, is the relationship between output and the exchange rate that must hold when the home money market and the foreign exchange market (the asset markets) are in equilibrium. Both elements are necessary because the economy as a whole is in equilibrium only when both the output market and the asset markets are in equilibrium.

Output, the Exchange Rate, and Output Market Equilibrium

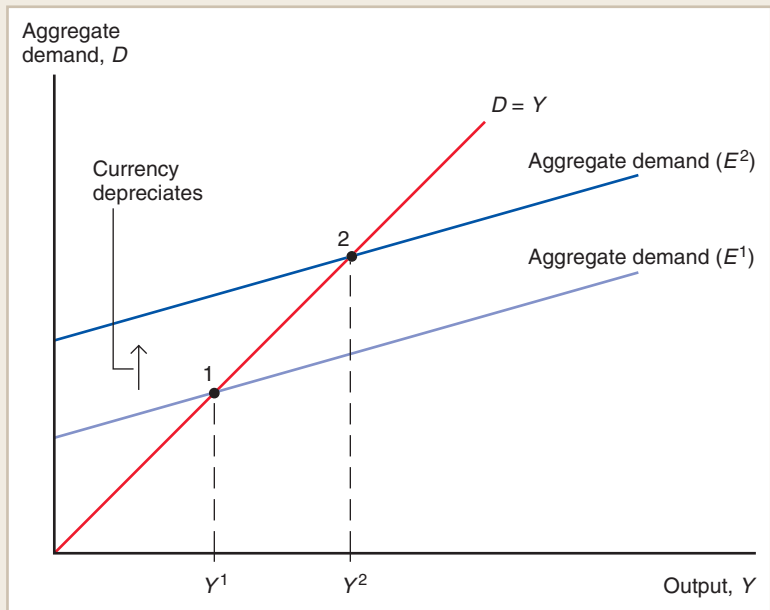
Figure 16-3 illustrates the relationship between the exchange rate and output implied by output market equilibrium. Specifically, the figure illustrates the effect of a depreciation of the domestic currency against foreign currency (that is, a rise in E from E^1 to E^2) for fixed values of the domestic price level, P , and the foreign price level, P^* . With fixed price levels at home and abroad, the rise in the nominal exchange rate makes foreign goods and services more expensive relative to domestic goods and services. This relative price change shifts the aggregate demand schedule upward.

The fall in the relative price of domestic output shifts the aggregate demand schedule upward because at each level of domestic output, the demand for domestic products is now higher. For example, foreign and American consumers of autos alike shift their demands toward American models when the dollar depreciates. Output expands from Y^1 to Y^2 as firms find themselves faced with excess demand at initial production levels.

Although we have considered the effect of a change in E with P and P^* held fixed, it is straightforward to analyze the effects of changes in P or P^* on output. *Any rise in the real exchange rate EP^*/P (whether due to a rise in E , a rise in P^* , or a fall in P) will cause an upward shift in the aggregate demand function and an expansion of output, all else equal.* (A rise in P^* , for example, has effects qualitatively identical to those of a rise in E .) *Similarly, any fall in EP^*/P , regardless of its cause (a fall in E , a fall in P^* , or a rise in P), will cause output to contract, all else equal.* (A rise in P , with E and P^* held fixed, for

Figure 16-3**Output Effect of a Currency Depreciation with Fixed Output Prices**

A rise in the exchange rate from E^1 to E^2 (a currency depreciation) raises aggregate demand to *aggregate demand* (E^2) and output to Y^2 , all else equal.



example, makes domestic products more expensive relative to foreign products, reduces aggregate demand for domestic output, and causes output to fall.)

Deriving the *DD* Schedule

If we assume P and P^* are fixed in the short run, a depreciation of the domestic currency (a rise in E) is associated with a rise in domestic output, Y , while an appreciation (a fall in E) is associated with a fall in Y . This association provides us with one of the two relationships between E and Y needed to describe the short-run macroeconomic behavior of an open economy. We summarize this relationship by the *DD* schedule, which shows all combinations of output and the exchange rate for which the output market is in short-run equilibrium (aggregate demand = aggregate output).

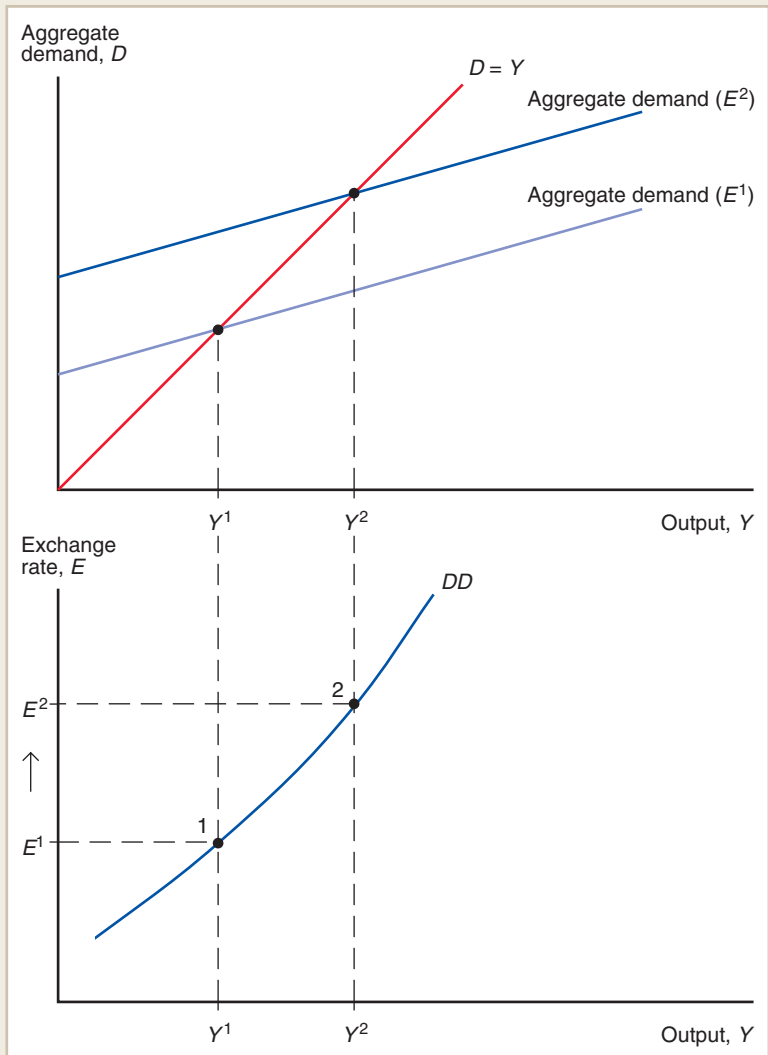
Figure 16-4 shows how to derive the *DD* schedule, which relates E and Y when P and P^* are fixed. The upper part of the figure reproduces the result of Figure 16-3 (a depreciation of the domestic currency shifts the aggregate demand function upward, causing output to rise). The *DD* schedule in the lower part graphs the resulting relationship between the exchange rate and output (given that P and P^* are held constant). Point 1 on the *DD* schedule gives the output level Y^1 at which aggregate demand equals aggregate supply when the exchange rate is E^1 . A depreciation of the currency to E^2 leads to the higher output level Y^2 according to the figure's upper part, and this information allows us to locate point 2 on *DD*.

Factors That Shift the *DD* Schedule

A number of factors affect the position of the *DD* schedule: the levels of government demand, taxes, and investment; the domestic and foreign price levels; variations in domestic consumption behavior; and the foreign demand for home output. To understand the effects

Figure 16-4**Deriving the DD Schedule**

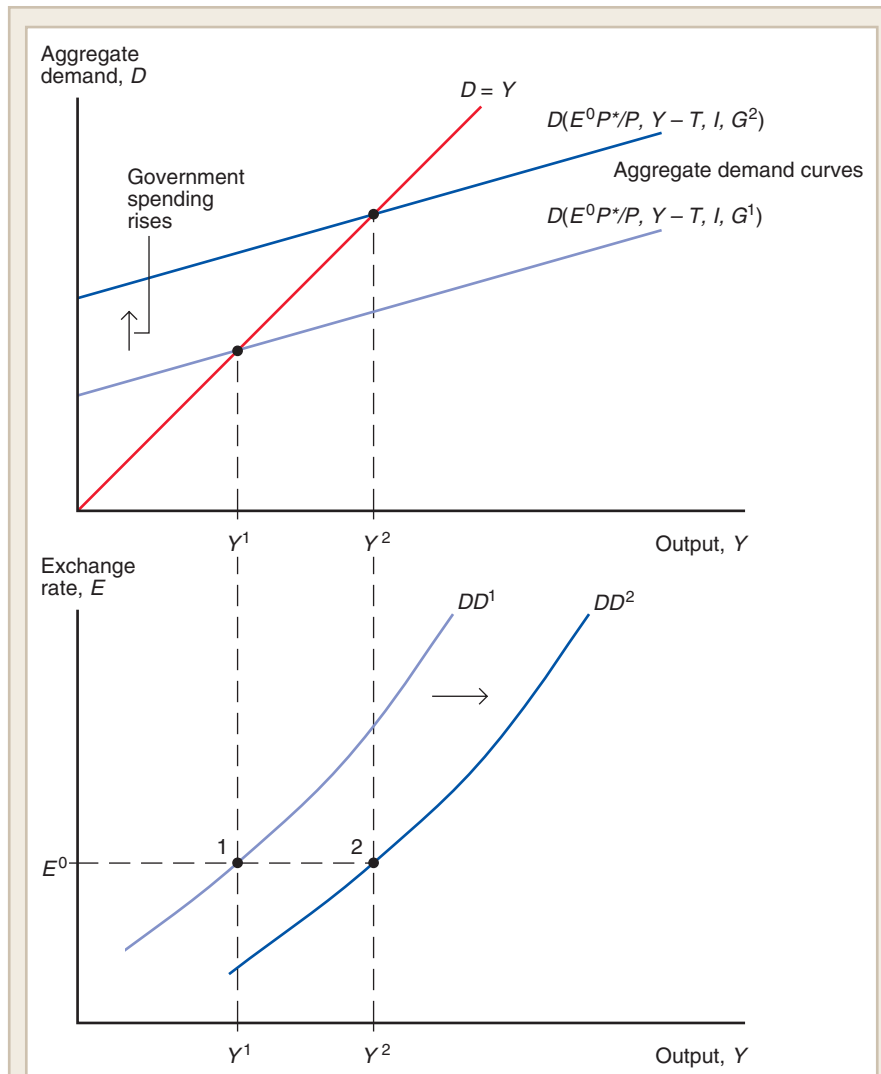
The DD schedule (shown in the lower panel) slopes upward because a rise in the exchange rate from E^1 to E^2 , all else equal, causes output to rise from Y^1 to Y^2 .



of shifts in each of these factors, we must study how the DD schedule shifts when it changes. In the following discussions we assume that all other factors remain fixed.

1. A change in G . Figure 16-5 shows the effect on DD of a rise in government purchases from G^1 to G^2 , given a constant exchange rate of E^0 . An example would be the increase in U.S. military and security expenditures following the September 11, 2001, attacks. As shown in the upper part of the figure, the exchange rate E^0 leads to an equilibrium output level Y^1 at the initial level of government demand; so point 1 is one point on DD^1 .

An increase in G causes the aggregate demand schedule in the upper part of the figure to shift upward. Everything else remaining unchanged, output increases from Y^1 to Y^2 . Point 2 in the bottom part shows the higher level of output at which aggregate demand and supply are now equal, given an unchanged exchange rate of E^0 . Point 2 is on a new DD curve, DD^2 .

**Figure 16-5****Government Demand and the Position of the *DD* Schedule**

A rise in government demand from G^1 to G^2 raises output at every level of the exchange rate. The change therefore shifts *DD* to the right.

For any given exchange rate, the level of output equating aggregate demand and supply is higher after the increase in G . This implies that *an increase in G causes DD to shift to the right, as shown in Figure 16-5. Similarly, a decrease in G causes DD to shift to the left.*

The method and reasoning we have just used to study how an increase in G shifts the *DD* curve can be applied to all the cases that follow. Here we summarize the results. To test your understanding, use diagrams similar to Figure 16-5 to illustrate how the economic factors listed below change the curves.

2. *A change in T .* Taxes, T , affect aggregate demand by changing disposable income, and thus consumption, for any level of Y . It follows that an increase in taxes causes the aggregate demand function of Figure 16-1 to shift *downward* given the exchange rate E . Since this effect is the opposite of that of an increase in G , an increase in T must cause the DD schedule to shift leftward. Similarly, a fall in T , such as the tax cut enacted after 2001 by President George W. Bush, causes a rightward shift of DD .

3. *A change in I .* An increase in investment demand has the same effect as an increase in G : The aggregate demand schedule shifts upward and DD shifts to the right. A fall in investment demand shifts DD to the left.

4. *A change in P .* Given E and P^* , an increase in P makes domestic output more expensive relative to foreign output and lowers net export demand. The DD schedule shifts to the left as aggregate demand falls. A fall in P makes domestic goods cheaper and causes a rightward shift of DD .

5. *A change in P^* .* Given E and P , a rise in P^* makes foreign goods and services relatively more expensive. Aggregate demand for domestic output therefore rises and DD shifts to the right. Similarly, a fall in P^* causes DD to shift to the left.

6. *A change in the consumption function.* Suppose residents of the home economy suddenly decide they want to consume more and save less at each level of disposable income. This could occur, for example, if home prices increase and homeowners borrow against their additional wealth. If the increase in consumption spending is not devoted entirely to imports from abroad, aggregate demand for domestic output rises and the aggregate demand schedule shifts upward for any given exchange rate E . This implies a shift to the right of the DD schedule. An autonomous fall in consumption (if it is not entirely due to a fall in import demand) shifts DD to the left.

7. *A demand shift between foreign and domestic goods.* Suppose there is no change in the domestic consumption function but domestic and foreign residents suddenly decide to devote more of their spending to goods and services produced in the home country. (For example, fears of mad cow disease abroad raise the demand for U.S. beef products.) If home disposable income and the real exchange rate remain the same, this shift in demand *improves* the current account by raising exports and lowering imports. The aggregate demand schedule shifts upward and DD therefore shifts to the right. The same reasoning shows that a shift in world demand away from domestic products and toward foreign products causes DD to shift to the left.

You may have noticed that a simple rule allows you to predict the effect on DD of any of the disturbances we have discussed: *Any disturbance that raises aggregate demand for domestic output shifts the DD schedule to the right; any disturbance that lowers aggregate demand for domestic output shifts the DD schedule to the left.*

Asset Market Equilibrium in the Short Run: The AA Schedule

We have now derived the first element in our account of short-run exchange rate and income determination, the relation between the exchange rate and output that is consistent with the equality of aggregate demand and supply. That relation is summarized by the DD schedule, which shows all exchange rate and output levels at which the output market is in short-run equilibrium. As we noted at the beginning of the preceding section, however,

equilibrium in the economy as a whole requires equilibrium in the asset markets as well as in the output market, and there is no reason in general why points on the DD schedule should lead to asset market equilibrium.

To complete the story of short-run equilibrium, we therefore introduce a second element to ensure that the exchange rate and output level consistent with output market equilibrium are also consistent with asset market equilibrium. The schedule of exchange rate and output combinations that are consistent with equilibrium in the domestic money market and the foreign exchange market is called the **AA schedule**.

Output, the Exchange Rate, and Asset Market Equilibrium

In Chapter 13 we studied the interest parity condition, which states that the foreign exchange market is in equilibrium only when the expected rates of return on domestic and foreign currency deposits are equal. In Chapter 14 we learned how the interest rates that enter the interest parity relationship are determined by the equality of real money supply and real money demand in national money markets. Now we combine these asset market equilibrium conditions to see how the exchange rate and output must be related when all asset markets simultaneously clear. Because the focus for now is on the domestic economy, the foreign interest rate is taken as given.

For a given expected future exchange rate, E^e , the interest parity condition describing foreign exchange market equilibrium is equation (13-2),

$$R = R^* + (E^e - E)/E,$$

where R is the interest rate on domestic currency deposits and R^* is the interest rate on foreign currency deposits. In Chapter 14 we saw that the domestic interest rate satisfying the interest parity condition must also equate the real domestic money supply (M^s/P) to aggregate real money demand (see equation (14-4)):

$$M^s/P = L(R, Y).$$

You will recall that aggregate real money demand $L(R, Y)$ rises when the interest rate falls because a fall in R makes interest-bearing nonmoney assets less attractive to hold. (Conversely, a rise in the interest rate lowers real money demand.) A rise in real output, Y , increases real money demand by raising the volume of monetary transactions people must carry out (and a fall in real output reduces real money demand by reducing people's transactions needs).

We now use the diagrammatic tools developed in Chapter 14 to study the changes in the exchange rate that must accompany output changes so that asset markets remain in equilibrium. Figure 16-6 shows the equilibrium domestic interest rate and exchange rate associated with the output level Y^1 for a given nominal money supply, M^s , a given domestic price level, P , a given foreign interest rate, R^* , and a given value of the expected future exchange rate, E^e . In the lower part of the figure, we see that with real output at Y^1 and the real money supply at M^s/P , the interest rate R^1 clears the home money market (point 1) while the exchange rate E^1 clears the foreign exchange market (point 1'). The exchange rate E^1 clears the foreign exchange market because it equates the expected rate of return on foreign deposits, measured in terms of domestic currency, to R^1 .

A rise in output from Y^1 to Y^2 raises aggregate real money demand from $L(R, Y^1)$ to $L(R, Y^2)$, shifting out the entire money demand schedule in the lower part of Figure 16-6. This shift, in turn, raises the equilibrium domestic interest rate to R^2 (point 2). With E^e and R^* fixed, the domestic currency must appreciate from E^1 to E^2 to bring the foreign exchange market back into equilibrium at point 2'. The domestic currency appreciates by

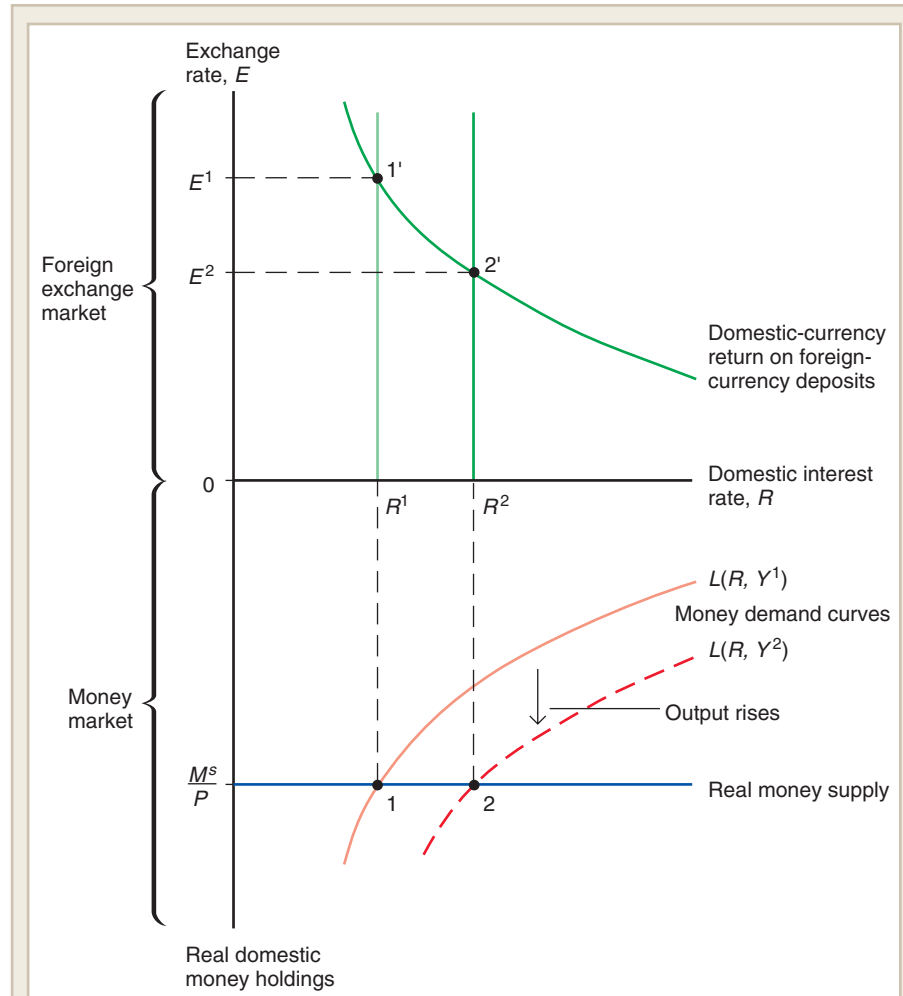


Figure 16-6

Output and the Exchange Rate in Asset Market Equilibrium

For the asset (foreign exchange and money) markets to remain in equilibrium, a rise in output must be accompanied by an appreciation of the currency, all else equal.

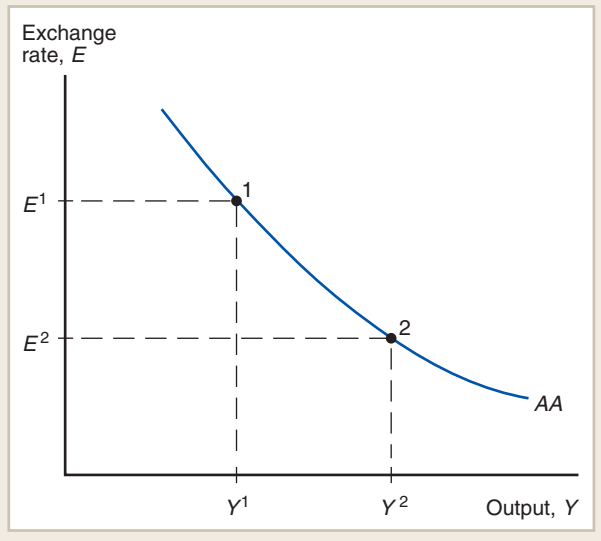
just enough that the increase in the rate at which it is expected to *depreciate* in the future offsets the increased interest rate advantage of home currency deposits. *For asset markets to remain in equilibrium, a rise in domestic output must be accompanied by an appreciation of the domestic currency, all else equal, and a fall in domestic output must be accompanied by a depreciation.*

Deriving the AA Schedule

While the *DD* schedule plots exchange rates and output levels at which the output market is in equilibrium, the *AA* schedule relates exchange rates and output levels that keep the money and foreign exchange markets in equilibrium. Figure 16-7 shows the *AA* schedule. From Figure 16-6 we see that for any output level, Y , there is a unique exchange rate, E ,

Figure 16-7**The AA Schedule**

The asset market equilibrium schedule (AA) slopes downward because a rise in output from Y^1 to Y^2 , all else equal, causes a rise in the home interest rate and a domestic currency appreciation from E^1 to E^2 .



satisfying the interest parity condition (given the real money supply, the foreign interest rate, and the expected future exchange rate). Our previous reasoning tells us that other things equal, a rise in Y^1 to Y^2 will produce an appreciation of the domestic currency, that is, a fall in the exchange rate from E^1 to E^2 . The AA schedule therefore has a negative slope, as shown in Figure 16-7.

Factors That Shift the AA Schedule

Five factors cause the AA schedule to shift: changes in the domestic money supply, M^s ; changes in the domestic price level, P ; changes in the expected future exchange rate, E^e ; changes in the foreign interest rate, R^* ; and shifts in the aggregate real money demand schedule.

1. A change in M^s . For a fixed level of output, an increase in M^s causes the domestic currency to depreciate in the foreign exchange market, all else equal (that is, E rises). Since for each level of output the exchange rate E is higher after the rise in M^s , the rise in M^s causes AA to shift *upward*. Similarly, a fall in M^s causes AA to shift *downward*.

2. A change in P . An increase in P reduces the *real* money supply and drives the interest rate upward. Other things (including Y) equal, this rise in the interest rate causes E to fall. The effect of a rise in P is therefore a downward shift of AA. A fall in P results in an upward shift of AA.

3. A change in E^e . Suppose participants in the foreign exchange market suddenly revise their expectations about the exchange rate's future value so that E^e rises. Such a change shifts the curve in the top part of Figure 16-6 (which measures the expected domestic currency return on foreign currency deposits) to the right. The rise in E^e therefore causes the domestic currency to depreciate, other things equal. Because the exchange rate producing equilibrium in the foreign exchange market is higher after a rise in E^e , given output, AA shifts upward when a rise in the expected future exchange rate occurs. It shifts downward when the expected future exchange rate falls.

4. A change in R^* . A rise in R^* raises the expected return on foreign currency deposits and therefore shifts the downward-sloping schedule at the top of Figure 16-6 to

the right. Given output, the domestic currency must depreciate to restore interest parity. A rise in R^* therefore has the same effect on AA as a rise in E^e . It causes an upward shift. A fall in R^* results in a downward shift of AA .

5. *A change in real money demand.* Suppose domestic residents decide they would prefer to hold lower real money balances at each output level and interest rate. (Such a change in asset-holding preferences is a *reduction in money demand*.) A reduction in money demand implies an inward shift of the aggregate real money demand function $L(R, Y)$ for any fixed level of Y , and it thus results in a lower interest rate and a rise in E . A reduction in money demand therefore has the same effect as an increase in the money supply, in that it shifts AA upward. The opposite disturbance of an increase in money demand would shift AA downward.

Short-Run Equilibrium for an Open Economy: Putting the DD and AA Schedules Together

By assuming that output prices are temporarily fixed, we have derived two separate schedules of exchange rate and output levels: the DD schedule, along which the output market is in equilibrium, and the AA schedule, along which the asset markets are in equilibrium. A short-run equilibrium for the economy as a whole must lie on *both* schedules because such a point must bring about equilibrium simultaneously in the output and asset markets. We can therefore find the economy's short-run equilibrium by finding the intersection of the DD and AA schedules. Once again, it is the assumption that domestic output prices are temporarily fixed that makes this intersection a *short-run* equilibrium. The analysis in this section continues to assume that the foreign interest rate R^* , the foreign price level P^* , and the expected future exchange rate E^e also are fixed.

Figure 16-8 combines the DD and AA schedules to locate short-run equilibrium. The intersection of DD and AA at point 1 is the only combination of exchange rate and output

Figure 16-8

Short-Run Equilibrium: The Intersection of DD and AA

The short-run equilibrium of the economy occurs at point 1, where the output market (whose equilibrium points are summarized by the DD curve) and asset market (whose equilibrium points are summarized by the AA curve) simultaneously clear.

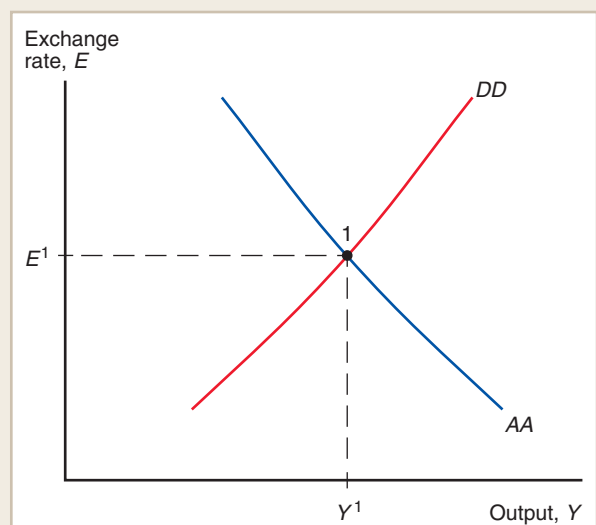
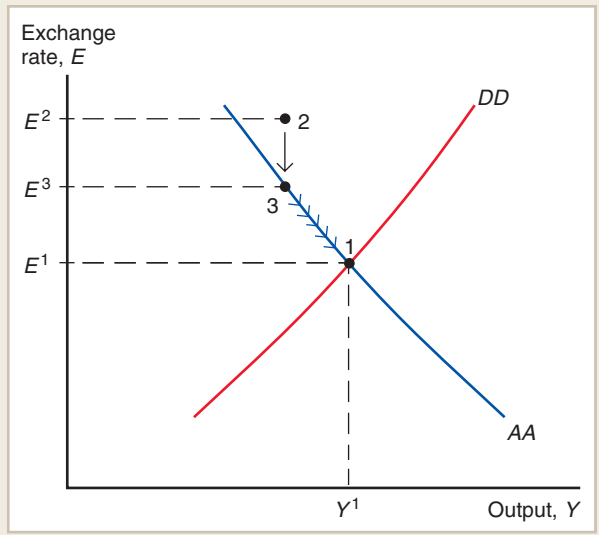


Figure 16-9**How the Economy Reaches Its Short-Run Equilibrium**

Because asset markets adjust very quickly, the exchange rate jumps immediately from point 2 to point 3 on AA^1 . The economy then moves to point 1 along AA^1 as output rises to meet aggregate demand.



consistent with both the equality of aggregate demand and aggregate supply *and* asset market equilibrium. The short-run equilibrium levels of the exchange rate and output are therefore E^1 and Y^1 .

To convince yourself that the economy will indeed settle at point 1, imagine that the economy is instead at a position like point 2 in Figure 16-9. At point 2, which lies above AA and DD , both the output and asset markets are out of equilibrium. Because E is so high relative to AA , the rate at which E is expected to fall in the future is also high relative to the rate that would maintain interest parity. The high expected future appreciation rate of the domestic currency implies that the expected domestic currency return on foreign deposits is below that on domestic deposits, so there is an excess demand for the domestic currency in the foreign exchange market. The high level of E at point 2 also makes domestic goods cheap for foreign buyers (given the goods' domestic-currency prices), causing an excess demand for output at that point.

The excess demand for domestic currency leads to an immediate fall in the exchange rate from E^2 to E^3 . This appreciation equalizes the expected returns on domestic and foreign deposits and places the economy at point 3 on the asset market equilibrium curve AA . But since point 3 is above the DD schedule, there is still excess demand for domestic output. As firms raise production to avoid depleting their inventories, the economy travels along AA to point 1, where aggregate demand and supply are equal. Because asset prices can jump immediately while changes in production plans take some time, the asset markets remain in continual equilibrium even while output is changing.

The exchange rate falls as the economy approaches point 1 along AA because rising national output causes money demand to rise, pushing the interest rate steadily upward. (The currency must appreciate steadily to lower the expected rate of future domestic currency appreciation and maintain interest parity.) Once the economy has reached point 1 on DD , aggregate demand equals output and producers no longer face involuntary inventory depletion. The economy therefore settles at point 1, the only point at which the output *and* asset markets clear.

Temporary Changes in Monetary and Fiscal Policy

Now that we have seen how the economy's short-run equilibrium is determined, we can study how shifts in government macroeconomic policies affect output and the exchange rate. Our interest in the effects of macroeconomic policies stems from their usefulness in counteracting economic disturbances that cause fluctuations in output, employment, and inflation. In this section we learn how government policies can be used to maintain full employment in open economies.

We concentrate on two types of government policy, **monetary policy**, which works through changes in the money supply, and **fiscal policy**, which works through changes in government spending or taxes.⁷ To avoid the complications that would be introduced by ongoing inflation, however, we do not look at situations in which the money supply grows over time. Thus, the only type of monetary policies we will study explicitly are one-shot increases or decreases in money supplies.⁸

In this section we examine *temporary* policy shifts, shifts that the public expects to be reversed in the near future. The expected future exchange rate, E^e , is now assumed to equal the long-run exchange rate discussed in Chapter 15, that is, the exchange rate that prevails once full employment is reached and domestic prices have adjusted fully to past disturbances in the output and asset markets. In line with this interpretation, a temporary policy change does *not* affect the long-run expected exchange rate, E^e .

We assume throughout that events in the economy we are studying do not influence the foreign interest rate, R^* , or price level, P^* , and that the domestic price level, P , is fixed in the short run.

Monetary Policy

The short-run effect of a temporary increase in the domestic money supply is shown in Figure 16-10. An increased money supply shifts AA^1 upward to AA^2 but does not affect the position of DD . The upward shift of the asset market equilibrium schedule moves the economy from point 1, with exchange rate E^1 and output Y^1 , to point 2, with exchange rate E^2 and output Y^2 . An increase in the money supply causes a depreciation of the domestic currency, an expansion of output, and therefore an increase in employment.

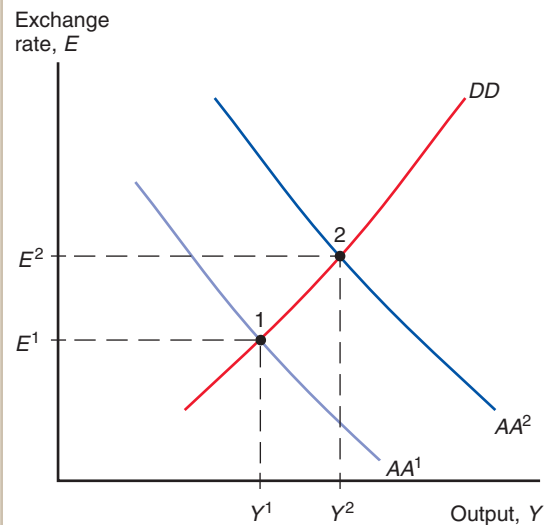
We can understand the economic forces causing these results by recalling our earlier discussions of asset market equilibrium and output determination. At the initial output level Y^1 and given the fixed price level, an increase in money supply must push down the home interest rate, R . We have been assuming the monetary change is temporary and does not affect the expected future exchange rate, E^e , so to preserve interest parity in the face of a decline in R (given that the foreign interest rate, R^* , does not change), the exchange rate must depreciate immediately to create the expectation that the home currency will appreciate in the future at a faster rate than was expected before R fell. The immediate depreciation of the domestic currency, however, makes home products cheaper relative to foreign products. There is therefore an increase in aggregate demand, which must be matched by an increase in output.

⁷A recent example of the latter (as noted earlier) would be the tax cut enacted during the 2001–2005 administration of President George W. Bush. Other policies, such as commercial policies (tariffs, quotas, etc.), have macroeconomic side effects. Such policies, however, are not used routinely for purposes of macroeconomic stabilization, so we do not discuss them in this chapter. (A problem at the end of this chapter does ask you to think about the macroeconomic effects of a tariff.)

⁸You can extend the results below to a setting with ongoing inflation by thinking of the exchange rate and price level changes we describe as departures from time paths along which E and P trend upward at constant rates.

Figure 16-10**Effects of a Temporary Increase in the Money Supply**

By shifting AA^1 upward, a temporary increase in the money supply causes a currency depreciation and a rise in output.

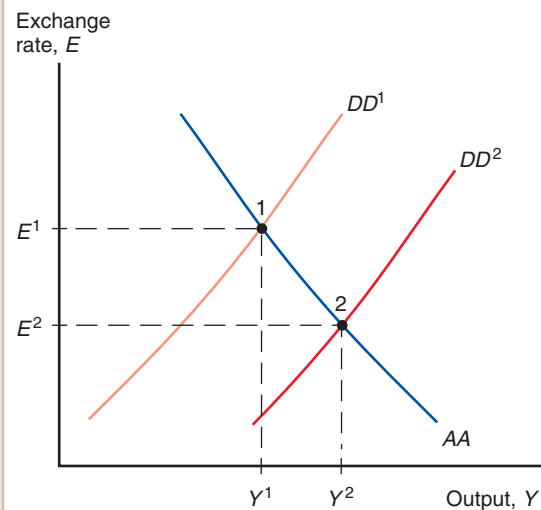
**Fiscal Policy**

As we saw earlier, expansionary fiscal policy can take the form of an increase in government spending, a cut in taxes, or some combination of the two that raises aggregate demand. A temporary fiscal expansion (which does not affect the expected future exchange rate) therefore shifts the DD schedule to the right but does not move AA .

Figure 16-11 shows how expansionary fiscal policy affects the economy in the short run. Initially the economy is at point 1, with an exchange rate E^1 and output Y^1 . Suppose the government decides to spend \$10 billion to develop a new space shuttle. This one-time increase in government purchases moves the economy to point 2, causing the currency to

Figure 16-11**Effects of a Temporary Fiscal Expansion**

By shifting DD^1 to the right, a temporary fiscal expansion causes a currency appreciation and a rise in output.



appreciate to E^2 and output to expand to Y^2 . The economy would respond in a similar way to a temporary cut in taxes.

What economic forces produce the movement from point 1 to point 2? The increase in output caused by the increase in government spending raises the transactions demand for real money holdings. Given the fixed price level, this increase in money demand pushes the interest rate, R , upward. Because the expected future exchange rate, E^e , and the foreign interest rate, R^* , have not changed, the domestic currency must appreciate to create the expectation of a subsequent depreciation just large enough to offset the higher international interest rate difference in favor of domestic currency deposits.

Policies to Maintain Full Employment

The analysis of this section can be applied to the problem of maintaining full employment in open economies. Because temporary monetary expansion and temporary fiscal expansion both raise output and employment, they can be used to counteract the effects of temporary disturbances that lead to recession. Similarly, disturbances that lead to overemployment can be offset through contractionary macroeconomic policies.

Figure 16-12 illustrates this use of macroeconomic policy. Suppose the economy's initial equilibrium is at point 1, where output equals its full-employment level, denoted Y^f . Suddenly there is a temporary shift in consumer tastes away from domestic products. As we saw earlier in this chapter, such a shift is a decrease in aggregate demand for domestic goods, and it causes the curve DD^1 to shift leftward, to DD^2 . At point 2, the new short-run equilibrium, the currency has depreciated to E^2 and output, at Y^2 , is below its full-employment level: The economy is in a recession. Because the shift in preferences is assumed to be temporary, it does not affect E^e , so there is no change in the position of AA^1 .

To restore full employment, the government may use monetary or fiscal policy, or both. A temporary fiscal expansion shifts DD^2 back to its original position, restoring full

Figure 16-12
Maintaining Full Employment
After a Temporary Fall in World
Demand for Domestic Products

A temporary fall in world demand shifts DD^1 to DD^2 , reducing output from Y^f to Y^2 and causing the currency to depreciate from E^1 to E^2 (point 2). Temporary fiscal expansion can restore full employment (point 1) by shifting the DD schedule back to its original position. Temporary monetary expansion can restore full employment (point 3) by shifting AA^1 to AA^2 . The two policies differ in their exchange rate effects: The fiscal policy restores the currency to its previous value (E^1); the monetary policy causes the currency to depreciate further to E^3 .

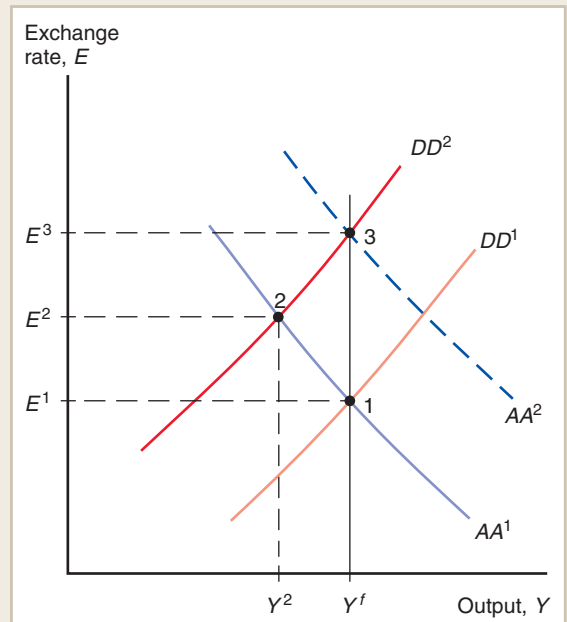
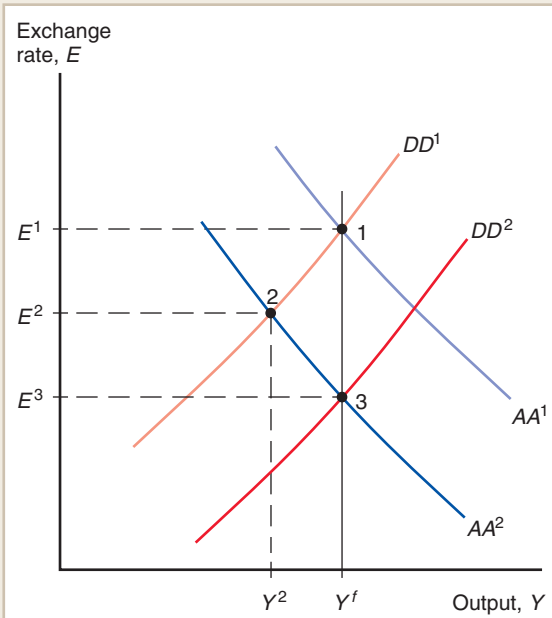


Figure 16-13**Policies to Maintain Full Employment After a Money Demand Increase**

After a temporary money demand increase (shown by the shift from AA^1 to AA^2), either an increase in the money supply or temporary fiscal expansion can be used to maintain full employment. The two policies have different exchange rate effects: The monetary policy restores the exchange rate back to E^1 , the fiscal policy leads to greater appreciation (E^3).



employment and returning the exchange rate to E^1 . A temporary money supply increase shifts the asset market equilibrium curve to AA^2 and places the economy at point 3, a move that restores full employment but causes the home currency to depreciate even further.

Another possible cause of recession is a temporary increase in the demand for money, illustrated in Figure 16-13. An increase in money demand pushes up the domestic interest rate and appreciates the currency, thereby making domestic goods more expensive and causing output to contract. Figure 16-13 shows this asset market disturbance as the downward shift of AA^1 to AA^2 , which moves the economy from its initial full-employment equilibrium at point 1 to point 2.

Expansionary macroeconomic policies can again restore full employment. A temporary money supply increase shifts the AA curve back to AA^1 and moves the economy back to its initial position at point 1. This temporary increase in money supply completely offsets the increase in money demand by giving domestic residents the additional money they desire to hold. Temporary fiscal expansion shifts DD^1 to DD^2 and restores full employment at point 3. But the move to point 3 involves an even greater appreciation of the currency.

Inflation Bias and Other Problems of Policy Formulation

The apparent ease with which full employment is maintained in our model is misleading, and you should not come away from our discussion of policy with the idea that it is easy to keep the macroeconomy on a steady course. Here are just a few of the many problems that can arise:

1. Sticky nominal prices not only give governments the power to raise output when it is abnormally low, but also may tempt them to create a politically useful economic boom,

say, just before a close election. This temptation causes problems when workers and firms anticipate it in advance, for they will raise wage demands and prices in the expectation of expansionary policies. The government will then find itself in the position of having to use expansionary policy tools merely to prevent the recession that higher domestic prices otherwise would cause! As a result, macroeconomic policy will display an **inflation bias**, leading to high inflation but no average gain in output. Such an increase in inflation occurred in the United States during the 1970s, as well as in many other countries. The inflation bias problem has led to a search for institutions, for example, central banks that operate independently of the government in power, that might convince market actors that government policies will not be used in a shortsighted way, at the expense of long-term price stability. As we noted in Chapter 14, many central banks throughout the world now seek to reach announced target levels of (low) inflation. Chapters 20 and 22 will discuss some of these efforts in detail.⁹

2. In practice it is sometimes hard to be sure whether a disturbance to the economy originates in the output or asset markets. Yet a government concerned about the exchange rate effect of its policy response needs to know this before it can choose between monetary and fiscal policy.

3. Real-world policy choices are frequently determined by bureaucratic necessities rather than by detailed consideration of whether shocks to the economy are real (that is, they originate in the output market) or monetary. Shifts in fiscal policy often can be made only after lengthy legislative deliberation, while monetary policy, in contrast, is usually exercised expeditiously by the central bank. To avoid procedural delays, governments are likely to respond to disturbances by changing monetary policy even when a shift in fiscal policy would be more appropriate.

4. Another problem with fiscal policy is its impact on the government budget. A tax cut or spending increase may lead to a government budget deficit that must sooner or later be closed by a fiscal reversal, as happened following the Bush administration's tax cut of the early 2000s. Unfortunately, there is no guarantee that the government will have the political will to synchronize these actions with the state of the business cycle. The state of the electoral cycle may be more important, as we have seen.

5. Policies that appear to act swiftly in our simple model operate in reality with lags of varying length. At the same time, the difficulty of evaluating the size and persistence of a given shock makes it hard to know precisely how much monetary or fiscal medicine to administer. These uncertainties force policy makers to base their actions on forecasts and hunches that may turn out to be quite wide of the mark.

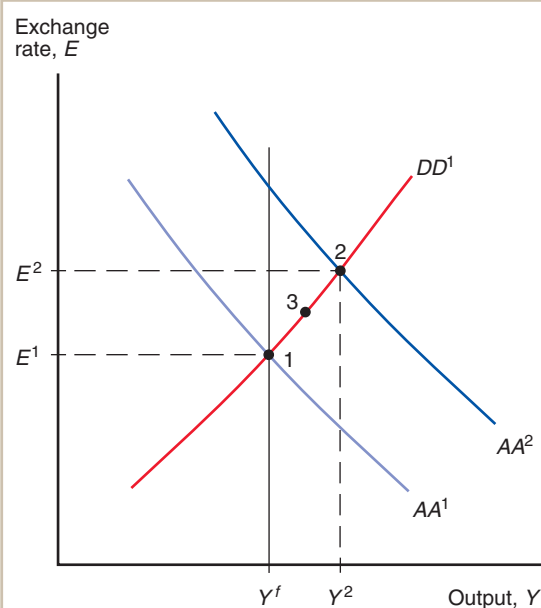
Permanent Shifts in Monetary and Fiscal Policy

A permanent policy shift affects not only the current value of the government's policy instrument (the money supply, government spending, or taxes) but also the *long-run* exchange rate. This in turn affects expectations about future exchange rates. Because these

⁹For a clear and detailed discussion of the inflation bias problem, see Chapter 14 in Andrew B. Abel, Ben S. Bernanke, and Dean Croushore, *Macroeconomics*, 6th ed. (Boston: Addison Wesley, 2008). The inflation bias problem can arise even when the government's policies are not politically motivated, as Abel, Bernanke, and Croushore explain. The basic idea is that when factors like minimum wage laws keep output inefficiently low by lowering employment, monetary expansion that raises employment may move the economy toward a more efficient use of its total resources. The government might wish to reach a better resource allocation purely on the grounds that such a change potentially benefits everyone in the economy. But the private sector's expectation of such policies still will generate inflation.

Figure 16-14**Short-Run Effects of a Permanent Increase in the Money Supply**

A permanent increase in the money supply, which shifts AA^1 to AA^2 and moves the economy from point 1 to point 2, has stronger effects on the exchange rate and output than an equal temporary increase, which moves the economy only to point 3.



changes in expectations have a major influence on the exchange rate prevailing in the short run, the effects of permanent policy shifts differ from those of temporary shifts. In this section we look at the effects of permanent changes in monetary and fiscal policy, in both the short and long runs.¹⁰

To make it easier to grasp the long-run effects of policies, we assume that the economy is initially at a long-run equilibrium position and that the policy changes we examine are the only economic changes that occur (our usual “other things equal” clause). These assumptions mean that the economy starts out at full employment with the exchange rate at its long-run level and with no change in the exchange rate expected. In particular, we know that the domestic interest rate must initially equal the foreign rate, R^* .

A Permanent Increase in the Money Supply

Figure 16-14 shows the short-run effects of a permanent increase in the money supply on an economy initially at its full-employment output level Y^f (point 1). As we saw earlier, even a temporary increase in M^s causes the asset market equilibrium schedule to shift upward from AA^1 to AA^2 . Because the increase in M^s is now permanent, however, it also affects the exchange rate expected for the future, E^e . Chapter 14 showed how a permanent increase in the money supply affects the long-run exchange rate: A permanent increase in M^s must ultimately lead to a proportional rise in E . Therefore, the permanent rise in M^s causes E^e , the expected future exchange rate, to rise proportionally.

Because a rise in E^e accompanies a *permanent* increase in the money supply, the upward shift of AA^1 to AA^2 is greater than that caused by an equal, but transitory, increase. At point 2,

¹⁰ You may be wondering whether a permanent change in fiscal policy is always possible. For example, if a government starts with a balanced budget, doesn't a fiscal expansion lead to a deficit, and thus require an eventual fiscal contraction? Problem 3 at the end of this chapter suggests an answer.

the economy's new short-run equilibrium, Y and E are both higher than they would be were the change in the money supply temporary. (Point 3 shows the equilibrium that might result from a temporary increase in M^s .)

Adjustment to a Permanent Increase in the Money Supply

The increase in the money supply shown in Figure 16-14 is not reversed by the central bank, so it is natural to ask how the economy is affected *over time*. At the short-run equilibrium, shown as point 2 in Figure 16-14, output is above its full-employment level and labor and machines are working overtime. Upward pressure on the price level develops as workers demand higher wages and producers raise prices to cover their increasing production costs. Chapter 14 showed that while an increase in the money supply must eventually cause all money prices to rise in proportion, it has no lasting effect on output, relative prices, or interest rates. Over time, the inflationary pressure that follows a permanent money supply expansion pushes the price level to its new long-run value and returns the economy to full employment.

Figure 16-15 will help you visualize the adjustment back to full employment. Whenever output is greater than its full-employment level Y^f and productive factors are working overtime, the price level P is rising to keep up with rising production costs. Although the DD and AA schedules are drawn for a constant price level P , we have seen how increases in P cause them to shift. A rise in P makes domestic goods more expensive relative to foreign goods, discouraging exports and encouraging imports. A rising domestic price level therefore causes DD^1 to shift to the left over time. Because a rising price level steadily reduces the real money supply over time, AA^2 also travels to the left as prices rise.

The DD and AA schedules stop shifting only when they intersect at the full-employment output level Y^f ; as long as output differs from Y^f , the price level will change and the two schedules will continue to shift. The schedules' final positions are shown in Figure 16-15 as

Figure 16-15

Long-Run Adjustment to a Permanent Increase in the Money Supply

After a permanent money supply increase, a steadily increasing price level shifts the DD and AA schedules to the left until a new long-run equilibrium (point 3) is reached.

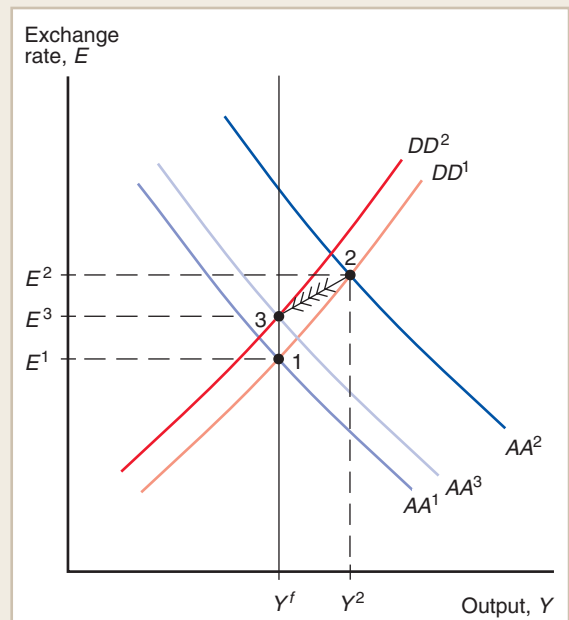
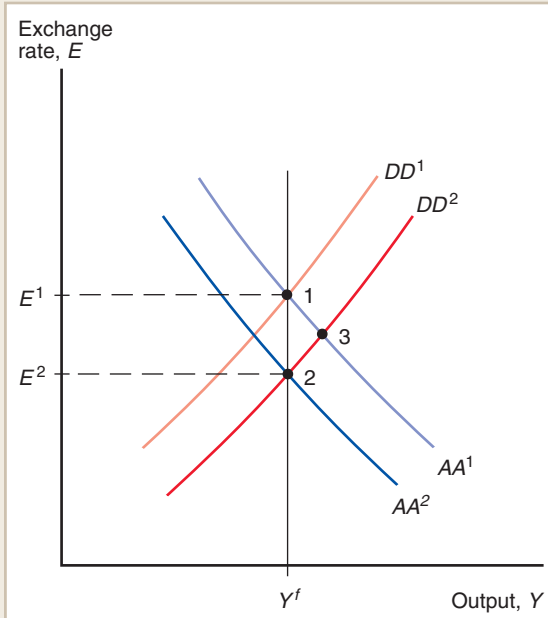


Figure 16-16**Effects of a Permanent Fiscal Expansion**

Because a permanent fiscal expansion changes exchange rate expectations, it shifts AA^1 leftward as it shifts DD^1 to the right. The effect on output (point 2) is nil if the economy starts in long-run equilibrium. A comparable *temporary* fiscal expansion, in contrast, would leave the economy at point 3.



DD^2 and AA^3 . At point 3, their intersection, the exchange rate, E , and the price level, P , have risen in proportion to the increase in the money supply, as required by the long-run neutrality of money. (AA^2 does not shift all the way back to its original position because E^e is permanently higher after a permanent increase in the money supply: It too has risen by the same percentage as M^s .)

Notice that along the adjustment path between the initial short-run equilibrium (point 2) and the long-run equilibrium (point 3), the domestic currency actually appreciates (from E^2 to E^3) following its initial sharp depreciation (from E^1 to E^2). This exchange rate behavior is an example of the *overshooting* phenomenon discussed in Chapter 14, in which the exchange rate's initial response to some change is greater than its long-run response.¹¹

We can draw on our conclusions to describe the proper policy response to a permanent monetary disturbance. A permanent increase in money demand, for example, can be offset with a permanent increase in the money supply of equal magnitude. Such a policy maintains full employment, but because the price level would fall in the absence of the policy, the policy will not have inflationary consequences. Instead, monetary expansion can move the economy straight to its long-run, full-employment position. Keep in mind, however, that it is hard in practice to diagnose the origin or persistence of a particular shock to the economy.

A Permanent Fiscal Expansion

A permanent fiscal expansion not only has an immediate impact in the output market but also affects the asset markets through its impact on long-run exchange rate expectations. Figure 16-16 shows the short-run effects of a government decision to spend an extra

¹¹While the exchange rate initially overshoots in the case shown in Figure 16-15, overshooting does not have to occur in all circumstances. Can you explain why, and does the “undershooting” case seem reasonable?

\$10 billion a year on its space travel program forever. As before, the direct effect of this rise in G on aggregate demand causes DD^1 to shift right to DD^2 . But because the increase in government demand for domestic goods and services is permanent in this case, it causes a long-run appreciation of the currency, as we saw in Chapter 15. The resulting fall in E^e pushes the asset market equilibrium schedule AA^1 downward to AA^2 . Point 2, where the new schedules DD^2 and AA^2 intersect, is the economy's short-run equilibrium, and at that point the currency has appreciated to E^2 from its initial level while output is unchanged at Y^f .

The important result illustrated in Figure 16-16 is that when a fiscal expansion is permanent, the additional currency appreciation caused by the shift in exchange rate expectations reduces the policy's expansionary effect on output. Without this additional expectations effect due to the permanence of the fiscal change, equilibrium would initially be at point 3, with higher output and a smaller appreciation. The greater the downward shift of the asset market equilibrium schedule, the greater the appreciation of the currency. This appreciation "crowds out" aggregate demand for domestic products by making them more expensive relative to foreign products.

Figure 16-16 is drawn to show a case in which fiscal expansion, contrary to what you might have guessed, has *no* net effect on output. This case is not, however, a special one; in fact, it is inevitable under the assumptions we have made. The argument that establishes this point requires five steps; by taking the time to understand it, you will solidify your understanding of the ground we have covered so far:

1. As a first step, convince yourself (perhaps by reviewing Chapter 14) that because the fiscal expansion does not affect the money supply, M^s , or the long-run values of the domestic interest rate (which equals the foreign interest rate) and output (Y^f), it can have no impact on the long-run price level.
2. Next, recall our assumption that the economy starts out in long-run equilibrium with the domestic interest rate, R , just equal to the foreign rate, R^* , and output equal to Y^f . Observe also that the fiscal expansion leaves the real money supply, M^s/P , unchanged in the short run (neither the numerator nor the denominator changes).
3. Now imagine, contrary to what Figure 16-16 shows, that output *did* rise above Y^f . Because M^s/P doesn't change in the short run (step 2), the domestic interest rate, R , would have to rise above its initial level of R^* to keep the money market in equilibrium. Since the foreign interest rate remains at R^* , however, a rise in Y to any level above Y^f implies an expected *depreciation* of the domestic currency (by interest parity).
4. Notice next that there is something wrong with this conclusion: We already know (from step 1) that the long-run price level is not affected by the fiscal expansion, so people can expect a nominal domestic currency depreciation just after the policy change only if the currency depreciates in *real* terms as the economy returns to long-run equilibrium. Such a real depreciation, by making domestic products relatively cheap, would only worsen the initial situation of overemployment that we have imagined to exist, and thus would prevent output from ever actually returning to Y^f .
5. Finally, conclude that the apparent contradiction is resolved only if output does *not* rise at all after the fiscal policy move. The only logical possibility is that the currency appreciates right away to its new long-run value. This appreciation crowds out just enough net export demand to leave output at the full-employment level despite the higher level of G .

Notice that this exchange rate change, which allows the output market to clear at full employment, leaves the asset markets in equilibrium as well. Since the exchange rate has jumped to its new long-run value, R remains at R^* . With output also at Y^f , however, the

long-run money market equilibrium condition $M^s/P = L(R^*, Y^f)$ still holds, as it did before the fiscal action. So our story hangs together: The currency appreciation that a permanent fiscal expansion provokes immediately brings the asset markets as well as the output market to positions of long-run equilibrium.

We conclude that *if the economy starts at long-run equilibrium, a permanent change in fiscal policy has no net effect on output. Instead, it causes an immediate and permanent exchange rate jump that offsets exactly the fiscal policy's direct effect on aggregate demand.*

Macroeconomic Policies and the Current Account

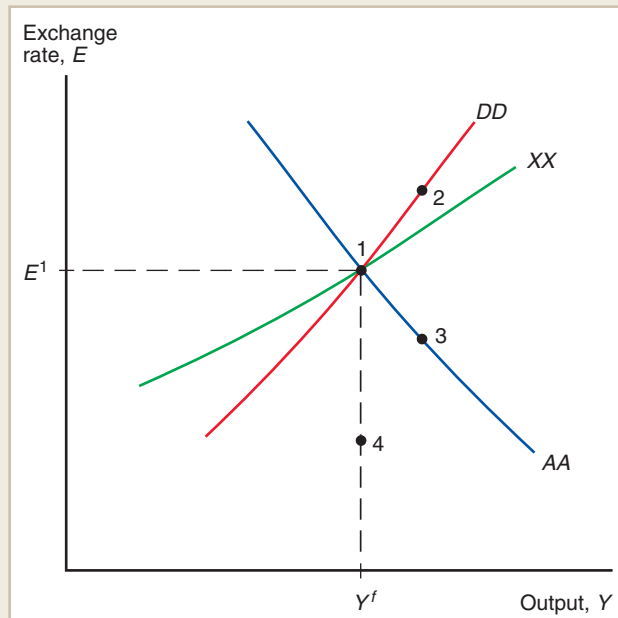
Policy makers are often concerned about the level of the current account. As we will discuss more fully in Chapter 18, an excessive imbalance in the current account—either a surplus or a deficit—may have undesirable long-run effects on national welfare. Large external imbalances may also generate political pressures for government restrictions on trade. It is therefore important to know how monetary and fiscal policies aimed at domestic objectives affect the current account.

Figure 16-17 shows how the *DD-AA* model can be extended to illustrate the effects of macroeconomic policies on the current account. In addition to the *DD* and *AA* curves, the figure contains a new curve, labeled *XX*, which shows combinations of the exchange rate and output at which the current account balance would be equal to some desired level, say $CA(EP^*/P, Y - T) = X$. The curve slopes upward because, other things equal, a rise in output encourages spending on imports and thus worsens the current account if it is not accompanied by a currency depreciation. Since the actual level of *CA* can differ from *X*, the economy's short-run equilibrium does *not* have to be on the *XX* curve.

The central feature of Figure 16-17 is that *XX* is *flatter* than *DD*. The reason is seen by asking how the current account changes as we move up along the *DD* curve from point 1,

Figure 16-17
How Macroeconomic Policies Affect the Current Account

Along the curve *XX*, the current account is constant at the level $CA = X$. Monetary expansion moves the economy to point 2 and thus raises the current account balance. Temporary fiscal expansion moves the economy to point 3 while permanent fiscal expansion moves it to point 4; in either case the current account balance falls.



where all three curves intersect (so that, initially, $CA = X$). As we increase Y in moving up along DD , the *domestic* demand for domestic output rises by less than the rise in output itself (since some income is saved and some spending falls on imports). Along DD , however, *total aggregate demand has to equal supply*. To prevent an excess supply of home output, E therefore must rise sharply enough along DD to make export demand rise faster than imports. In other words, net foreign demand—the current account—must rise sufficiently along DD as output rises to take up the slack left by domestic saving. Thus to the right of point 1, DD is above the XX curve, where $CA > X$; similar reasoning shows that to the left of point 1 DD lies below the XX curve (where $CA < X$).

The current account effects of macroeconomic policies can now be examined. As shown earlier, an increase in the money supply, for example, shifts the economy to a position like point 2, expanding output and depreciating the currency. Since point 2 lies above XX , the current account has improved as a result of the policy action. *Monetary expansion causes the current account balance to increase in the short run.*

Consider next a temporary fiscal expansion. This action shifts DD to the right and moves the economy to point 3 in the figure. Because the currency appreciates and income rises, there is a deterioration in the current account. A permanent fiscal expansion has the additional effect of shifting AA leftward, producing an equilibrium at point 4. Like point 3, point 4 is below XX , so once again the current account worsens, and by more than in the temporary case. *Expansionary fiscal policy reduces the current account balance.*

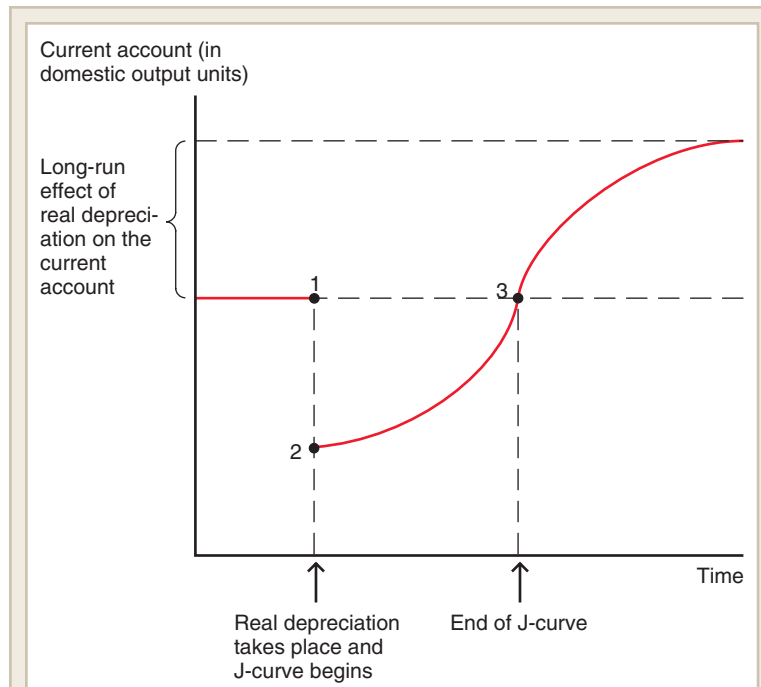
Gradual Trade Flow Adjustment and Current Account Dynamics

An important assumption underlying the DD - AA model is that, other things equal, a real depreciation of the home currency immediately improves the current account while a real appreciation causes the current account immediately to worsen. In reality, however, the behavior underlying trade flows may be far more complex than we have so far suggested, involving dynamic elements—on the supply as well as the demand side—that lead the current account to adjust only gradually to exchange rate changes. In this section we discuss some dynamic factors that seem important in explaining actual patterns of current account adjustment and indicate how their presence might modify the predictions of our model.

The J-Curve

It is sometimes observed that a country's current account *worsens* immediately after a real currency depreciation and begins to improve only some months later, contrary to the assumption we made in deriving the DD curve. If the current account initially worsens after a depreciation, its time path, shown in Figure 16-18, has an initial segment reminiscent of a J and therefore is called the **J-curve**.

The current account, measured in domestic output, can deteriorate sharply right after a real currency depreciation (the move from point 1 to point 2 in the figure) because most import and export orders are placed several months in advance. In the first few months after the depreciation, export and import volumes therefore may reflect buying decisions that were made on the basis of the old real exchange rate: The primary effect of the depreciation is to raise the value of the precontracted level of imports in terms of domestic products. Because exports measured in domestic output do not change while imports measured in domestic output rise, there is an initial fall in the current account, as shown.

**Figure 16-18****The J-Curve**

The J-curve describes the time lag with which a real currency depreciation improves the current account.

Even after the old export and import contracts have been fulfilled, it still takes time for new shipments to adjust fully to the relative price change. On the production side, producers of exports may have to install additional plant and equipment and hire new workers. To the extent that imports consist of intermediate materials used in domestic manufacturing, import adjustment will also occur gradually as importers switch to new production techniques that economize on intermediate inputs. There are lags on the consumption side as well. To expand significantly foreign consumption of domestic exports, for example, it may be necessary to build new retailing outlets abroad, a time-consuming process.

The result of these lags in adjustment is the gradually improving current account shown in Figure 16-18 as the move from point 2 to point 3. Eventually, the increase in the current account tapers off as the adjustment to the real depreciation is completed.

Empirical evidence indicates for most industrial countries a J-curve lasting more than six months but less than a year. Thus, point 3 in the figure is typically reached within a year of the real depreciation and the current account continues to improve afterward.¹²

The existence of a significant J-curve effect forces us to modify some of our earlier conclusions, at least for the short run of a year or less. Monetary expansion, for example, can depress output initially by depreciating the home currency. In this case, it may take

¹²See the discussion of Table 16A2-1 in Appendix 2 of this Chapter.

some time before an increase in the money supply results in an improved current account and therefore in higher aggregate demand.

If expansionary monetary policy actually depresses output in the short run, the domestic interest rate will need to fall farther than it normally would to clear the home money market. Correspondingly, the exchange rate will overshoot more sharply to create the larger expected domestic currency appreciation required for foreign exchange market equilibrium. By introducing an additional source of overshooting, J-curve effects amplify the volatility of exchange rates.

Exchange Rate Pass-Through and Inflation

Our discussion of how the current account is determined in the *DD-AA* model has assumed that nominal exchange rate changes cause proportional changes in real exchange rates in the short run. Because the *DD-AA* model assumes that the nominal output prices P and P^* cannot suddenly jump, movements in the real exchange rate, $q = EP^*/P$, correspond perfectly in the short run to movements in the nominal rate, E . In reality, however, even the short-run correspondence between nominal and real exchange rate movements, while quite close, is less than perfect. To understand fully how *nominal* exchange rate movements affect the current account in the short run, we need to examine more closely the linkage between the nominal exchange rate and the prices of exports and imports.

The domestic currency price of foreign output is the product of the exchange rate and the foreign currency price, or EP^* . We have assumed until now that when E rises, for example, P^* remains fixed so that the domestic currency price of goods imported from abroad rises in proportion. The percentage by which import prices rise when the home currency depreciates by 1 percent is known as the degree of **pass-through** from the exchange rate to import prices. In the version of the *DD-AA* model we studied above, the degree of pass-through is 1; any exchange rate change is passed through completely to import prices.

Contrary to this assumption, however, exchange rate pass-through can be incomplete. One possible reason for incomplete pass-through is international market segmentation, which allows imperfectly competitive firms to price to market by charging different prices for the same product in different countries (recall Chapter 15). A large foreign firm supplying automobiles to the United States may be so worried about losing market share that it does not immediately raise its U.S. prices by 10 percent when the dollar depreciates by 10 percent, despite the fact that its revenue from American sales, measured in its own currency, will decline. Similarly, the firm may hesitate to lower its U.S. prices by 10 percent after a dollar appreciation of that size because it can thereby earn higher profits without investing resources immediately in expanding its shipments to the United States. In either case, the firm may wait to find out if the currency movement reflects a definite trend before making price and production commitments that are costly to undo. In practice, many U.S. import prices tend to rise by only around half of a typical dollar depreciation over the following year.

We thus see that while a permanent nominal exchange rate change may be fully reflected in import prices in the long run, the degree of pass-through may be far less than 1 in the short run. Incomplete pass-through will have complicated effects, however, on the timing of current account adjustment. On the one hand, the short-run J-curve effect of a nominal currency change will be dampened by a low responsiveness of import prices to the exchange rate. On the other hand, incomplete pass-through implies that currency movements have less-than-proportional effects on the relative prices determining trade volumes. The failure of relative prices to adjust quickly will in turn be accompanied by a slow adjustment of trade volumes.

Exchange Rates and the Current Account



Our theoretical model showed that a permanent fiscal expansion would cause both an appreciation of the currency and a current account deficit. Although our discussion earlier in this chapter focused on the role of price-level movements in bringing the economy from its immediate position after a permanent policy change to its long-run position, the definition of the current account should alert you to another underlying dynamic. The net foreign wealth of an economy with a deficit is falling over time.

Although we have not explicitly incorporated wealth effects into our model, we would expect people's consumption to fall as their wealth falls. Because a country with a current account deficit is transferring wealth to foreigners, domestic consumption is falling over time and foreign consumption is rising. What are the exchange rate effects of this international redistribution of consumption demand in favor of foreigners? Foreigners have a relative preference for the goods that they produce, and as a result, the relative world demand for home goods will fall and the home currency will tend to depreciate in real terms.

This longer-run perspective leads to a more complicated picture of the real exchange rate's evolution following a permanent change such as a fiscal expansion. Initially, the home currency will appreciate as the current account balance falls sharply. But then, over time, the currency will begin to depreciate as market participants' expectations focus increasingly on the current account's effect on relative international wealth levels.

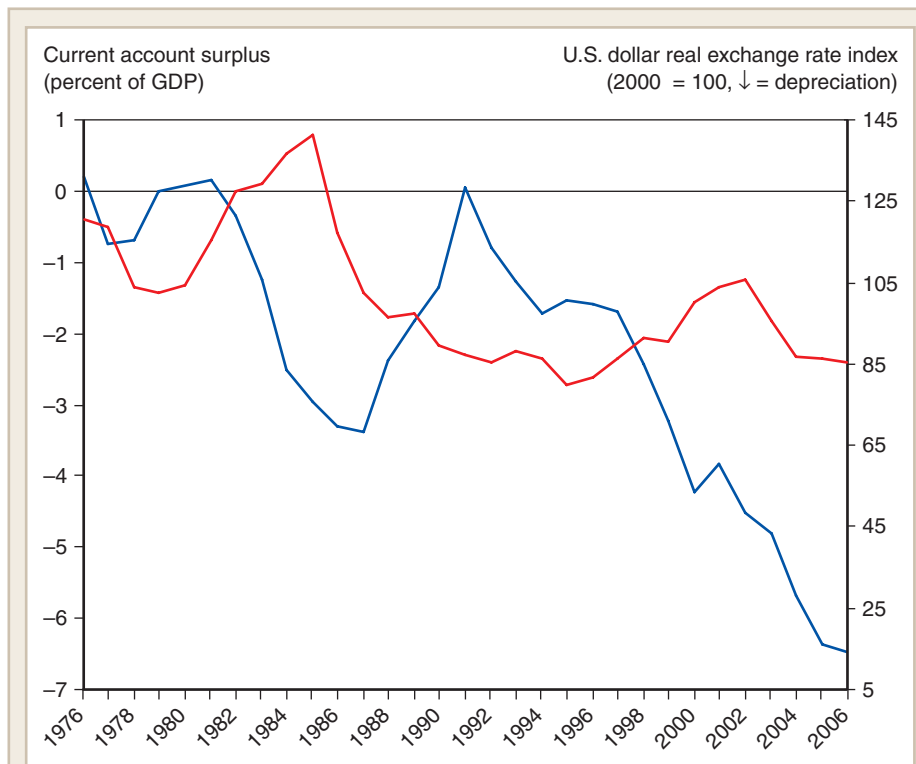
Data for the United States support this theoretical pattern. The figure on page 451 plots data on the U.S. current account and the dollar's real exchange rate since 1976. (In the figure, a rise in the exchange rate index is a real dollar appreciation; a decline is a real depreciation.) During the 1976–2006 period, there were two episodes of sharply increased current account deficits, both associated with fiscal expansions.

The first episode occurred when President Ronald Reagan cut taxes and increased military spending shortly after he entered the White House in 1981. You can see that the dollar's initial response was a substantial real appreciation. After 1985, however, the dollar began to decline sharply, even though the current account deficit had not yet turned around. The declining path of U.S. relative wealth implied that the current account would eventually return closer to balance, requiring a fall in the relative price of U.S. products to restrict imports and spur exports. Market expectations of this development quickly pushed the dollar down. Because of J-curve effects and the gradual effects of wealth on spending levels, the current account did not return to balance until the early 1990s.

The second episode of a sharply higher deficit shows a similar pattern. In the late 1990s, U.S. investment rose sharply as a result of the "dot com" boom in new information technology and Internet-based applications. Although that boom collapsed in 2000–2001, President George W. Bush, like Reagan, embarked on a program of massive tax cuts after the 2000 election. At the same time, the 2001 terrorist attacks on New York and Washington, followed by the wars in Afghanistan and Iraq, swelled government spending.

As the figure shows, once again the dollar appreciated as the current account deficit worsened.

Notice also how the link between nominal and real exchange rates may be further weakened by *domestic* price responses. In highly inflationary economies, for example, it is difficult to alter the real exchange rate EP^*/P simply by changing the nominal rate E , because the resulting increase in aggregate demand quickly sparks domestic inflation, which in turn raises P . To the extent that a country's export prices rise when its currency depreciates, any favorable effect on its competitive position in world markets will be dissipated. Such price increases, however, like partial pass-through, may weaken the J-curve.



The U.S. Current Account and the Dollar's Real Exchange Rate, 1976–2006

The dollar typically appreciates as a large current account deficit emerges, but it depreciates afterward.

Source: International Monetary Fund, *International Financial Statistics*.

But in 2003, as market expectations fixed on the unprecedented size of the deficit and the need for a large *eventual* dollar depreciation, the dollar began to depreciate. As of this writing, it remains to be seen how far that depreciation will have to go.*

*For an overview of current account adjustment in the 1980s, including attention to the cases of Germany and Japan, see Paul R. Krugman, "Has the Adjustment Process Worked?" *Policy Analyses in International Economics* 34 (Washington, D.C.: Institute for International Economics, 1991). An influential model of exchange rates and the current account is Rudiger Dornbusch and Stanley Fischer, "Exchange Rates and the Current Account," *American Economic Review* 70 (December 1980), pp. 960–971.

SUMMARY

1. The *aggregate demand* for an open economy's output consists of four components, corresponding to the four components of GNP: consumption demand, investment demand, government demand, and the current account (net export demand). An important determinant of the current account is the real exchange rate, the ratio of the foreign price level (measured in domestic currency) to the domestic price level.

2. Output is determined in the short run by the equality of aggregate demand and aggregate supply. When aggregate demand is greater than output, firms increase production to avoid unintended inventory depletion. When aggregate demand is less than output, firms cut back production to avoid unintended accumulation of inventories.
3. The economy's short-run equilibrium occurs at the exchange rate and output level where—given the price level, the expected future exchange rate, and foreign economic conditions—aggregate demand equals aggregate supply and the asset markets are in equilibrium. In a diagram with the exchange rate and real output on its axes, the short-run equilibrium can be visualized as the intersection of an upward-sloping *DD* schedule, along which the output market clears, and a downward-sloping *AA* schedule, along which the asset markets clear.
4. A temporary increase in the money supply, which does not alter the long-run expected exchange rate, causes a depreciation of the currency and a rise in output. Temporary fiscal expansion also results in a rise in output, but it causes the currency to appreciate. *Monetary policy* and *fiscal policy* can be used by the government to offset the effects of disturbances to output and employment.
5. Permanent shifts in the money supply, which do alter the long-run expected exchange rate, cause sharper exchange rate movements and therefore have stronger short-run effects on output than transitory shifts. If the economy is at full employment, a permanent increase in the money supply leads to a rising price level that ultimately reverses the effect on the real exchange rate of the nominal exchange rate's initial depreciation. In the long run, output returns to its initial level and all money prices rise in proportion to the increase in the money supply.
6. Because permanent fiscal expansion changes the long-run expected exchange rate, it causes a sharper currency appreciation than an equal temporary expansion. If the economy starts out in long-run equilibrium, the additional appreciation makes domestic goods and services so expensive that the resulting "crowding out" of net export demand nullifies the policy's effect on output and employment. In this case, a permanent fiscal expansion has no expansionary effect at all.
7. A major practical problem is to ensure that the government's ability to stimulate the economy does not tempt it to gear policy to short-term political goals, thus creating an *inflation bias*. Other problems include the difficulty in identifying the sources or durations of economic changes and time lags in implementing policies.
8. If exports and imports adjust gradually to real exchange rate changes, the current account may follow a *J-curve* pattern after a real currency depreciation, first worsening and then improving. If such a *J-curve* exists, currency depreciation may have a contractionary initial effect on output, and exchange rate overshooting will be amplified. Limited exchange rate *pass-through*, along with domestic price increases, may reduce the effect of a nominal exchange rate change on the real exchange rate.

KEY TERMS

AA schedule, p. 432

aggregate demand, p. 421

DD schedule, p. 428

fiscal policy, p. 437

inflation bias, p. 441

J-curve, p. 447

monetary policy, p. 437

pass-through, p. 449

PROBLEMS

1. How does the *DD* schedule shift if there is a decline in investment demand?
2. Suppose the government imposes a tariff on all imports. Use the *DD-AA* model to analyze the effects this measure would have on the economy. Analyze both temporary and permanent tariffs.
3. Imagine that Congress passes a constitutional amendment requiring the U.S. government to maintain a balanced budget at all times. Thus, if the government wishes to change government spending, it must change taxes by the same amount, that is, $\Delta G = \Delta T$ always. Does the constitutional amendment imply that the government can no longer use fiscal policy to affect employment and output? (Hint: Analyze a “balanced-budget” increase in government spending, one that is accompanied by an equal tax hike.)
4. Suppose there is a permanent fall in private aggregate demand for a country’s output (a downward shift of the entire aggregate demand schedule). What is the effect on output? What government policy response would you recommend?
5. Why does a temporary increase in government spending cause the current account to fall by a smaller amount than does a permanent increase in government spending?
6. If a government initially has a balanced budget but then cuts taxes, it is running a deficit that it must somehow finance. Suppose people think the government will finance its deficit by printing the extra money it now needs to cover its expenditures. Would you still expect the tax cut to cause a currency appreciation?
7. You observe that a country’s currency depreciates but its current account worsens at the same time. What data might you look at to decide whether you are witnessing a J-curve effect? What other macroeconomic change might bring about a currency depreciation coupled with a deterioration of the current account, even if there is no J-curve?
8. A new government is elected and announces that once it is inaugurated, it will increase the money supply. Use the *DD-AA* model to study the economy’s response to this announcement.
9. How would you draw the *DD-AA* diagram when the current account’s response to exchange rate changes follows a J-curve? Use this modified diagram to examine the effects of temporary and permanent changes in monetary and fiscal policy.
10. What does the Marshall-Lerner condition look like if the country whose real exchange rate changes does *not* start out with a current account of zero? (The Marshall-Lerner condition is derived in Appendix 2 under the “standard” assumption of an initially balanced current account.)
11. Our model takes the price level P as given in the short run, but in reality the currency appreciation caused by a permanent fiscal expansion might cause P to fall a bit by lowering some import prices. If P can fall slightly as a result of a permanent fiscal expansion, is it still true that there are no output effects? (As above, assume an initial long-run equilibrium.)
12. Suppose that interest parity does not hold exactly, but that the true relationship is $R = R^* + (E^e - E)/E + \rho$ where ρ is a term measuring the differential riskiness of domestic versus foreign deposits. Suppose a permanent rise in domestic government spending, by creating the prospect of future government deficits, also raises ρ , that is, makes domestic currency deposits more risky. Evaluate the policy’s output effects in this situation.
13. If an economy does *not* start out at full employment, is it still true that a permanent change in fiscal policy has no current effect on output?
14. The box on p. 450 suggested that even when a fiscal expansion is permanent, market actors might expect that, because of the resulting rise in the current account deficit,

- some part of the initial currency appreciation is temporary. If so, how would this affect your view on the short-run effects of permanent fiscal expansion?
15. See if you can retrace the steps in the five-step argument on p. 445 to show that a permanent fiscal expansion cannot cause output to *fall*.
 16. The chapter's discussion of "Inflation Bias and Other Problems of Policy Formulation" suggests (p. 441, paragraph 4) that there may not really be any such thing as a *permanent* fiscal expansion. What do you think? How would these considerations affect the exchange rate and output effects of fiscal policy? Do you see any parallels with the chapter's discussion of the longer-run impact of current account imbalances?
 17. If you compare low-inflation economies with economies in which inflation is high and very volatile, how might you expect the degree of exchange rate pass-through to differ, and why?

FURTHER READING

- Victor Argy and Michael G. Porter. "The Forward Exchange Market and the Effects of Domestic and External Disturbances Under Alternative Exchange Rate Systems." *International Monetary Fund Staff Papers* 19 (November 1972), pp. 503–532. Advanced analysis of a macroeconomic model similar to the one in this chapter.
- Victor Argy and Joanne K. Salop. "Price and Output Effects of Monetary and Fiscal Policies Under Flexible Exchange Rates." *International Monetary Fund Staff Papers* 26 (June 1979), pp. 224–256. The effects of macroeconomic policies under alternative institutional assumptions about wage indexation and the wage-price adjustment process in general.
- Ralph C. Bryant et al., eds. *Empirical Macroeconomics for Interdependent Economies*. Washington, D.C.: Brookings Institution, 1988. This study compares what 12 leading econometric models predict about the domestic and foreign effects of individual countries' macroeconomic policies.
- Rudiger Dornbusch. "Exchange Rate Expectations and Monetary Policy." *Journal of International Economics* 6 (August 1976), pp. 231–244. A formal examination of monetary policy and the exchange rate in a model with a J-curve.
- Rudiger Dornbusch and Paul Krugman. "Flexible Exchange Rates in the Short Run." *Brookings Papers on Economic Activity* 3: 1976, pp. 537–575. Theory and evidence on short-run macroeconomic adjustment under floating exchange rates.
- Joseph E. Gagnon. "Productive Capacity, Product Varieties, and the Elasticities Approach to Trade." International Finance Discussion Papers 781, Board of Governors of the Federal Reserve System, 2003. Looks at the role of new products in long-run trade elasticities.
- Peter Hooper, Karen Johnson, and Jaime Marquez. *Trade Elasticities for G-7 Countries*. Princeton Studies in International Economics 87. International Economics Section, Department of Economics, Princeton University, August 2000. Updated estimates of import and export price elasticities.
- Robert A. Mundell. *International Economics*, Chapter 17. New York: Macmillan, 1968. A classic account of macroeconomic policy effects under floating exchange rates.
- Subramanian Rangan and Robert Z. Lawrence. *A Prism on Globalization*. Washington, D.C.: Brookings Institution, 1999. An examination of multinational firms' responses to exchange rate movements.



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APPENDIX 1 TO CHAPTER

16

Intertemporal Trade and Consumption Demand

We assume in the chapter that private consumption demand is a function of disposable income, $C = C(Y^d)$, with the property that when Y^d rises, consumption rises by less (so that saving, $Y^d - C(Y^d)$, goes up too). This appendix interprets this assumption in the context of the intertemporal model of consumption behavior discussed in the appendix to Chapter 7.

The discussion in Chapter 7 assumed that consumers' welfare depends on present consumption demand D_P and future consumption demand D_F . If present income is Q_P and future income is Q_F , consumers can use borrowing or saving to allocate their consumption over time in any way consistent with the *intertemporal budget constraint*

$$D_P + D_F/(1 + r) = Q_P + Q_F/(1 + r),$$

where r is the real rate of interest.

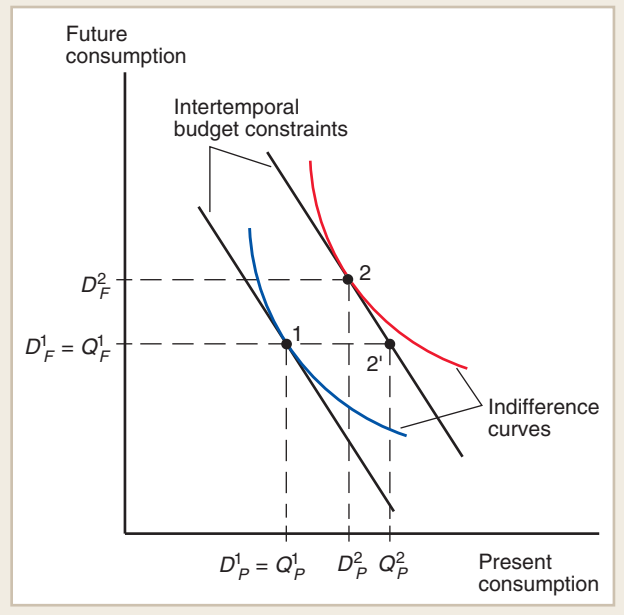
Figure 16A1-1 reminds you of how consumption and saving were determined in Chapter 7. If present and future output are initially described by the point labeled 1 in the figure, consumers' wishes to pick the highest utility indifference curve consistent with their budget constraints leads to consumption at point 1 as well.

We have assumed zero saving at point 1 to show most clearly the effect of a rise in current output, which we turn to next. Suppose present output rises while future output doesn't, moving the income endowment to point 2', which lies horizontally to the right of point 1. You can see that the consumer will wish to spread the increase in consumption this allows her over her *entire* lifetime. She can do this by saving some of the present income rise, $Q_P^2 - Q_P^1$ and moving up to the left along her budget line from her endowment point 2' to point 2.

Figure 16A1-1

Change in Output and Saving

A one-period increase in output raises saving.



If we now reinterpret the notation so that present output, Q_P , corresponds to disposable income, Y^d , and present consumption demand corresponds to $C(Y^d)$, we see that while consumption certainly depends on factors other than current disposable income—notably, future income and the real interest rate—its behavior does imply that a rise in lifetime income that is concentrated in the present will indeed lead to a rise in current consumption that is less than the rise in current income. Since the output changes we have been considering in this chapter are all temporary changes that result from the short-run stickiness of domestic money prices, the consumption behavior we simply assumed in the chapter does capture the feature of intertemporal consumption behavior essential for the *DD-AA* model to work.

We could also use Figure 16A1-1 to look at the consumption effects of the real interest rate, which we mentioned in footnote 1. If the economy is initially at point 1, a fall in the real interest rate r causes the budget line to rotate counterclockwise about point 1, causing a rise in present consumption. If initially the economy had been saving a positive amount, however, as at point 2, this effect would be ambiguous, a reflection of the contrary pulls of the income and substitution effects we introduced in Chapter 5. In this second case, the endowment point is point 2', so a fall in the real interest rate causes a counterclockwise rotation of the budget line about point 2'. Empirical evidence indicates that the positive effect of a lower real interest rate on consumption probably is weak.

Use of the preceding framework to analyze the intertemporal aspects of fiscal policy would lead us too far afield, although this is one of the most fascinating topics in macroeconomics. We refer readers instead to any good intermediate macroeconomics text.¹³

¹³For example, see Abel, Bernanke, and Croushore, *Macroeconomics*, Chapter 15.

APPENDIX 2 TO CHAPTER

16

The Marshall-Lerner Condition and Empirical Estimates of Trade Elasticities

The chapter assumed that a real depreciation of a country's currency improves its current account. As we noted, however, the validity of this assumption depends on the response of export and import volumes to real exchange rate changes. In this appendix we derive a condition on those responses for the assumption in the text to be valid. The condition, called the *Marshall-Lerner condition*, states that, all else equal, a real depreciation improves the current account if export and import volumes are sufficiently elastic with respect to the real exchange rate. (The condition is named after two of the economists who discovered it, Alfred Marshall and Abba Lerner.) After deriving the Marshall-Lerner condition, we look at empirical estimates of trade elasticities and analyze their implications for actual current account responses to real exchange rate changes.

To start, write the current account, measured in domestic output units, as the difference between exports and imports of goods and services similarly measured:

$$CA(EP^*/P, Y^d) = EX(EP^*/P) - IM(EP^*/P, Y^d).$$

Above, export demand is written as a function of EP^*/P alone because foreign income is being held constant.

Let q denote the real exchange rate EP^*/P and let EX^* denote domestic imports measured in terms of *foreign*, rather than domestic, output. The notation EX^* is used because domestic imports from abroad, measured in foreign output, equal the volume of foreign exports to the home country. If we identify q with the price of foreign products in terms of domestic products, then IM and EX^* are related by

$$IM = q \times EX^*,$$

that is, imports measured in domestic output = (domestic output units/foreign output unit) \times (imports measured in foreign output units).¹⁴

The current account can therefore be expressed as

$$CA(q, Y^d) = EX(q) - q \times EX^*(q, Y^d).$$

Now let EX_q stand for the effect of a rise in q (a real depreciation) on export demand and let EX_q^* stand for the effect of a rise in q on import volume. Thus,

$$EX_q = \Delta EX / \Delta q, EX_q^* = \Delta EX^* / \Delta q.$$

¹⁴As we warned earlier in the chapter, the identification of the real exchange rate with relative output prices is not quite exact since, as we defined it, the real exchange rate is the relative price of expenditure baskets. For most practical purposes, however, the discrepancy is not qualitatively important. A more serious problem with our analysis is that national outputs consist in part of nontradables, and the real exchange rate covers their prices as well as those of tradables. To avoid the additional complexity that would result from a more detailed treatment of the composition of national outputs, we assume in deriving the Marshall-Lerner condition that the real exchange rate can be approximately identified with the relative price of imports in terms of exports.

As we saw in the chapter, EX_q is positive (a real depreciation makes home products relatively cheaper and stimulates exports) while EX_q^* is negative (a relative cheapening of home products reduces domestic import demand). Using these definitions, we can now ask how a rise in q affects the current account, all else equal.

If superscript¹ indicates the initial value of a variable while superscript² indicates its value after q has changed by $\Delta q = q^2 - q^1$, then the change in the current account caused by a real exchange rate change Δq is

$$\begin{aligned}\Delta CA &= CA^2 - CA^1 = (EX^2 - q^2 \times EX^{*2}) - (EX^1 - q^1 \times EX^{*1}) \\ &= \Delta EX - (q^2 \times \Delta EX^*) - (\Delta q \times EX^{*1}).\end{aligned}$$

Dividing through by Δq gives the current account's response to a change in q ,

$$\Delta CA/\Delta q = EX_q - (q^2 \times EX_q^*) - EX^{*1}.$$

This equation summarizes the two current account effects of a real depreciation discussed in the text, the *volume* effect and the *value* effect. The terms involving EX_q and EX_q^* represent the volume effect, the effect of the change in q on the number of output units exported and imported. These terms are always positive because $EX_q > 0$ and $EX_q^* < 0$. The last term above, EX^{*1} , represents the value effect, and it is preceded by a minus sign. This last term tells us that a rise in q worsens the current account to the extent that it raises the domestic output value of the initial volume of imports.

We are interested in knowing when the right-hand side of the equation above is positive, so that a real depreciation causes the current account balance to increase. To answer this question, we first define the *elasticity of export demand* with respect to q ,

$$\eta = (q^1/EX^1)EX_q,$$

and the *elasticity of import demand* with respect to q ,

$$\eta^* = -(q^1/EX^{*1})EX_q^*.$$

(The definition of η^* involves a minus sign because $EX_q^* < 0$ and we are defining trade elasticities as positive numbers.) Returning to our equation for $\Delta CA/\Delta q$, we multiply its right-hand side by (q^1/EX^1) to express it in terms of trade elasticities. Then if the current account is initially zero (that is, $EX^1 = q^1 \times EX^{*1}$), this last step shows that $\Delta CA/\Delta q$ is positive when

$$\eta + (q^2/q^1)\eta^* - 1 > 0.$$

If the change in q is assumed to be small, so that $q^2 \approx q^1$, the condition for an increase in q to improve the current account is

$$\eta + \eta^* > 1.$$

This is the Marshall-Lerner condition. The condition states that if the current account is initially zero, a real currency depreciation causes a current account surplus if the sum of the relative price elasticities of export and import demand exceeds 1. (If the current account is not zero initially, the condition becomes substantially more complex.) In applying the Marshall-Lerner condition, remember that its derivation assumes that disposable income is held constant when q changes.

TABLE 16A2-1 Estimated Price Elasticities for International Trade in Manufactured Goods

Country	η			η^*		
	Impact	Short-run	Long-run	Impact	Short-run	Long-run
Austria	0.39	0.71	1.37	0.03	0.36	0.80
Belgium	0.18	0.59	1.55	—	—	0.70
Britain	—	—	0.31	0.60	0.75	0.75
Canada	0.08	0.40	0.71	0.72	0.72	0.72
Denmark	0.82	1.13	1.13	0.55	0.93	1.14
France	0.20	0.48	1.25	—	0.49	0.60
Germany	—	—	1.41	0.57	0.77	0.77
Italy	—	0.56	0.64	0.94	0.94	0.94
Japan	0.59	1.01	1.61	0.16	0.72	0.97
Netherlands	0.24	0.49	0.89	0.71	1.22	1.22
Norway	0.40	0.74	1.49	—	0.01	0.71
Sweden	0.27	0.73	1.59	—	—	0.94
Switzerland	0.28	0.42	0.73	0.25	0.25	0.25
United States	0.18	0.48	1.67	—	1.06	1.06

Source: Estimates are taken from Jacques R. Artus and Malcolm D. Knight, *Issues in the Assessment of the Exchange Rates of Industrial Countries*. Occasional Paper 29. Washington, D.C.: International Monetary Fund, July 1984, table 4. Unavailable estimates are indicated by dashes.

Now that we have the Marshall-Lerner condition, we can ask whether empirical estimates of trade equations imply price elasticities consistent with this chapter's assumption that a real exchange rate depreciation improves the current account. Table 16A2-1 presents International Monetary Fund elasticity estimates for trade in manufactured goods. The table reports export and import price elasticities measured over three successively longer time horizons, and thus allows for the possibility that export and import demands adjust gradually to relative price changes, as in our discussion of the J-curve effect. "Impact" elasticities measure the response of trade flows to relative price changes in the first six months after the change; "short-run" elasticities apply to a one-year adjustment period; and "long-run" elasticities measure the response of trade flows to the price changes over a hypothetical infinite adjustment period.

For most countries, the impact elasticities are so small that the sum of the impact export and import elasticities is less than 1. Since the impact elasticities usually fail to satisfy the Marshall-Lerner condition, the estimates support the existence of an initial J-curve effect that causes the current account to deteriorate immediately following a real depreciation.

It is also true, however, that most countries represented in the table satisfy the Marshall-Lerner condition in the short run and that virtually all do so in the long run. The evidence is therefore consistent with the assumption made in the chapter: Except over short time periods, a real depreciation is likely to improve the current account while a real appreciation is likely to worsen it.